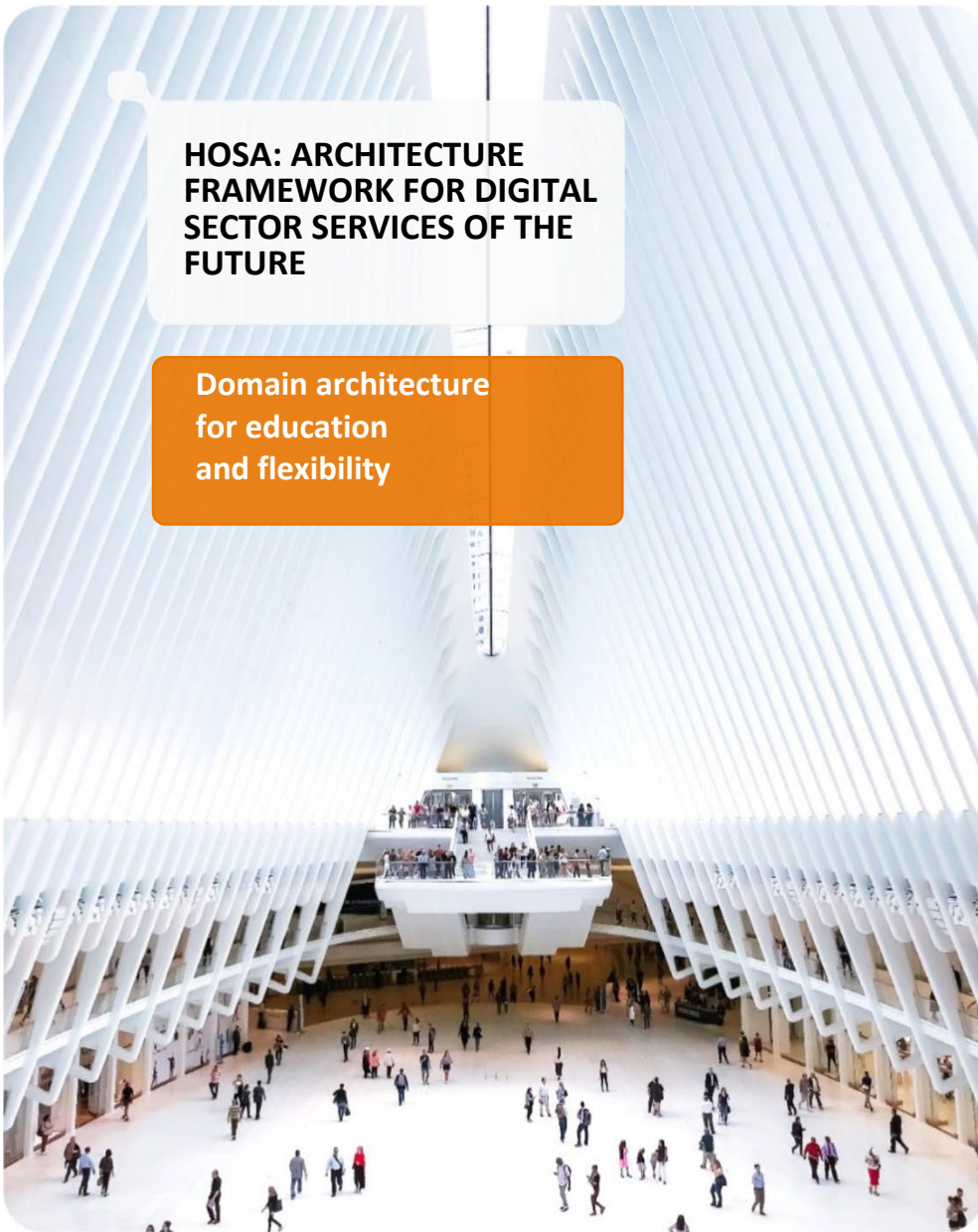


Driving innovation together

HOSA: ARCHITECTURE FRAMEWORK FOR DIGITAL SECTOR SERVICES OF THE FUTURE

Domain architecture
for education
and flexibility



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Driven by: CIOs of the higher education institutions, Higher Education Architectural Council, SURF and so on.

1 Foreword

This domain architecture outlines what digital support in education should look like in three to ten years' time to fit in with the supported ambitions of the higher education sector, changes in research and international (technological) developments. Such a domain architecture is similar to a zoning plan and includes a vision of the future of flexible education and its relationship to the associated systems. This vision also forms the basis for a roadmap to realise and prioritise the domain architecture.

However, a zoning plan is not sufficient for the construction of a building. This also requires subsequent architectural work and designs. This document provides the framework for the assessment of such follow-up architectures and designs. Here we provide an initial indication of the current situation based on various discussions and sessions with the working group. Further analysis of the current situation is required for the actual realisation of sector services.

We use the concept of business platforms to draw up the application architecture in this domain architecture. This concept fits in with the coming decade, which is also referred to as the *digital age*. A business platform is based on value-creating interactions between external producers and consumers. The platform's overall objective is to create matches between users and facilitate the exchange of products, services, content, data or social currency, thereby creating value for all participants (Parker, 2016).

We choose this concept because it provides insight into online marketplaces that are emerging in various places thanks to increasing collaboration in the sector. The emphasis is on the term 'business' here. By using the same foundation, we create an overview and a common starting point for the discussions between the many stakeholders. This can also present various initiatives in a consistent way.

The process of moving from the current situation to the desired situation was not yet part of HOSA's initial setup in 2020. This will later be continued when the steering committee adopts the plan for 2021. This includes the further elaboration of the first level for HOSA with a roadmap and the development of the corresponding architectural process.



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3 Introduction

3.1 Motivation

The higher education institutions have found that the number of cross-institutional initiatives will expand and have a greater impact on their own services. The Acceleration Agenda for ICT educational innovation in collaborations drafted by the higher education sector and various sector partners is such an initiative. VSNU is also investigating the topics universities want to invest in together, such as research facilities, ICT for education renewal, and sustainable operations management. Higher professional education is also collaborating across institutions, for example on the subject of research support. The CIOs of institutions, SURF and a number of sector partners have therefore taken the initiative to create an architecture for the digital sector services of the future.

The developments for more flexible education, lifelong learning and data management are leading to more cross-institutional collaboration and organisation for common information and ICT services (sector services). Questions that arise in this regard include: “How do we ensure the sector services are future-proof?”, “How do we ensure the sector services are generally coherent?”, “How do we make reuse possible?”, and more recently, “How do we assure, protect and promote public values in the digitisation of education and research?”.

Sector partners such as SURF, Studielink, DUO, DANS and NWO try to facilitate and support all institutions in this as much as possible. However, this is a complex process that creates a need for a joint architecture: for the sector-wide definition, development and deployment of information and ICT services, it is necessary to provide clarity about the demand for these services, the overall requirements that apply, their design and setup, and the work the ICT service providers are doing for the institutions. We want to create this common framework based on an architectural approach: the Higher Education Sector Architecture (Hoger Onderwijs Sector Architectuur or HOSA).

3.2 Goals

The HOSA project aims to define an architecture for sector services that are important for strategic collaboration between higher education institutions, sector partners and market players. HOSA is therefore based on the optimal articulation of the sector’s demand with regard to sector services. It provides a facilitating framework for interoperability between institutions and providers of common ICT services. HOSA will lead to current and new sector service initiatives more quickly and in a more future-oriented and future-proof way. Sector partners and market players in ICT services can easily respond to this with their service portfolio.

3.3 Scope of the domain architecture

The primary scope of the domain architecture is the higher education sector (higher academic education and higher professional education). The international context is also taken into account. The time horizon is the medium and long term looking forward, with an assessment of the functional needs for sector services for more flexible education. As far as education is concerned, attention is also given to services, processes, functionality, data and technology, governance, ownership, management and support. This is a conceptual description with guidelines for solutions.

This domain architecture is a conceptual description of the setup of sector services for more flexible education in the broad sense of the word. It includes guidelines on positioning and functionalities of the new sector services for more flexible education, which should also be able to support traditional education. When developing this domain architecture, the educational process as described in HORA 2.1 was taken as a starting point (www.hora.nl).

3.4 The objectives structure

An objectives structure for the domain architectures has been drawn up to provide insight into the sector’s goals and ambitions. The foundation for this objectives structure is laid in the strategic agenda of the Ministry of Education, Culture and Science (OCW), supplemented with goals from other policy documents (see diagram below).

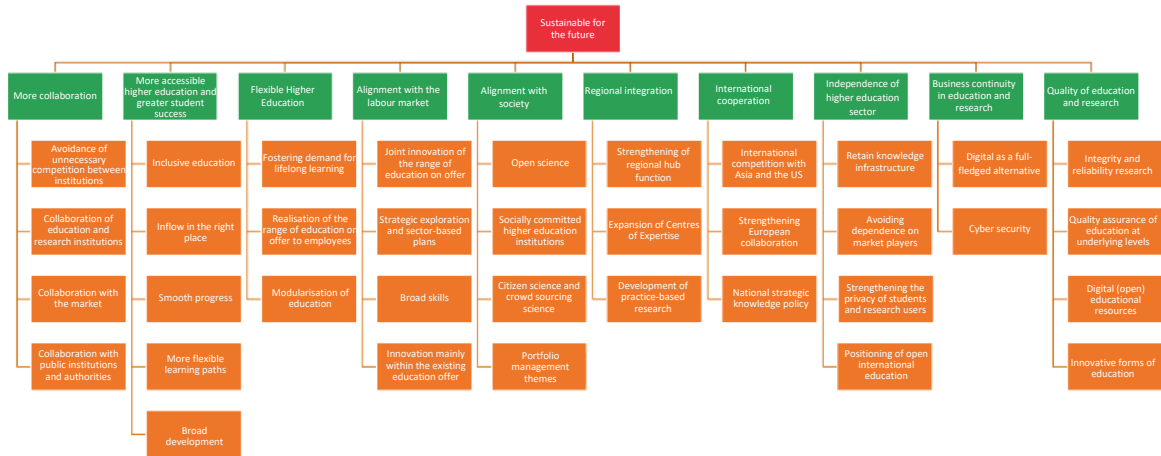


Figure 1: Setup of higher education sector objectives structure (see Appendix 0 for a readable version)

4 Current situation

This domain architecture aims to describe the current education situation based on the existing services and change initiatives that have been or are being undertaken by various organisations and bodies. It is partly based on the description of the report 'De Staat van het Onderwijs 2020' by the Education Inspectorate of the Ministry of Education, Culture and Science. This report examines the flexibility within higher education based on pathways designed to make part-time and work-study programmes more flexible and based on student registrations for experiments to do with making education more flexible. This report shows that these pathways are being used more and more, and they therefore meet the needs of students. In the working population, the need appears to be more in completing individual modules without opting for a full graduation path, but no reliable figures are available yet in this regard. The researchers also noted that attendance in programmes that are not government funded (accredited) is down and students only want to take a few modules from these programmes.

Further results from the pilots of the Ministry of Education, Culture and Science for more flexible education offer a broader picture and more guidance in terms for what needs to be done to increase flexibility. Three experiments have been defined within higher education. One of these focuses on learning outcomes, which are determined in consultation with the student. Another experiment is about accrediting just a part of the programme, so that the student does not have to be assessed for the entire programme. However, this is only possible for institutions that are not government funded. The third experiment is about an educational minor open to people who have not enrolled in a bachelor's degree programme, to allow them to obtain limited educational competence. At the end of the experiment, this was included as a ministerial regulation in the current policy.

The experiments show that the focus is shifting from the curriculum to the student. The flexible routes within the learning outcomes experiment are based on a fixed set of learning outcomes defined together with the student, rather than a fixed educational programme.

The quote below from the 2020 education status report clearly shows how the Education Inspectorate sees more flexibility in education:

"Higher education is currently characterised by collaboration between institutions, personalisation, students' freedom of choice, internationalisation and digitisation. Flexibility and collaboration are encouraged to make higher education even more accessible. It is important that all present and future forms of education and collaboration partnerships are adequately governed and supervised. The current legislation is not appropriate for this in all respects. If more flexible education becomes the norm, as is expected, the Higher Education Act must be amended."¹

The inventory of initiatives shows a more detailed picture of flexible education than the Education Inspectorate currently describes. The development of the sector architecture for higher education takes into account this more advanced picture in order not to hinder these initiatives.

¹ Inspectie van het Onderwijs, Ministerie van OCW (2020). 'Rapport de Staat van het Onderwijs 2020', <https://www.onderwijsinspectie.nl/documenten/rapporten/2020/04/22/staat-van-het-onderwijs-2020>

4.1 Initiatives

A number of initiatives for more flexible education address some parts of existing issues. Below we describe some well-known initiatives and their intended objectives. These initiatives are about promoting more flexibility and improving collaboration with a route that is usually aimed at standardisation.

The identified initiatives mainly focus on student exchanges and making education offers easy to find by making available and linking various education catalogues. Other initiatives are about the provision of (open) educational resources. The composite education offer is mainly based on MOOCs and is often situated within the provider's learning environment. We have not found any initiatives that offer a learning environment aimed at the learners themselves or that include educational learning resources from other institutions.

Studielink

Studielink is the Dutch national database for higher education admissions. Its services are a well-known form of sector-specific collaboration in the Netherlands. This national hub for higher education enrolment has a national portal that enables future students to register and enrol in government funded programmes. Studielink also acts as a broker that handles the exchange of data between students, institutions, DUO, the Immigration and Naturalisation Service and banks in the enrolment chain. Studielink allows enrolment data to be exchanged between the relevant education institutions and the Dutch Office of Education (DUO). Studielink recognises the plans to make higher education more flexible and has generated support for enrolment in a Joint Degree and the facilitation of digital proof of paid tuition fees. Progress is also being made in terms of support for registrations and enrolments for education component and enrolment per study credit. Studielink is also working on a student centric approach as part of an innovation track. This allows students to view and manage information and simplifies the student's journey in the enrolment chain, for example by offering a link to the student grant application process and the Studiekeuze123 environment, which offers objective information on how to choose from the range of higher education on offer.

Acceleration Plan for More Flexible Education

A number of zones have been defined under the Acceleration Plan, a collaboration project of VSNU, VH and SURF. The zone for more flexible education has identified issues such as student mobility and modular education as key areas. In both paths, the possibilities to allow students to make use of the education offers at other institutions have been examined in pilot projects. This is about the opening up the education offer and about allowing enrolment of students from other education institutions. The pilot also takes into account that the achieved results can be transferred to the student's home institution. It is also proposed to use micro-credentials for lifelong learning in the context of mutual recognition and quality assurance.

'Tripadvisor' for lifelong learning offer

On the initiative of VSNU, the vocational secondary education and higher education sectors are working on a joint platform to open up the range of lifelong learning on offer. A first version is planned in late 2021. This platform is also easy to integrate into other platforms. This development is in line with the advice provided by the report Ikwilverderleer.nl, which was presented to the Lower House of the Netherlands at the end of 2019.

Studiekeuze123

Stichting Studiekeuze123 was founded by students, the higher education sector and the Ministry of Education, Culture and Science to collect and distribute objective information on how to choose from the range of higher education on offer. Education institutions are asked to provide their education catalogues to make information easy to find and to offer comparison searches for the entire range of education on offer in the Netherlands. Standardisation is important in order to make the programmes comparable. The Studiekeuze123 steps can also contribute to the proper practical development of the registration of higher education institutions and education programmes (RIO-HO). HOVI (Hoger Onderwijs Voorlichtings Informatie) provides information on higher education and is used as the basis for the exchange of education data.

RIO

Dienst Uitvoering Onderwijs (DUO), the Dutch Office of Education, is working to update and improve the central registration of overall educational offers. RIO (Registratie Instellingen en Opleidingen) is an information model for the registration of institutions and education programmes. Education institutions use it to clearly define their own organisational structure and education on offer based on so-called 'educational reality'. For primary education, general secondary education and vocational secondary education, this information has already been (partially) entered in the RIO register, but the register for higher education (RIO-HO) is still under development. It is important for the RIO-HO information model that the education programmes are registered in a comparable way and that agreement is reached on the standardisation of the modules in order to be able to switch education programmes. The RIO-HO information model is also suitable for the registration of individual modules and courses on offer that are not part of an education programmes.

Erasmus Without Paper (EWP)

The Erasmus+ programme is being fully digitised to help student administrations to exchange students between research universities and universities of applied sciences within Europe. Many European parties are participating to establish the processes and agreements for recognitions and standards in this respect. The objective of EWP 2.0 is to have a working digital exchange network in place by 2021. Although EWP is not meant to be a standard, other countries and continents are very interested in the programme's progress. The European Student Card (ESC) is also helping to simplify the administrative handling of student exchanges.

STAP

STAP (STimulans ArbeidsmarktPositie) is a personal development budget of about EUR 1,000 for employed and non-employed individuals. The idea is that the STAP budget offers learners a choice from a wide range of courses and other educational activities – including teacher education – to improve their work and their position in the labour market. People can invest in their own development by obtaining a certificate that is recognised by the sector or by taking a course, for example. The STAP register is supposed to be ready by 1 January 2022. It is built by the Dutch Office of Education (DUO) and is linked to the RIO register. If government funded institutions wish to qualify for STAP funding, their lifelong learning modules will eventually also have to be included in this register.

Kies op Maat

Students want tailor-made solutions when it comes to their studies, and taking courses outside of their own institution makes this possible. Kies Op Maat, a broad education offer from 27 universities of applied sciences and 4 research universities, makes it easy for students to enrol for a minor or a subject at a different education institution.

Edu-Dex

For some time now, the commercial market has been using a standard for making education easy to find. This involves 160 instructors exchanging more than 55,000 courses taken by various companies, governments, portals and apps. This model is also very useful within the higher education sector and can probably be integrated for the commercial offerings.

OOAPI

A few years ago, SURF started developing the open education API (Open Onderwijs API) OOAPI, an open standard for sharing educational data.² This standard allows education institutions to make educational data available to data consumers in a secure way. This includes aspects such as study credits, timetables, free workspaces, education offers (which may result in a national education catalogue), and enrolment for educational units at other institutions.

² Managed by EDUstandaard, see also https://www.edustandaard.nl/standaard_werkgroepen/ooapi/

With the OOAPI, SURF aims to make education more flexible, support student mobility, enable students to define their own learning path, and provide an overview of educational offers at the level of the educational unit. The OOAPI is a technical interface that allows different data sources within an institution (such as SIS and other applications that register (relevant) data) to be opened up to different users.

OpenupEd

The range of MOOCs that can be used freely and be employed in courses of regular education programmes is probably encouraged by OpenupEd, an Erasmus+ initiative. Various European universities offer courses as part of that framework. The content must be freely available and can therefore be used within regular education programmes. Although such initiatives are still limited, their availability seems to be improving thanks to the funding requirements for research and publications.

Digital Open Educational Resources (Acceleration Plan)

With the 'Towards digital (open) learning resources' zone of the Acceleration Plan, the VSNU, VH and SURF are working on a platform that allows lecturers and students to use and put together an optimal mix of educational resources. This makes education programmes and courses more flexible. The realisation and tests for this platform were carried out in 2021, after which it was examined how such a platform could work in the future for further development and collaboration in the field of educational resources within higher education.

EduMij / MedMij

MedMij is the Dutch standard for the secure exchange of health data between patients and healthcare professionals. This is done via a personal health environment (PGO). An educational variant is currently being considered: EduMij. This concept enables learning and developing individuals to manage their own learning and development data during their entire lifespan. This includes the presentation of study data, subsequent certificates and work experience in a clearly organised CV similar to the Europass CV. This means the aim is to make EduMij an implementation of personal data management. EduMij is currently researching in what direction the concept needs to evolve: an agreements system, operator, or facilitation programme.

1cHO

1cHO stands for '1 cijfer HO' ('one grade for higher education'). This initiative of the Dutch Office of Education (DUO) makes available information on the attendance and results of students in higher education from the DUO registers from 1991 to the present day. This file can be used to check whether the information for a certain citizen service number or education number matches the institution's records. 1cHO is made available in My DUO every year in January or February.

4.2 Focus areas

The interviews, reports and sessions of the inventory phase of the domain architecture revealed various focus areas. The most important focus areas are mentioned below.

Alignment with knowledge needs

The development of knowledge is changing fast. Making this knowledge available and transferable is also an important point, especially if the knowledge in question is quickly made obsolete by changes. Meeting social needs plays a role in this. Education renewal based on discussions in various professional groups, as is currently the case, will no longer be sufficient. The development of education will therefore have to be based more on the available data about which knowledge and competencies the labour market requires.

Competition

Now that the societal needs are changing, fewer traditional parties are entering the education market. In addition, national borders hardly matter anymore. Developments in the offering of education (or opportunities for learning) are leading to innovative business models. The market for learning in a different way is strongly driven by players from other sectors. Knowing their own strengths and unique position gives education institutions the opportunity to safeguard and continually develop their public value in this new situation. Several university rectors now recognise the risks from declining public values and increasing dependence on tech giants.

Targeted at regular students

The education offer is still largely based on the education of regular students entering from secondary (academic) education and exiting via a nominal diploma path. This type of format and funding in this area are expected to decline (see trends and forecasts of the Ministry of Education, Culture and Science in 'Strategische agenda hoger onderwijs en onderzoek – Houdbaar voor de toekomst'). Educational demand is increasingly focusing on the ability to put together a package of smaller modules. At the same time, the Ministry of Education, Culture and Science and the market continue to demand full diplomas. In addition to the modular structure, the range of education must also be aligned with various ways of learning. This may mean that education needs to be further detached from campuses.

Vulnerability

Higher education institutions are not sufficiently equipped on the use of digital capabilities for the continuity of their primary processes. The current measures often address physical fallbacks to other locations, and are always based on the starting point that education is provided in a classroom and evaluation is often based on a central exam session with supervision. Several cybersecurity incidents have demonstrated the vulnerability of the public infrastructure, including the infrastructure of higher education. The coronavirus restrictions have also revealed vulnerabilities in the services provided by the operational management of higher education institutions.

Little flexibility

Although it is recognised that offering and execution higher education requires more flexibility, the institutions' current processes are still very much focussed on the regular educational setup for fixed graduation paths. The modularisation of education requires not only the enrolment of students from other institutions, but also compatibility of the content of the individual modules. It is necessary to examine ways to make the sequence of modules more flexible, as well as the possibilities for starting modules at different times of the year or taking and testing modules in a different way.

Overview of initiatives

There is a great need for change in the education offer, given the various initiatives in this area. Several bodies and collaboration partnerships have taken steps to market solutions. Each initiative makes choices that match the collaboration partnerships' scope and range. There is a risk that duplicate registrations will arise, which may have some differences in the details (and will hopefully not conflict with each other).

Funding model and governance

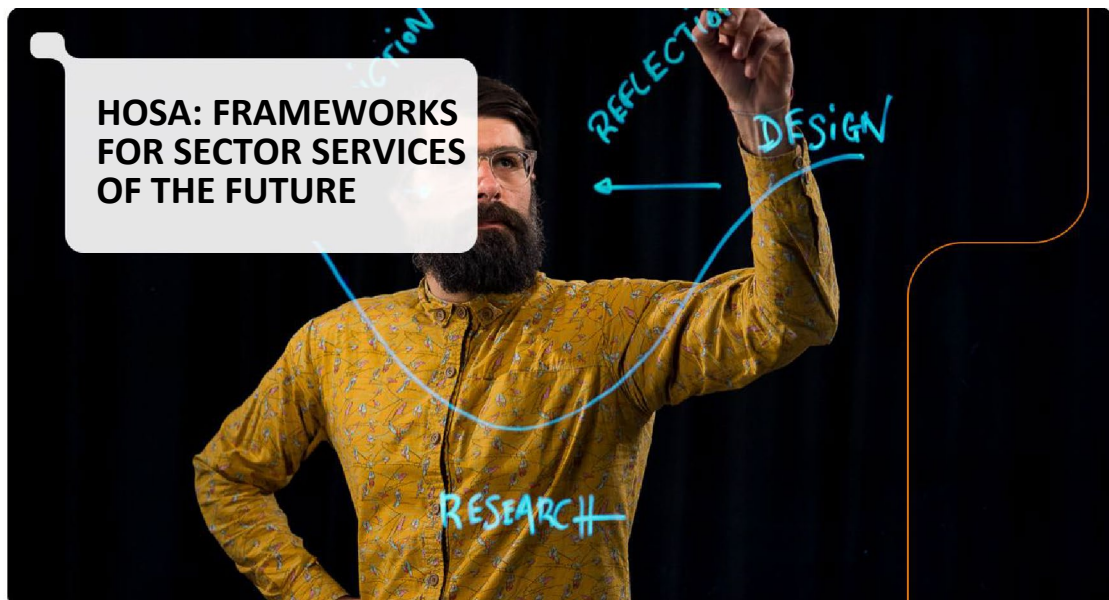
The current higher education funding model is aimed at the successful completion of diploma paths. The number of students at the national level is also important to determine the income per student. All the current processes and systems in the higher education sector tend to be based on this. For changes related to making education more flexible, there are now calls for corresponding changes to the funding methodology. This is taken into account in HOSA.

Use of standards

Standards are in place for aligning different informationsystems offering education, but they are not yet being sufficiently or fully used. In addition, agreements are needed to regulate the mutual recognition of achieved ECTS and awarded microcredentials. This issue needs to be regulated within the higher education sector. It also helps that the working group for agreements and standards for lifelong learning and more flexible education ('Afspraken en standaarden voor LLO en Flex') commissioned by KetenRegieOverleg HO as a sector implements this. A broader development and adoption of standards such as OOAPI and RIO-HO remain necessary.

Implementation of freedom of choice

During their programme, students often have the option to complete part of their studies elsewhere. This usually involves an international exchange, such as Erasmus+, and the implementation of a cohort. Exchanges between Dutch higher education institutions are more difficult to achieve. They are allowed and it is possible, but are less accessible. The student mobility pilot of the Acceleration Team for More Flexible Education aims to improve the accessibility of such exchanges, particularly by making them more student friendly and by reducing the institutions' administrative work.



5 Sector aspirations

The higher education sector has great ambitions to make education more flexible. Many collaboration partnerships and discussions already exist to move forward on this, but these are as yet insufficient to shape the ambitions at the sector level. The forecasts of the future need for higher professional education and higher academic education are expecting a decline in regular students, but a rising need for learning in the working population (see the trends and projections of the Ministry of Education, Culture and Science in 'Strategische agenda onderwijs en onderzoek – Houdbaar voor de toekomst'). The following sections briefly discuss these ambitions.

5.1 More collaboration

According to the strategic agenda, the various higher education institutions need to collaborate more. It looks at both the joint development of education and educational resources and the joint execution of educational activities. Making developed educational materials available for reuse at other institutions is also an appropriate form of collaboration. The operational function for educational support within the institutions and sector services will also have to be set up for this.

5.2 More accessible higher education and greater study success

Higher education needs to be made more accessible to increase the participation of people who are finding it difficult to access the labour market. Institutions can jointly make educational resources more accessible and can put together a more appropriate learning path based on a modular education structure. Students should also receive advice on their chances of success based on their academic progress early on in the process. This can be supported by automated advice in the future.

5.3 Flexible higher education

More flexibility in higher education is necessary to make education better suited to the different characteristics and needs of the various target groups. A second reason is that digitisation, globalisation and the ageing population are changing the labour market that higher education prepares for. Trends are affecting the type of work, the quality of work and the required skills and competencies. Sector services must therefore be able to support the modularisation of educational units and certification, so that students can study in a flexible way in terms of pace of study, location, composition of courses, depth of content form of learning.

5.4 Lifelong Development

The continuous changes in roles and the associated skills require the lifelong development of knowledge and skills. Innovative solutions are required to create a range of education and the necessary resources to align this range with the labour market. In order to keep the range of education up to date, it is necessary to respond quickly to the changes.

5.5 Alignment with society

Education programmes and educational resources need to be developed more in collaboration with the professional world to ensure they are always in line with knowledge needs and the needs of society. Examples include gamification and simulation to shape learning in a safe way. Education programmes must be aligned with complex social issues by bringing together various disciplines.

5.6 Alignment with the labour market

Work is changing fast. The demands on employees are constantly changing due to digitisation, the ageing of the population and globalisation. This requires lifelong development, and the content of education must continue to meet the needs of the labour market.

5.7 Regional integration

The region benefits from a clear approach from the higher education sector. The higher education sector can play a connecting role in projects in a region that transcend disciplines both in terms of content and facilitation of the realisation. For example, a more prominent role of practice-based research in higher professional education could increase the level of knowledge in the region. Students from the region could respond to this based on knowledge and skills from the national higher education services, for example for collaboration and sharing joint research and developments. This can also be realised in lifelong learning by professionals within the region.

5.8 International collaboration

Global competition in education and research is increasing. Countries like China, the United States and neighbouring Germany are rapidly making ambitious investments in education and research. Many emerging economies are evolving from countries with low-cost labour to knowledge-based economies. Collaboration at a European level is therefore becoming increasingly important. The changing geopolitical context also requires a more strategic knowledge policy. To remain competitive, national and international collaboration, particularly on a European level, is needed. Initiatives such as Erasmus Without Paper are already implementing this. The Netherlands has an excellent open research system that is doing well in Europe.

5.9 Education quality assurance

Based on the quality agreements with higher education, important steps have been taken in terms of quality assurance. Many of these steps have a digital component. The aim for the future is to make the quality improvements that have been achieved in this way permanent. According to the quality agreements, the things we need to work on include drawing up quality standards at a module level and making sure they are comparable at a national (and international) level. To make education more flexible, it is important that modules that are now simply part of an entire accredited education programme are generally acknowledged. This will include agreements on competencies and probably also NVAO accreditation of incomplete programmes (not yet at module level) for commercial bachelor's degree programmes provided by institutions that are not government funded. The Acceleration Team for More Flexible Education is drawing up a policy document on microcredentials that is to be discussed by the administrative bodies of VSNU and VH. The realisation of this can be based on the SURF edubadges infrastructure, which can increase reliability but will only partially contribute to quality assurance. The Ministry of Education, Culture and Science is examining the possibilities of institution accreditation, of which quality assurance for modular education would be an integral part.

6 Developments

HOSA has looked into technological developments for possible future developments within the higher education sector, and has identified a number of developments that may be relevant. The HOSA Education working group has retrieved these from scientific publications, policy documents and media.

6.1 Digital disruption and digital companies

Many sectors are changing so much because of digitisation that this is being referred to as digital disruption or digital transformation. Such developments can also be seen in the higher education sector. Some examples are the rise of EDX and Coursera, or LinkedIn, which will be offering courses to professionals. This creates new competition from parties who do not traditionally belong to the sector and tend to be based on new business models. This transformation will also affect education and research in the higher education sector. It is important to know which functions are at the heart of national higher education sector and are crucial to the functioning of society.

6.2 Cloud

The use of the cloud is here to stay and has raised issues regarding ownership and unintended dependency. This may lead to problems regarding continuity and liability in the event of a partial failure of functions in the cloud. Larger problems may arise when the cloud service fails for a longer period of time, when data are lost or corrupted in the cloud, or when dependencies on cloud suppliers become imbalanced.

6.3 Blockchain

Several technological developments are taking place in terms of reliable data exchange. We often look at secure methods of storage and transport in that regard. The party handling central resource management plays an important role in this. When blockchain technology is used, this role is assigned to all the stakeholders. It is expected that in the future such technologies will be applied to support the reliable exchange of data for completed certificates.

6.4 Artificial intelligence

Artificial intelligence can be applied by using machine learning with large datasets. This can be done to offer advice based on historical values, but is also being used increasingly for recognition based on unexpected indicators. The combination of many measurement points helps to give advice, but also raises questions about ethics and effectiveness. When artificial intelligence is used transparently and offered as advice to the end user, it contributes to acceptance.

6.5 Omnichannel

More and more work is being done to make services available via various channels. This approach is becoming more mature as its use increases. Spotify and Netflix, which focus on the user with interaction across different channels, are good examples (classroom in a pocket). The omnichannel approach can add significant value to support for learning and research. Also the physical world is integrated closely with the digital world.

6.6 Multiple user interfaces

Whereas omnichannel is mainly about providing the same content data through different channels, multiple user interfaces is mainly about different forms of interaction with the end user. The variation in user interfaces makes it necessary to properly align the structure of education and the underlying processes. Interaction takes place by means such as chatbots, mobile devices, gestures, speech or thru gaming.

6.7 Virtual reality

Developments in virtual and augmented reality allow for different ways of practising in the professional field. For example, simulations and gaming scenarios can help to improve learning support. This provides opportunities for more training instead of just a theoretical treatment. In the higher education sector, the strength of this lies in connecting the various virtual environments in order to improve the total experience of virtual and augmented reality by means of a virtual classroom.

6.8 Data driven

Support for choices, analyses and advice is increasingly based on data from numerous and varied data sources. The use of data is developing experimentally with examples such as smart campus and adaptive learning. In terms of data management and reliability, services must become available within the higher education sector to be able to safely apply each other's data. Based on the zone for the secure and reliable use of study data in the Acceleration Plan, work is already under way to develop a national code of conduct for the use of study data.

6.9 Consumerisation

Technological developments are now largely determined by the consumption of technology by consumers. In many cases the driving force behind this is that the general public shapes a product through their profiles and behaviour. The technology available for this may also add value to innovations in education, and sector services may contribute to the deployment of these resources.

7 Architectural vision

HOSA offers an architectural vision for the higher education sector with a horizon of roughly three to ten years. This architectural vision is based on the sector's initiatives and ambitions, technological developments and focus areas in the current situation. Various main processes have been identified within HOSA Education, which are explained further below. It concerns the definition, development, offering and implementation of education.

7.1 Introduction

The higher education sector is evolving. The demand for education is changing. The emergence of artificial intelligence and other technologies requires different knowledge and skills in the working population. This is having a major impact on existing professions and is resulting in high demand for additional training. Global developments are also having an impact, such as the emergence of megacities with mega-universities in Asia, which are accelerating innovation in the region or resulting in competition. Technology enables other forms of education, so that companies and service providers can enter the market with a new competitive supply. To cope with these developments and stay competitive, more collaboration is needed in the regions or within Europe.

The Netherlands has a number of ambitions that are facilitated by the higher education sector. For example, to make the country a more data-driven knowledge economy as stated in the Knowledge and Innovation Covenant. Regions are also focusing on innovation and stimulate working together with higher education institutions to become smart regions that are more in tune with developments. The Ministry of Education, Culture and Science has set a number of goals in the strategic agenda together with the higher education sector. The main goal is to make education sustainable for the future. The sector aims to achieve this by making education more flexible, increasing collaboration (regional, national and international), improving alignment with the labour market and improving regional integration.

In HOSA, these strategic agenda goals are linked to objectives that are broadly supported in the sector and are reflected in the objectives structure (see Section 3.4 and Annex 11.3). To achieve these goals often requires sector services. HOSA has developed the starting points for these into a framework.

More flexible education

The first goal is to make education more flexible. The Acceleration Plan, a joint initiative of VH, VSNU and SURF, is working on this at a national level. HOSA expects education to become more and more flexible in the coming decade. Flexible and traditional education will coexist, and it is expected that institutions and faculties will have their own emphasis in this regard. This means that the landscape of sector services must be able to support both flexible and traditional education. More flexible education means that students are increasingly crossing institution boundaries. It is therefore necessary that various data are kept or exchanged on a national level. This creates the need for national sector services that enable efficient data exchange and clear provision of services to students.

Collaboration

Another goal is to expand collaboration between institutions. Various institutions have one or more fixed partner institutions with which they develop and offer education together. Examples are the collaboration partnership between Leiden University, TU Delft and Erasmus University Rotterdam, the collaboration partnership between the Amsterdam University of Applied Sciences and the University of Amsterdam, and the collaboration partnership between the University of Amsterdam and Vrije Universiteit Amsterdam. Such collaborations also raise certain questions: How will we exchange achieved marks? How do we make the educational offer available and organise enrolment for all courses? Which digital learning environment will we use and how will we integrate the various learning environments with each other?

A collaboration partnership between two institutions can be organised by the institutions themselves, provided that major investments are made. However, this becomes extremely complex with multiple partners or changing partnerships. HOSA therefore states that the national sector services of the future must be able to support collaboration partnerships between institutions. HOSA introduces a number of starting points for this. First and foremost, sector services must make data exchange between institutions easier. This can be data regarding modules, education, students, results, educational resources, or educational data for policy analysis. These can then be exchanged between an institution and a national sector partner or between institutions themselves.

A second principle is that sector services do not just have their own dedicated national access portal. This means that the functionality of sector services, such as enrolment for a course, can be offered on a national portal, an institution portal, or a collaboration partnership portal. The sector service handles everything with the institution services concerned in the background. This makes it easier for institutions to connect at different levels and enter into collaboration partnerships.

Alignment with the labour market

Another impactful goal is alignment with the labour market. Work is changing fast. Digitisation, the ageing population and globalisation are constantly leading to different demands on employees. This requires education to pay more attention to lifelong development.

This shifts the focus from traditional learners to lifelong learners. The question is then which target group the sector services of the future will focus on. Are they going to focus primarily on students or on professionals? For this the Acceleration Plan uses four student routes, including 'Modular study' and 'Study at your own pace'. Both routes show how regular education can be made more suitable for professionals. Although this is certainly not possible for all education, HOSA expects students and professionals to grow closer together. This development is also reflected in a nationwide overview of the education individuals have received during their lifetime. No distinction should be made between students and professionals in this regard.

HOSA is based on the learners, with traditional students as one of the possibilities. The term learner is comparable to the term citizen in a government context, or to the term individual as used by HORA. Current developments will make the learner the centre of attention. More flexible education and lifelong development means a shift in the perspective of the education consumer. Whereas a traditional student often stayed within the boundaries of a single institution, lifelong learners and flexible students often deal with multiple institutions. This eventually creates the need to organise some things across several organisations and even countries for learners (see Figure 2).

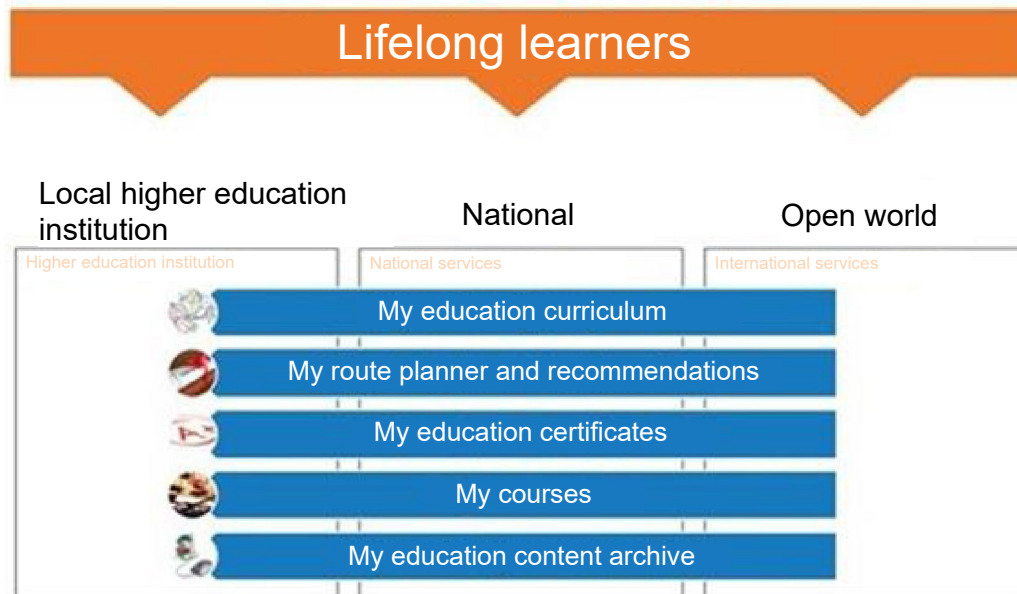


Figure 2: Change of perspective for lifelong development

Alignment with society and regional integration

Another goal that affects the architecture of sector services is the alignment of education with society and the labour market. Education programmes and educational resources need to be developed more in collaboration with the professional world to ensure they are constantly in line with the (knowledge) needs of society. At the policy level, institutions are increasingly working with the region to define education by providing appropriate education programmes. Mapping out the needs is now often a manual process. In the future, sector services will provide digital support to regions, governments and institutions for tasks such as combining economic data. This makes it easier and more straightforward for the regions and the professional world to work together with the higher education sector. This also makes it unnecessary to contact various institutions, as the higher education institutions can act as a single party in their dealings with the region and the professional world.

International collaboration

Finally, the goal of international collaboration also has an impact on the sector services. This often involves strengthening European collaboration in order to compete with the US and Asia. First of all, this means that HOSA must be able to align with the European initiatives and standards. It must also be possible to reuse or scale up initiatives from the Netherlands in European countries. This is stated in HOSA's overarching principles. Integration patterns for international data exchange must be agreed. HOSA expects the emergence of hubs around the national sector services in this regard which will be used for collaboration with foreign institutions (rather than direct contact).

7.2 Principles

These developments will take place during a decade that is also referred to as the *digital* age. Many businesses are transitioning into *digital companies*. The end product and the accompanying services are primarily digital and largely consist of data or software, for example. The supporting processes have also been fully digitised. Higher education institutions will also go through this development. Some manual operations will disappear, and advice will no longer always be provided by humans. It could be that in the future students could receive automated advice on possible learning routes. Digital concepts and technologies such as business platforms, AI and blockchain will also make an entrance in the sector.

Modular structure of education

The traditional way of structuring education tends to be based on the education programmes. The courses are closely linked to the education programme and the sequence of the subjects has often been implicitly defined in the education programme. The goals that many institutions have set to make education more flexible are causing a shift in this regard. The Acceleration Plan identifies three student routes for the large-scale application of education modularisation: 'Off the beaten track', 'My diploma' and 'Modular studying' (see: [Zone for More Flexible Education – Versnellingsplan.nl](#)). In 'Off the beaten track', it is important that learners quickly see whether a subject from another institution fits in with their own programme. In 'My diploma', it must be easy to see whether certain subjects fit into a programme and lead to a graduation. And in 'Modular study', the emphasis is entirely on individual education modules.

In the coming years, traditional education and flexible education will coexist, with institutions and their faculties having their own emphasis. However, when we take a deeper look, we find that HOSA provides the foundation for making more flexible education possible. HOSA therefore assumes a modular structure of education. Sector services will support this in the future with functionalities such as microcredentials for completed education modules and enrolment in education modules.

One overview for the learner

In the future, there is expected to be more of an emphasis on lifelong learning alongside regular education. This creates a greater need for a general overview for the learner, where they can keep track of their developments and results achieved with education institutions as well as third parties. The same need can be found in the student routes in the Acceleration Plan: 'Off the beaten track' and 'Modular study'.

In the future the learner's personal development will continue to be mapped out based on the development opportunities offered by education. Such a learning path must be sufficiently modular to allow for changes in direction and time. This gives learners a sort of route planner and recommendations based on all the education on offer. Study coaches and advisers can use this route planner for their personal coaching of learners.

The results achieved in modular education are included as digital certificates in the lifelong learner's personal profile. The higher education sector services guarantee the value of these certificates as proof of the achieved results. There will probably be no querying of central registers in terms of content in this regard, but reliability checks and invalidation of issued digital certificates are indeed expected.

Data exchange

To make data exchange effectively possible, it is important to make arrangements about educational data across the various institutions, and to standardise data about content, lectures, modules and programmes, for example. Data will be exchanged between many parties, including public, private and foreign institutions. Sector partners such as DUO, Studielink, Nuffic, Studiekeuze123 and SURF will also be involved. Agreements on data exchange also strengthen local collaboration between institutions and collaboration with foreign institutions. EMREX, for example, is an initiative for exchanging available data on achieved qualifications and certificates. It exchanges digital information based on the qualification registers of the Dutch Office of Education (DUO) to support international exchange students.

Comparability of education

More flexible education requires module comparability at different (international) institutions, the composition of a personal educational programme and the option to switch from a modular study path to a diploma path. Here, the description of both the content and the form of the education offer and learning outcomes will have to be standardised further to become comparable and connectible. Initial experience with this has been acquired in the pilot project learning outcomes.

As education becomes more flexible, the manual process of comparing education, learning outcomes or final terms will no longer be able to keep up with demand and will have to be partially automated on a larger scale. For example, an educational professional may offer the final advice, but the insight is made up from automated advice. To make this possible, education will have to be further datafied. This complex issue must be shaped by means of common international standards.

Stackable learning

Stacking content to create an educational programme is not easy in practice, but this way of thinking does help to connect the different steps within education and create consistency. In such case, modules as well as components at other levels can be stacked into programmes or courses of study (see Figure 3). This allows microcontent to be used to put together resource bundles and then lectures. A course or subject can then be created by stacking lectures. To achieve the necessary flexibility in terms of the sector services of the future, it is important to properly shape the logical relationship between the various components of education and their structure.

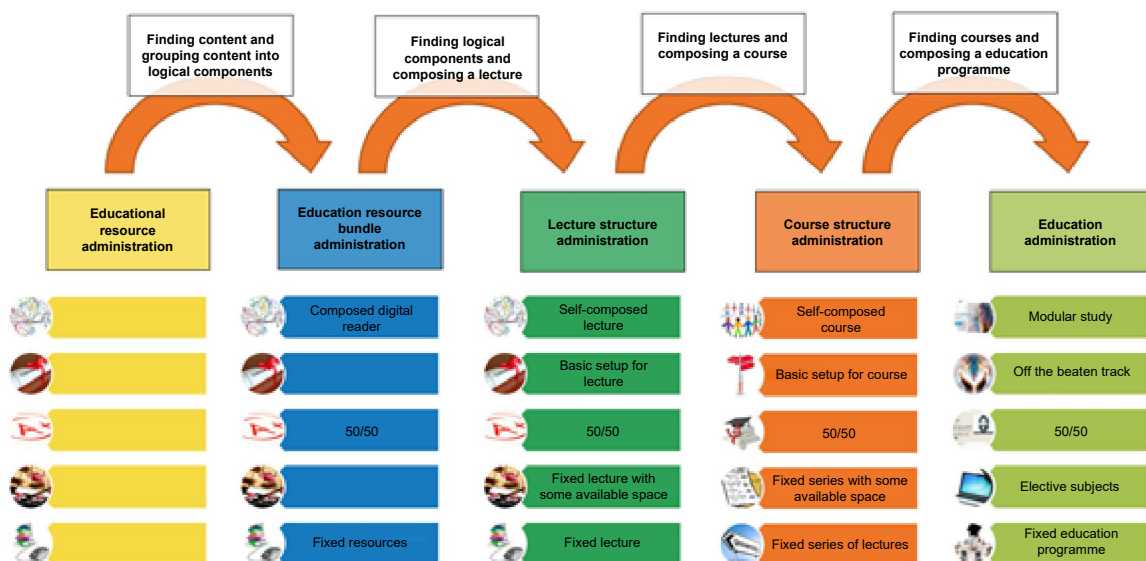


Figure 3: Stackable learning

Financial settlement

HOSA takes into account the expected need for financial settlement and possible changes in the funding methodology to make higher education more flexible. HOSA aims to handle all financial settlement in the education domain in a similar way, allowing the rules on higher education funding to be modified. It should be possible to facilitate any mutual financial settlement between higher education institutions within HOSA in accordance with the chosen modular level, based on the institutions’ specialisation and differentiation within the sector. It is expected that a sector service can also offer support in the mutual allocation of costs between institutions and flexible education budgeting.

Exchange of services

Developments in education are increasingly calling for exchange between different parties, such as students, lecturers, researchers, companies, governments and citizens. This involves the exchange of educational data, educational content, educational modules and services, for example.

Sector services support different types of collaboration

Collaboration is important for education objectives on many levels: between institutions locally in the region, internationally, within subject areas, or with the business world. For institutions, there is also the question how

they can properly support their collaboration partnerships at the various levels. At present, these collaboration partnerships are usually set up on a case-by-case basis. This has the disadvantage that they are difficult to scale. However, the collaboration ambitions of the higher education sector require such scalability.

HOSA makes the sector services suitable for collaboration on those levels by ensuring that the same services can be offered simultaneously on portals at the level of an institution, collaboration partnership, subject area, and national or international initiative. For example, the service for enrolling in a subject can be offered by an institution, regional collaboration partnership or national enrolment portal.

Room for specialisation

Because of more flexible education, institutions or commercial providers may specialise more in certain areas of the education process. One example could be an institution that focuses on education development. Other specialisations include administering tests and guiding students in the form of on-campus education or only online. In the long term, there may also be a need for new roles in the sector to be filled by the institutions themselves or by other parties that see opportunities there. For example, a study coach may specialise in a specific sector or a sector library may focus on ebooks. Such new roles have also emerged in other sectors where more flexibility is already present, such as the travel industry and (online) retail. Future sector services are prepared for this to ensure such changes can be supported. The architecture of the higher education sector can provide an ecosystem where data can be exchanged in a reliable and meaningful manner.

Diversity of interfaces and channels

The starting point that sector services support collaboration partnerships at various levels will eventually lead to the creation of multiple portals using underlying services from sector services. Some examples of this are a national portal or an institution portal. Due to technological developments such as omnichannel and multiple user interfaces, the usual interaction with text on a portal will be insufficient. That is why sector services are designed to support interaction through a wide variety of interfaces and channels, including chatbots, mobile, gestures and games.

Platform strategy

Developments in education and research are increasingly calling for exchange between different parties, such as students, lecturers, researchers, companies, governments and citizens. This may involve content, data and services, such as educational resources and education modules for learners. HOSA therefore uses the concept of business platforms to draw up the application architecture for the sector services. This concept provides insight into online marketplaces, which are emerging in various places thanks to increasing collaboration in the sector.

Business platforms are rooted in the tech giants that are reshaping service delivery. For the higher education sector, HOSA mentions similar platforms, but based on the public sector and public values. These digital public sector platforms facilitate interaction and collaboration, bring supply and demand together, and focus on common values and norms.

A key goal is to facilitate a healthy ecosystem of institutions and lifelong learners, including students. The platform provides an open collaborative infrastructure for various interactions and governance to assure a healthy ecosystem. A platform approach also suits the expectations lifelong learners have of modern service delivery: an open architecture, opportunities to work with the data, use of artificial intelligence, variety in user interfaces, use of cloud architecture, and an ecosystem of services.

8 Platform strategy

8.1 What is a platform?

As indicated in the vision, the HOSA domain architecture is based on digital public sector platforms as the basis for the sector services. But what exactly is a platform?

Business platforms are a global trend, with well-known examples such as Uber, bol.com and AirBnB. More and more traditional companies, such as General Electric, Philips and Nike, are taking inspiration from this concept and have adopted business platform features. Platforms are also on the rise in the public sector. Examples in the education domain are EDx, Coursera, Amazon Ignite and Woolf. These platforms provide an environment that enables value-creating interactions between manufacturers and consumers. A platform offers open, accessible services for these interactions and arranges the underlying governance.

The platforms' overall objective is to link supply and demand between users and service providers, content, knowledge and data, and to make their exchange easier. Business platforms can easily scale up their services because they usually do not produce the services, data, knowledge and content themselves. For example, Uber does not have any taxis or taxi drivers, and therefore does not have to buy any taxis or hire more drivers itself in case demand goes up. Uber also does not have to organise the maintenance of a fleet. And the Coursera platform brings together the demand of learners and the supply of other organisations rather than organising education itself.

A platform integrates the functions and competencies that are necessary to deliver services to users. The platform can help in finding the right supply, simplifies the offering of new services, supports and simplifies the transactions between the providers and users, monitors usage, and guards quality. Finally, a business platform offers an open, collaborative infrastructure for interactions between the parties operating on the platform, with governance that ensures a healthy ecosystem.

8.2 Platform setup

The changes in education require an underlying infrastructure that no longer acts as a traditional basic administration, but as an open digital public sector platform. The platform strategy helps to drive and realise ambitions, and is in line with society's expectations with regard to modern service delivery.

The platforms encourage open collaboration in education and have an open and modular architecture that combines and makes various functions available for the exchange of educational data. In addition to basic functions for exchanging educational data, advanced functions such as AI and the cloud are also applied to provide the best possible support for all aspects of education. These platforms are characterised by a variety of (user) interfaces tailored to the user's role on the platform. The platforms also have clear, open and standardised interfaces. They support the entire education process and interconnect seamlessly. Reuse, connection to and alignment with the platform are easier to achieve thanks to the modular setup and open architecture.

It is important that governance on such platforms is set up in a way that properly assures and monitors independence, transparency, privacy, security, integrity and reliability. The key to success is that the platforms act as service providers with integrity, transparency and reliability towards the various stakeholders, such as citizens, teachers, regions, public institutions and private parties. The platforms can also be used internationally.

8.3 Education platforms

When we look at higher education at the sector level, and therefore not simply at the tasks of higher education institutions, we can distinguish roughly four main processes for HOSA:

- Education definition: mapping out and defining educational themes based on social themes and the required competencies in the business world.
- Education development: the creation of educational resources, courses and educational programmes.
- Education offering: making education available to learners so that they can find an education option that suits them and they can register or enrol.
- Education execution: the actual provision of education to learners and the achievement of credentials and qualifications.

Based on the platform strategy and developments for more flexible education, four platforms for education can be identified: the Smart Region Platform, the Education Exchange Platform, the Lifelong Learning Platform, and the User Study Experience Platform. We will elaborate on these below.

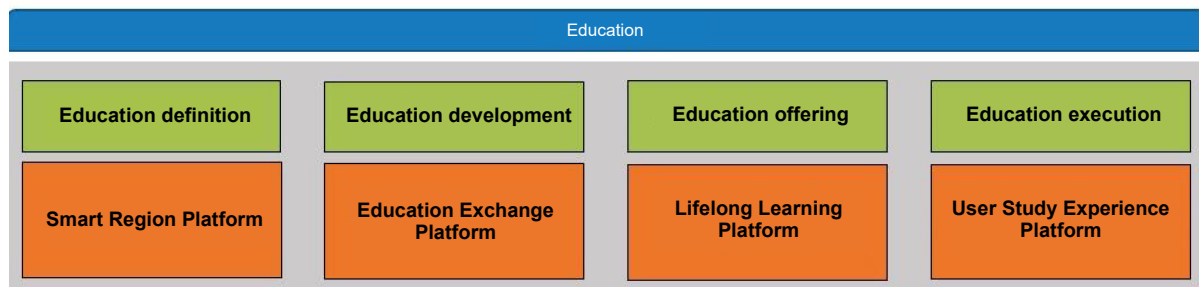


Figure 4: HOSA education platforms

8.3.1 Smart Region Platform

In order to form a smart region on a regional, national or international level, joint insight into the region knowledge is needed now and in the future. The Smart Region Platform offers the possibility to gain this insight together. Regions are developing into truly smart regions based on data and analytics.

8.3.2 Education Exchange Platform

In order to create well-defined education, educational professionals are put in contact with each other and supported to share and improve their educational components. The platform acts as an ecosystem for offering and acquiring educational content, modules and programmes. The actors on this platform make available (open) content in high-quality, easily accessible components based on added value.

8.3.3 Lifelong Learning Platform

From the moment they enter into their education, students can develop a personal profile of the skills and competencies they acquire within and outside formal education. Higher education institutions offer opportunities for further development on the Lifelong Learning Platform, which also facilitates enrolment and financial settlement between the various stakeholders.

8.3.4 User Study Experience

Studying in the higher education sector takes shape by making available personalised information in a standardised way on the platform from the various parties handling educational execution. A student may be enrolled in an education module of university X and use the online and physical facilities of university Y on the campus of university of applied sciences Z.

9 Stakeholders

The HOSA Education stakeholders can be categorised into five groups. They are mutually dependent parties that do not play a decisive role within the HOSA platforms on their own. Platforms will therefore often be designed based on partnerships between two or more stakeholders.

9.1 Citizens, students and learners

For the higher education sector, citizens, students and learners are the direct contacts for education and courses. The form of study is an important factor in coordination with citizens. Government and business also play a part in financial settlement for these services provided to citizens by the higher education sector.

It is expected that citizens will need further flexibility in the higher education offer in the coming years. This applies to regular students in a programme and to students who are taking a higher education course to stay up to date on the subject area or to broaden or deepen their knowledge in other subject areas. The share of students in a regular education programme with respect to working individuals who are also taking courses will change significantly. More and more working people are studying, and incentive schemes will be introduced to make this easier.

When citizens engage in lifelong development, it is important that the sector services support this from that perspective. Citizens benefit from a consistent set of services. This means, for example, that the achieved results and enrolment must be available in a single overview.

9.2 Government

In the social implementation of education, control at knowledge level and quality are the government's responsibility. It will have to put in place a policy and funding to assure the reliability and continuity of education while offering enough freedom in terms of study content to allow market forces to have their effect. The government also assures that supervisory roles are filled to guide public values in education.

9.3 Education institutions

As stakeholders in the higher education sector, the universities and institutions of higher professional education form the foundation of the higher education sector. This makes them leaders in the construction and design of sector services, in which they must take into account knowledge institutes and adjacent education institutions, such as secondary vocational schools and other secondary schools. Together, the education institutions make up the landscape in which the various education platforms provide the range of education requested by other stakeholders. From HOSA's point of view, the focus of education institutions is on the collaboration and data exchange that shape the sector as a whole.

9.4 Companies

HOSA identifies three primary interests for companies in terms of sector services. The business world wants education to supply professionals to the labour market. In terms of the required knowledge, parties in the business world are an important factor. They need trained professionals and are also important partners for offering educational opportunities, such as internships and content-related assignments. Secondly, companies are also active in the offering of education. It is important to companies that they are able to connect with sector services as well. And thirdly, some companies offer content, functionality and services for education. They too have an interest in being able to offer their services as part of the HOSA architecture.

9.5 Regions

With the region as a stakeholder, we mean society in a specific form in which citizens, governments and businesses deal with the higher education sector from a regional perspective. These are often specific focus areas in fields such as economics, the environment, healthcare or transport, where the higher education sector can act as a knowledge partner. The term region is not limited to a specific area of the Netherlands and can also be an area in Europe or another part of the world.

Major regions with a specific character from the top sectors in the Netherlands are, for example, aviation operations near Schiphol (Airport), port activities near Rotterdam (Seaport), and IT and knowledge developments near Eindhoven (Brainport). At the European level, examples include Rotterdam/Antwerp for shipping, border regions where there is significant cross-border collaboration and the entire waterflow area of the Rhine river for water quality.

Institutions are often active in partnerships within the regions. It is therefore important for them that sector services support collaboration partnerships between institutions.

9.6 Sector partners

Education is made possible by various parties performing important sector tasks in the background. Some examples are DUO, Studielink, Nuffic, NVAO, VSNU, VH and SURF. Despite the differences among these parties, there is also a common factor from an HOSA perspective: a role in offering (parts of) sector services in the future. For example, the VSNU's lifelong learning catalogue can be described as a sector service from a HOSA point of view.

10 Process and application architecture

As indicated in Section 8.3, the HOSA domain architecture Education is based on four main processes, with integration at the process level supported by platforms. Below we explain the following platforms.

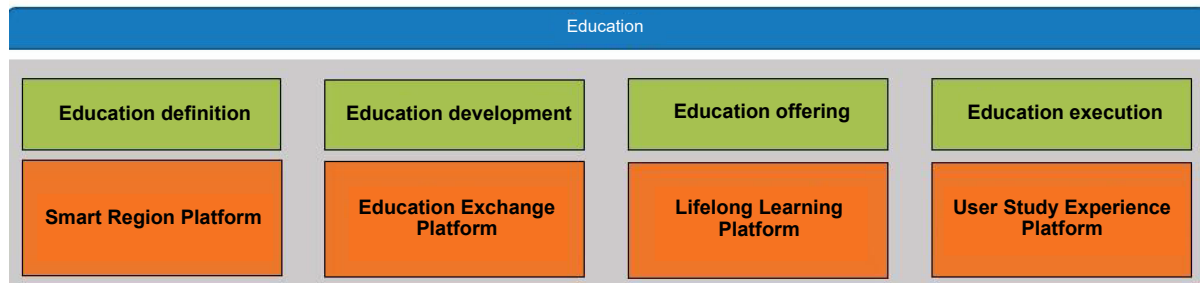


Figure 5: HOSA education platforms

10.1 Education definition

What happens in this process?

This process focuses on mapping the demand for education and defining the appropriate supply. In the strategic agenda, the Ministry of Education, Culture and Science mentions the ambition to use sector-based plans more. In this process, officials from institutions, sector partners and governments work together in the role of policy-makers. Other sectors and the professional world are also involved in the process and provide input on the educational needs that are expected in a few years' time. Thanks to this collaboration in the region the need for education of the region is determined. The Commission for Effective Higher Education (Commissie Doelmatigheid Hoger Onderwijs or CDHO) supervises this by looking at the macro expedience.

It is likely that all organisations concerned have both a demand for and supply of data relevant for others. In the current situation, everyone collects the data they need and stores these data locally. With some initiatives, such as 1cHO and Open Education Data, data are made openly available.

In the course of their career, lifelong learners can go through a period of reorientation. One possible reason is that their own profession is coming to an end due to certain technological developments and a new career step is necessary. Information from this process provides insight into the development of subject areas and the emergence of new subject areas.

What is the role of the platform that supports this process?

This part of the process is aimed at policy makers from institutions, sector partners and governments who are collaborating to determine the education needs of a region. These are local, national and international regions. The Smart Region Platform provides an environment where data from various parties are brought together. This could be data on education or macroeconomic data, for example. Logical providers of such data are the institutions, Studielink, DUO, Nuffic, the Ministry of Education, Culture and Science, and CBS. ROA.nl, a research group at Maastricht University, has been examining the relationship between research and the labour market for many years. The need for education programmes is determined based on data analysis. This can be done at various levels: locally, regionally, nationally, or even broader.

This platform fullfills the same role in defining the demand for research in the research domain. The stakeholders can broadly map out the need for knowledge for the future in the region.

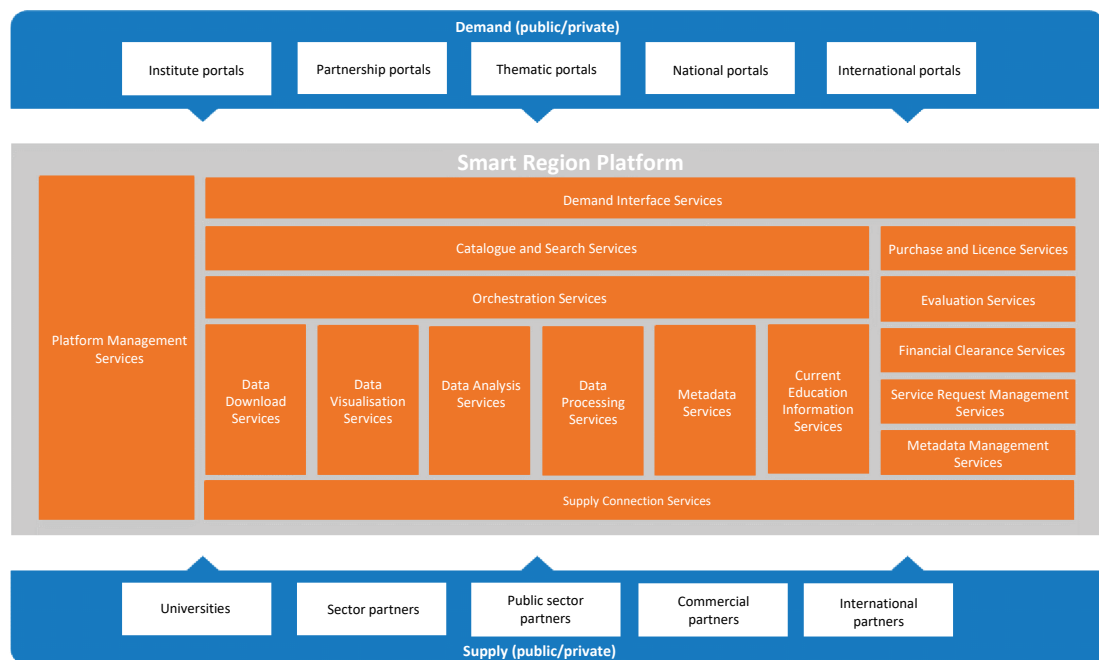


Figure 6: Smart Region Platform

What components does the platform consist of?

Demand Interface Services

The user environment focuses on professional employees in roles such as policy-makers or data scientists at institutions, sector partners or authorities. They can find data and services on the platform with the use of a catalogue and search function. If the platform becomes successful, the amount of available data and connected services will increase. In that case, good filtering mechanisms and search algorithms are essential to find relevant data. The platform also offers an environment where professional staff can obtain data and services needed to define education (*Purchase and Licensing Services*).

Retrieve and link

The platform offers services to retrieve or link data made available by other sources (*Data Download Services*). For example, from sources of parties also operating and participating on the platform.

Metadata Services

The platform offers services that help providers with the metadata (*Metadata Services*) of their datasets. The services for validating metadata are one example of this. The addition of metadata makes it possible to search for and within datasets and make connections between datasets. Metadata are added based on specific standards. Governance is set up to determine and maintain these standards. The use of these standards can be monitored from a community perspective.

Processing, Analysis and Visualisation Services

Both structured and unstructured datasets can be offered and found on the platform. To this end, the platform offers services that support policy officers, data scientists and so on to process datasets into other datasets that can be applied to gain insight (*Data Processing Services*). The platform also offers services for analysing data (*Data Analysis Services*). Employees also receive support for the presentation of analysis results (*Data Visualisation Services*). For example, services that can convert unstructured datasets into structured datasets or can combine datasets with each other. Both visualisation and dataset processing services are offered as Software as a Service.

Education Information

The platform supports insight into the current education portfolio by making links possible for example with the student information systems of institutions, (*Education Information Manager*). The platform also offers possibilities to search through this information. This provides insight into the themes for which education is already being provided or developed (*Current Education Information Services*). Based on this, developments can be shown nationwide.

Evaluation Manager

The users of data are able to assess the data. The evaluation is shown along with the data the employee is interested in. Data providers can respond to this feedback.

Service Request Management Services

The services have transparent service levels. The platform has a service function that routes user questions to the relevant provider to give platform users the right support for their use of the data or services.

Supply Connection Services

An interfacing component is available for linking services and making available datasets and services. This allows providers of datasets and services to easily make their datasets and services available via the platform in a standardised way. The component enables institutions to offer their own facilities as a service on the platform. This functionality promotes collaboration, reuse, differentiated services and so on.

Platform Management Services

The Smart Region platform offers opportunities to assure and meet agreements, for example with regard to the quality of the provided services and datasets. Overall agreements are required to identify unwanted content or non-performing partners. Agreements must also be made about the role the platform or data from the platform plays in an institution accreditation (including commercial parties). This is handled by platform management (*Platform Management Services*), which also looks after the platform's setup, (continued) development and implementation in collaboration with the key stakeholders.

Financial settlement

Functionality will be made available on the platform (*Financial Clearance Services*) for any financial settlement for the use of datasets and/or services. This supports the settlement of costs between providers and users.

Orchestration Services

An orchestration component connects individual platform components. This makes sure the platform traffic is properly managed.

What are the key starting points and principles here?

Ownership of the various data must be clearly established. The owner determines what the data can be used for and provides a statement about the quality of the data. The owner also makes sure that any questions about the dataset are answered. Data science has been on the rise for several years now. In education this has become visible as student analytics. This is also an important topic in the current Acceleration Plan. For data science the procedure is different than for traditional management information environments. In the past a lot of effort was always put into fully structuring the data in advance, but this is not necessary for data science. The data are only fully structured after patterns have been found with the aid of data science and their usability has been proven with data science.

Not all data will be stored on the platform itself. The platform offers opportunities to use data from partners in other sources. Metadata management is set up to document the location and quality of data, for example. Metadata also makes it possible to search within data and link data to each other.

Relationship with other platforms

This platform is the same platform as the Smart Region Platform for research. On this platform, data can be used to assess what knowledge needs to be developed and distributed within a region. The platforms are similar in terms of the underlying technologies. The reuse of building blocks is obvious. The Smart Region Platform will focus mainly on sharing, finding, obtaining, processing, analysing and visualizing trend-like data.

Which initiatives can already be seen?

In the current situation, the following initiatives can serve as an example for part of this future platform:

- 1cHO: The 1cHO file contains all participation and results data of students in higher education from 1991 to 1 October of the previous year.
- The Dutch Office of Education (DUO) collects data on government funded education in the Netherlands and makes a large part of this available online.
- Open Education Data ([DUO - Open onderwijsdata](#)): The Dutch Office of Education (DUO) has developed an API with data from various institutions. This API provides an infrastructure for collecting open educational data from institutions involved in education, making that information collectively searchable and supporting the reuse of these combined data collections. The API includes datasets from DUO, the Education Inspectorate, Vensters Voortgezet Onderwijs, the Ministry of Education, Culture and Science and DANS. The datasets mainly refer to primary and secondary education.

10.2 Education development

What happens in this process?

After the need for education and research has been defined in the previous process step together with the parties in the region, education is developed in this step. This education has various aspects, such as content, learning formats and learning paths. Educational professionals from various institutions work together in this process to design, develop and make education available and provide locally collected resources. This is done on a local, national and international scale. The process should therefore be in line with support for international collaboration for education development within the EU. In addition, this process involves collaboration with science and publishers.

Where previously this process was organised in often closed processes with players who did their best to make content available in a convenient way, over time this is expected to result in an ecosystem of providers and users. These educational professionals can offer or acquire education components themselves on behalf of their institutions. Roles are created to facilitate this.

What is the role of the platform that supports this process?

The Education Exchange Platform offers a marketplace where educational professionals can meet to exchange offerings. It is aimed at exchanging education components such as content, lectures, modules and even complete education programmes. Education is not designed or created on the platform. The main use of the platform is to provide and exchange education. The content is therefore located elsewhere, for example at the institution that is offering it.

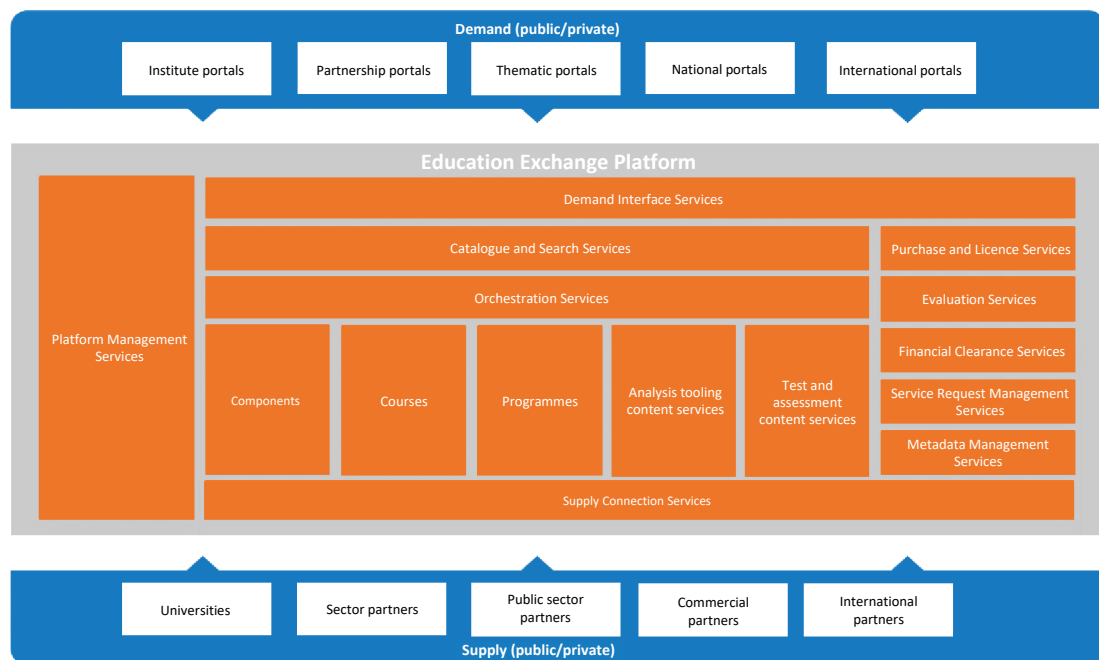


Figure 7: Education Exchange Platform

This platform is closely related to the goal of open educational resources. It is therefore unnecessary to create separate storage for open and closed learning resources. The platform can generate a separate view when the ‘open educational resources’ attribute is included in the source metadata. If necessary, the platform can make a separate ‘open educational resources portal’ available that only shows open educational resources.

The platform is more or less an evolution of traditional library systems. The main difference is that the educational developers themselves are adding and making available the education metadata to the users. In doing so, they choose to make the information open or closed and they handle any questions about the content themselves.

What components does the platform consist of?

Demand Interface Services

The platform offers the option to generate different views of what is available. In any case, a portal is available showing the entire range. The platform also offers support in the use of institution portals (*Demand Interface Services*). For example, institutions can decide to use a national portal or their own portal.

Catalogue and Search Services

The platform offers a catalogue (*Catalogue and Search Services*) of content, lectures, modules and education programmes. Good filters such as search mechanisms and mechanisms for matching supply and demand are important. On this platform, the independence of these filters is less important because educational professionals are the primary target group. This means that governance can be somewhat ‘looser’ than on other platforms.

Five main components

The platform can be categorised into five main components to support the exchange of the education offer: *components* (lessons, lectures, classes), *courses*, *programmes* (education programmes and certifiable units), *analysis tooling content* (content analysis), and *test and assessment content* (test and assessment resources). This makes the platform in line with the developments in international educational standards.

The first component focuses on education *components* such as content. These educational resources will appear in many forms, including smart books, games, software code, digital readers, datasets and video. The platform must be able to cope with all these different appearances.

The second component focuses on *courses*. Some examples are learning formats, interaction and assessment. It is important to be able to link and connect different types of content here. It must also be possible to establish a relationship with the *components*.

Programmes are the third component on the platform. This concerns both modules and education programmes that have been grouped into certifiable units. Complete modules and education programmes can be exchanged with this component. Some examples in this regard are content descriptions of the module, structured data on how the module is set up, and a coherent content package. The third component is related to the two aforementioned components in order to exchange the associated content and lectures.

The fourth component focuses the ability to analyse the offered content (*Analysis Tooling Content Services*). In order to integrate this tooling properly, the professional world is allowed to provide specific content. This content analysis is usually created from practice-based research and made usable for education execution.

The platform's fifth component is the exchange of test and assessment resources (*Test and Assessment Content Services*). In order to put together a curriculum for educational modules, educational resources from the sector are made available and content-related resources for conducting tests are exchanged. These resources must always be carefully separated from the educational resources, to avoid that students use test resources to study for the test instead of assessing what they have learned. In higher education for professionals, the content of tests is often drawn up and kept up-to-date in consultation with the professional world.

Support services

Making education available to others requires additional support. Some examples are opportunities to manage the associated licence and service levels (*Purchase and Licence Services*) and to allocate costs (*Financial Clearance Services*). In addition, there will be a need to forward questions about the education offerings to the right person (*Service Request Management Services*) and to provide services to evaluate the offered content, services and data on the platform (*Evaluation Services*).

As with the Smart Region Platform, an orchestration component (*Orchestration Services*) connects the individual platform components, provides quality assurance capabilities on the platform (*Platform Management Services*), and offers suppliers an easy, standardised linking service (*Supply Connection Services*).

What are the key starting points and principles here?

The supplied systems of the institutions, sector partners and affiliated companies are the sources for the educational resources, course data and education data. They are the owners and can make education and/or education resources available to other institutions, either free of charge or for a fee.

The development of making content and education available to third parties probably means that institutions will no longer store content in the digital learning environment. It is likely to become more important to have a separate environment for managing educational content in addition to the digital learning environment. The scope and definition of a digital learning environment also play a role here. Splitting up a digital learning environment into a learning management system (LMS) and a learning content management system (LMCS) is a positive step, but still leaves the educational content too dependent on individual education offers. The provision and use of educational content with content repositories at sector level seems to be going a step further in that regard.

Traditionally, the sector is used to separate environments for managing educational resources, courses and education programmes. As described in the vision, a stackable learning approach offers the necessary flexibility. When in the future an educational professional purchases (part of) an education programme, this will directly include the content and metadata of the courses. This platform enables this type of consistency.

Relationship with other platforms

The relationships with the other platforms in this domain architecture appear to be mostly indirect. For example, if a module or course is developed within the institution, it will be in a course development environment or in the digital learning environment. The module or course is made available on the Education Exchange Platform via the course's metadata. Another institution acquires the course and makes it available in the digital learning environment. Any learner taking the course can access it via the User Study Experience Platform, for example. However, the course remains in the digital learning environment.

Which initiatives can already be seen?

In the current situation, the following initiatives can serve as examples for part of this future platform:

- Open and Online Education Incentive Scheme: the Minister of Education, Culture and Science makes a subsidy available for experimenting with open educational resources. SURF coordinates the incentive scheme.
- Moving towards digital (open) educational resources zone – Versnellingsplan.nl.
- Teacherspayteachers.com: website founded in 2006 that enables lecturers to sell educational content. *'Teachers Pay Teachers claims to have sold more than a billion online teaching materials through its marketplace. Some teachers have earned more than \$1 million selling materials on the site.'*
- Amazon launched a marketplace for online learning resources around 2019 called Ignite. This service is only available to teachers. Amazon is asking 30% of the proceeds. Amazon also has an open variant: Inspire.
- TES: This UK marketplace for educational resources is also aimed at lecturers wishing to sell educational resources to other lecturers.
- SURFeduShare is a search portal for open educational resources.

10.3 Education offering

What happens in this process?

This process shows the developed education so that learners can orientate themselves broadly. Learners, including regular students, can choose education programmes and modules and register and enrol in them. In the longer term, it is also possible to make available individual lectures. In this process, learners can choose the option that best suits the career they have planned and can update this in their educational profile. They can also see which party can best guide them through their learning path.

Institutions are trying to position themselves as effectively as possible in terms of content and form of education and are aiming to achieve the right match. From the perspective of the strategic agenda of the Ministry of Education, Culture and Science, this is important and unnecessary competition must be avoided. The process also includes financial settlement.

What is the role of the platform that supports this process?

The Lifelong Learning Platform aims to match the demand of learners to the supply from institutions and other parties. All modules and education programmes of Dutch institutions can be found in the platform's user environment. Registration and enrolment in modules and education programmes, as well as financial settlement, are also handled via the platform.

The platform primarily functions as a generic user environment that learners can use throughout their lifetime as an overview and starting point for new courses, certifiable modules or complete education programmes. Besides that, the platform mainly offers an administrative environment and infrastructure that enables data exchanges between institutions, sector partners and other parties to support lifelong learning. Eventually attention will also be paid to the recognition of competencies and skills that have been gained in other ways, for example through MOOCs or work experience.

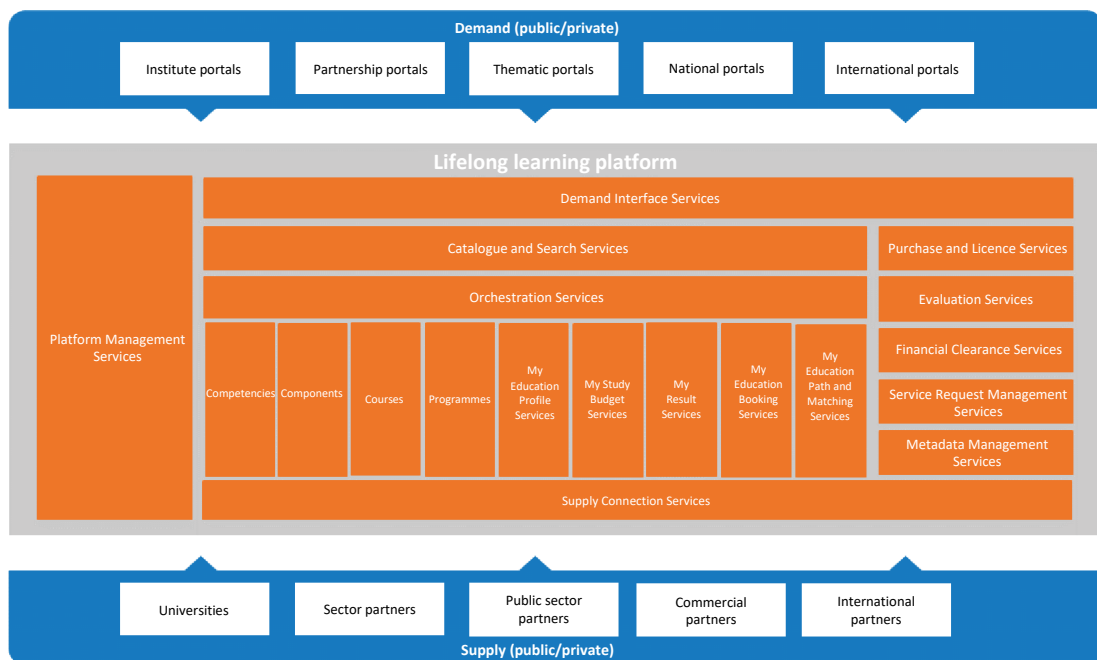


Figure 8: Lifelong Learning Platform

What components does the platform consist of?

Demand Interface Services

The platform offers the possibility to generate different views of what is available. In any case, a portal is available showing the entire offering. The platform also offers support in the use of institution portals (*Demand Interface Services*). Institutions can use the platform’s generic portal or their own portal. The selection and registration for a module will then take place on the institution’s portal, but will be handled in the background via the platform. The *Demand Interface Services* offer institutions the option to manage the range of education on offer. Institutions can select channels to offer their range and determine whether this is their own channel.

Catalogue and Search Services

The platform also offers the possibility to make the content available from collaborating institutions via theme-based portals (*Catalogue and Search Services*). One example is a lifelong learning portal for citizens who have already completed an education programme and are working. An ecosystem of companies can emerge around the platform that uses the platform’s data to create portals, apps or voice interfaces for institutions. Governance is necessary to prevent parties from making their own portals with data from institutions, for example. This requires the institutions’ permission and is subject to specific conditions for use.

Own user environment

The platform’s own user environment offers an education catalogue of programmes, modules and lectures: *components* (lessons, lectures, classes), *courses* (subjects) and *programmes* (education programmes and certifiable units). Search functions and matching mechanisms are available for this. Learners can adjust filters themselves to achieve results that are optimal for them. There is also the option of activating automated advice. Here too, learners can set search criteria for the desired offering.

When planning their career, learners can map out their education needs (*My Education Path and Matching Services*). In this environment, they can conduct anonymous comparisons with peers, assess whether a qualification for a programme based on completed modules is within reach, and create an overview of which skills or knowledge is becoming relevant for their subject area. This is also where courses and education programmes are matched. There is a test of whether the learner has sufficient existing knowledge to start a course, module or education programme. Learners can also indicate the extent to which they are interested in modules that are still to be developed. This creates a forecast of learner needs. Learners can also indicate

which existing education offer they are interested in. The options for financing the learning path are also shown (*My Study Budget Services*). For this there is room for regular funding and additional financial services to create a study budget or to use study credits.

The personal education profile (*My Education Profile Services*) offers learners an overview of various matters. They can use this profile their entire life to maintain an overview of the education they have received and the results they have achieved (*My Result Services*) and the competencies they have developed (*Competencies*). The overview of the achieved results uses microcredentials (edubadges) that provide information about the grade, level, learning outcomes and ECs without any content-related data of the assessment. Institutions assure the quality of this grade by means of mutual agreements and periodic assessment. The institution's grade records are the source and contain more metadata about how they were obtained. The *Competencies* in the profile offered in education must be linked to developments in the International Standard Classification of Education (ISCED).³ To this end, the higher education sector also needs to determine how a service such as SBB⁴ (assessment and monitoring of competences at vocational secondary education level) can ensure the definition and mutual recognition of specific competencies, at least on a national level and later also internationally.

Financial overviews are also available on the education offer platform. Learners can see the costs of completed education programmes and which study credits have been deducted (*My Study Budget*). This allows them to keep track of matters such as personal education budgets. As soon as a module is booked via an institution portal and is handled via the platform, the deduction of the cost is shown in the personal education budget. Payments per module or study item can also be made on this platform.

My Education Booking Services offers the possibility to handle registrations and make them and enrolments available in the higher education sector in a standardised way. This allows students to show that they have registered for an educational seminar, on which basis they may gain access to innovative applications of start-ups that have presented their products there.

Eventually there may be opportunities to offer additional services to learners in the ecosystem surrounding the platform. Some examples are assessments and learners' insight into what they are capable of. Learners can then use the results to plan their own career (*My Education Matching Services*). This would stimulate the commercial market to develop such functionality. However, this does require a clear framework and proper governance.

Result processing

The exchange of achieved results requires a messaging service (*Supply Connect Services*) that can guarantee a high level of reliability for the stakeholders. In addition to a link with the platforms for the development and implementation of education, a link at European level will also be required.

As on the Education Exchange Platform, the services that support the interaction are made available. Some examples are opportunities to manage the associated licence and service levels (*Purchase and Licence Services*) and to allocate costs (*Financial Clearance Services*). In addition, there will be a need to forward questions about the education offer to a suitable person (*Service Request Management Services*) and to provide services to evaluate the offered content, services and data on the platform (*Evaluation Services*).

Platform Management Services

The Lifelong Learning Platform offers opportunities to assure the overall quality, in order to flag things like unwanted content or non-performing partners. This requires overarching agreements. Agreements must also be made about the role played by the platform or data from the platform in an institution accreditation (including commercial parties).

³ <https://www.onderwijsincijfers.nl/kengetallen/internationaal/toedeling-nederlandse-onderwijsprogrammas-isced>

⁴ <https://www.s-bb.nl/>

Part of quality assurance involves the evaluation or rating of the completed education. The institutions will have to determine which starting points they will use to set this up. Do they want to use a simple model in which learners can assign a score to a completed module? Although institutions have a lot of experience with educational evaluations within their own organisation, such a model can lead to undesirable effects at a national level.

Supply Connect Services

The platform has an integration centre to enable the many links between the platform and institutions, companies and other parties. This is where API services, data integration, aggregation of institution data and so on are offered. In addition to these technical services, a support team needs to ensure standardised data models and national standards that are in line with international standards. Institutions can also specify certain preferences, for example which parties are allowed to reuse their data from the education catalogue. The platform also offers reporting options that show institutions how popular their own offering is or how often learners return to them for a module.

What are the key starting points and principles here?

The platform is successful when there will be a tendency to add more and more functionality to the platform itself. However, it is important to keep the core of the platform lean and simple and to focus on the core interactions between providers and learners. This will ensure the platform's robustness and performance. It will also prevent any update problems caused by ever increasing complexity. Additional functionality will be offered from the surrounding ecosystem, which is integrated into the platform via APIs.

Because this also involves personal data, it must be very clear where the responsibilities lie. Is a construction foreseen that sees all institutions as clients, as with Studielink? Or should this be arranged by the government? Do learners have the choice to share or not share data with the platform? Or will higher education studies in the Netherlands soon only be possible if learners share data via these platforms? If so, this should be included in the Higher Education Act.

Despite the importance of national platforms, it must also remain possible to register and enrol via other services. Registration, enrolment and participation in education can be provided without a mandatory central sector service.

Relationship with other platforms

As described above, learners can indicate on the Lifelong Learning Platform whether they are interested in modules that are still to be developed. This creates a forecast of learner needs. This forecast is shared with the Smart Region Platform. The platform will integrate with the User Study Experience Platform to execute the education.

Which initiatives can already be seen?

In the current situation, the following initiatives can serve as examples for part of this future platform:

- Studielink arranges the registration, selection and placement, enrolment, payment of tuition fees and student residence permit for education programmes. This is being expanded with a service to register for a Joint Degree and education programme components in the future.
- RIO and STAP register (education offer including lifelong learning).
- VSNU is developing a separate lifelong learning portal that also includes higher professional education and vocational secondary education and has separate underlying administrations and integrations. Based on the platform concept, this would only be a specific view of the range that has been ticked as suitable for working individuals by the institutions' administration.
- Acceleration Plan for More Flexible Education (student mobility pilot), eduID (cross-institutional identity) and OOAPI (as standard for data exchange about the education offers).
- SURF: edubadges and the exploration of DUO for a register of microcredentials.

- Erasmus Without Paper (EWP), Europass with edubadges and ESI with eduID.
- SK123 / HOVI – Studiekeuze123: objective information about all accredited academic and higher professional education programmes in the Netherlands.
- STAP: a personal development budget to improve people's position in the labour market.
- K-O-M: Kies Op Maat allows students in academic or higher professional education to easily take certain minors or subjects at other universities of applied sciences and research universities in the Netherlands, often free of charge.
- Edu-Dex: provides up-to-date, reliable and complete information to hundreds of thousands of potential course participants.
- EduMij: is conceptually similar to the starting points in this domain architecture for building up and exchanging personal educational data.

10.4 Education execution

What happens in this process?

This process is about the actual implementation of education and study on campus, online and at other locations. Higher professional education in particular is increasingly using online formats and the work environment in the professional field. The content of the education execution can be drawn up by the higher education institution itself or by another higher education institution, or can be compiled in the professional world or a region in the form of modules. The specific study implementation will lead to other forms of study support. This also reflects the implementation differences in on-campus, online or workplace learning.

Higher education institutions will be position themselves with their implementation of the education and forms of study. For example, an institution can choose a specialisation in which education is centralized around working in project groups. These project groups can help students to maintain an equal rate of study over several years. Other higher education institutions could specialise in supporting self-study based on international learning opportunities such as MOOCs, which can be used as modules.

Assessment is currently still considered as the conclusion of a subject or learning path, but can also be developed further into a specialisation. The evaluation of work experience can also be a form of assessment that produces credits. A relationship will also be established with the UWV skills ontology for this, for example.

In case of modular studying and increasing collaboration between institutions in the region, students tend to take a more cross-institutional approach. In the current situation, they are still facing a multitude of digital learning environments and the access control for the necessary resources and services at these institutions is a constant challenge. The aim is to make the services similar to students and not keep their use independent from accounts from different higher education institutions.

What is the role of the platform that supports this process?

The platform for the implementation of education facilitates access to resources and services that are important for studying in modular, structured education. Besides the content side, connecting the players in the study focus area is also an important point that should support the platform.

The platform brings together the digital learning environments of various institutions where the learner is taking a module. This integration makes it possible to enter the module the learner has registered for. This keeps the education within the institutions and allows them to be in control of education. The overall integration creates a coherent whole for the learner.

The platform offers the underlying mechanism that allows the learner to study seamlessly across the various environments of the education institutions they are registered with. In addition, learners can also count on support in the physical space on the campus of a higher education institution. In the future, they will be able to make direct use of a number of physical services when they enter the campus of another institution.

The range on portals will come from institutions, employers or European initiatives. It is also possible to build a learning environment for each professional group that is aligned with the platforms for education execution. The platform's added value will become visible in the registration of learning analytics, which are also the basis for justifying the calculation for used content and services.

Another option is to let collaborating institutions in a region create their own portal on the platform, which visually brings together the modules for learners in a single environment. Learners have a single overview of all the modules they are currently taking, and can then go directly to that education in the institution's digital learning environment. Defining European standards is important to be able to use the platform across Europe. We are also investigating the possibility of connecting MOOC platforms in this way.

The platform also provides (lifelong) access to the content of courses learners have taken in the past. This allows learners to access the resources at a later date.

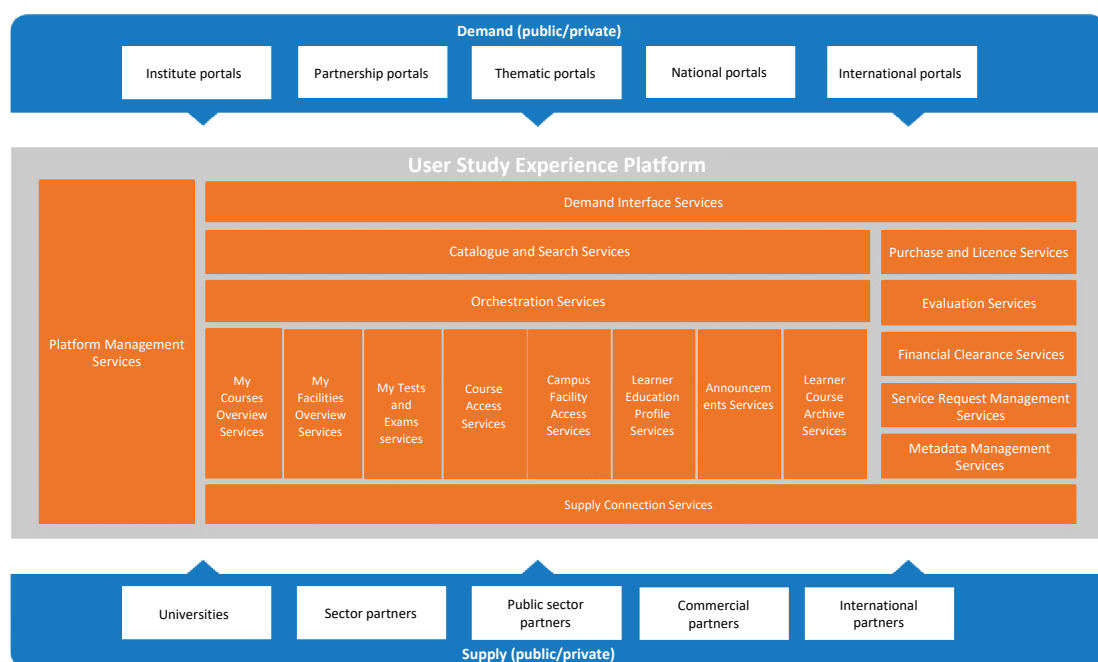


Figure 9: User Study Experience Platform

What components does the platform consist of?

The platform connects various components in education execution. The players in this area are primarily the students and higher education institutions, which will be making a connection with the professional world and regional parties. The following components play a role in this:

- The central education profile such as EduMij (*Learner Education Profile Services* as for MedMij).
- Use of infrastructure at other higher education institutions, such as roaming, Wi-Fi, printing, reservation and use of project or meeting rooms (*Campus Facility Access Services*).

Demand Interface Services

The platform features *Demand Interface Services*. First of all, it offers the possibility to link the institutions' digital learning environments and portals to the platform. This allows institutions to integrate courses from partner institution digital learning environments into their own portal. Students attending institution X can then take a subject in the digital learning environment of partner institution Y from the portal of institution X. This facilitates studying off the beaten track.

The platform's *Demand Interface Services* offers a generic portal as a basic service for national education programmes, for example. This allows multiple institutions to integrate their specific subjects from their digital

learning environments into a separate portal offered by the platform. This portal can be set up in accordance with the corporate style of the institution or collaboration partnership. In addition, there is a basic content management system for posting important announcements (*Announcements*). Finally, the User Interface Manager offers integration at user interface level with other external platforms, such as European or other international initiatives (*Course Access Services*).

My Course Overview Services

This component offers an overview of the modules the learner is taking. From this overview, the learner is guided to the relevant modules in the institutions' digital learning environments. This instantly shows learners all the modules they are taking at different institutions. At a national level, this component can be offered to professionals who are studying modules at various institutions. And at regional level, the component can be used by a collaboration partnership of institutions.

My Facilities Overview Services

This component provides an overview of the (physical) facilities that a learner can use on campus. For example, a learner can make reservations and configurations for flexible work and meeting spaces. The access is organised in background.

Learner Course Archive Services

This component allows learners to archive educational resources from completed modules. This makes teaching resources from past subjects accessible.

Provider environment

The provider environment allows the institution to manage the integrations it owns (*Course Access Management*). They can choose where they want to offer the entire range and whether they do this via one of their own channels. Institutions can also specify certain preferences, for example which institutions can offer subjects from their digital learning environments. The platform also offers reporting capabilities.

Tests and exams

Testing and exam services (*My Tests & Exams Services*) can also be linked to the platform for education execution. Because of developments in other forms of testing, a specific context is required for tests and exams when exchanging test plans across institutions. Specific tests and exams can also be taken at national test centres for professional groups.

Supply Connect Services

Because of the many links between the platform and institutions, companies and other parties, the platform has an integration centre. This is where API services, data integration and aggregation of institution data are offered. This environment handles the exchange of educational scores with the institutions, for example.

Platform management

There are possibilities to manage the platform as a whole. This includes granting access to key staff of the institutions concerned. It should also be possible to facilitate the monitoring of national agreements. Technical platform monitoring also lays the foundation for early detection of failures in the chain.

What are the key starting points and principles here?

Students can make use of education execution based on a national educational profile. This national educational profile will be gradually shaped by various initiatives to obtain a good view of the student and to be able to exchange information. The student also has the option to participate in the study opportunities from various angles. A higher education institution will have its own educational environment and portal, but the professional world can also offer these. This provides the student the opportunity to use the most appropriate environment within the sector. This offers higher education institutions an opportunity to specialise in certain forms of education or in certain subject areas.

Students will be enrolled in a higher education institution based on a primary education offer and can use study opportunities in other environments that make their services available. Any costs or billing will have to be coordinated within the higher education sector. This model is similar to the mobile telephony model within the EU. Higher education institutions can take on this responsibility, but this can also be done by the professional world or facilitating parties. The platform can also be used to carry out work placement paths.

Example:

A student can be enrolled in Inholland University of Applied Sciences and take a course on the Saxion University of Applied Sciences campus with content provided by Fontys University of Applied Sciences. The learning environment can be facilitated by the National Nursing Training Consultation Network (Landelijk Overleg Opleidingen Verpleegkunde or LOOV).

Integration is organised at the subject or module level in the digital learning environment. As soon as learners have registered for a subject, they can go directly from a portal to that subject in the digital learning environment. This allows the learner to work within an integrated environment when studying modules or going off the beaten track.

Relationship with other platforms

The User Study Experience Platform includes an important integration with the platform for offering education, the Lifelong Learning Platform. The administrative basis for offering education is the guiding principle for rights in terms of education execution. Integration will also be required to return the achieved results of execution to the administrative handling of the offer in a secure and reliable manner. There is also a connection with the Education Exchange Platform. This will mainly concern the education content.

Which initiatives can already be seen?

In the current situation, the following initiatives can serve as an example for part of this future platform:

- Eduroam
- SURFconext
- eduID
- Edurep, Wikiwijs
- NL source (central plagiarism check)
- SURFSharekit
- Up2University (Geant) (from parts of different providers into one digital learning environment)
- SURF: flexible digital learning environment

11 Principles

The architecture for the higher education sector for more flexible education is characterised by a strong connection between various platforms. This means a large number of processes and applications are fed information from various components that have their source within and outside the higher education sector. The principles below are specific to the education domain and partly differentiate the principles defined at general HOSA level for more flexible education. Attention has been paid to the manageability of the platforms, as that is where the greatest risk of damage or failure for the organisation lies in terms of platform reliability.

Principle	Rationale	Consequences
FO-001 supporting differentiation and specialisation	<ul style="list-style-type: none"> Sector services support further specialisation and differentiation of education and the development of (sector) platforms. 	<ul style="list-style-type: none"> New business roles are supported within the sector services (including lifelong learning, use of AI and big data). The available education may (optionally) be offered via sector services from central services (programmes, minors, modules, courses and so on). Both government funded and non-government funded institutions offer a modular and switchable structure of education offer and learning paths. The platforms are modular in design and are clearly decoupled from other parts of the platform.
FO-002 reliable, unique, personal and digital identity	<ul style="list-style-type: none"> Persons (students, lifelong learners, employees, alumni and potentials) can be identified as unique persons during their active connection with education across various institutions in the higher education sector and can authenticate themselves with respect to institutions, regions and the professional world with a reliable identity. 	<ul style="list-style-type: none"> A pseudonym specific to higher education based on a personal digital identity (such as eduID) to identify active students/lifelong learners. A pseudonym specific to higher education to make employees (lecturers/researchers) identifiable based on a personal digital identity (such as eduID).
FO-003 personal lifelong learning profile	<ul style="list-style-type: none"> Data sharing of education-related matters will also be possible based on the example of how personal data is shared on mijn.overheid.nl or how medical data is shared via MedMij, for example with LSP+ (Landelijk Schakel Punt). 	<ul style="list-style-type: none"> Individuals have a personal profile that keeps track of their development for life. These data can only be shared at the person's request.
FO-004 on-demand certifications	<ul style="list-style-type: none"> Achieved certifications can be retrieved reliably via a central functionality. (The person gives permission for querying based on privacy-by-design.) 	<ul style="list-style-type: none"> Collection of achieved results in a central register (such as DUO). Release of data on achieved results from a personal educational file (for example based on IRMA).
FO-005 assured availability, continuity, agility and scalability	<ul style="list-style-type: none"> Sector services are characterised by availability, continuity, agility and scalability. Innovation is supported by agility, which makes change possible. 	<ul style="list-style-type: none"> The platforms function independently. They are independent of major commercial parties, such as the major tech giants and publishers. The organisation of more flexible education is based on a digital-first, omnichannel approach. The platforms have a variety of providers of underlying services. Some examples of these are SURF, institutions, commercial providers, and innovative start-ups. The provider ensures good user support. The platforms are modular in design and are clearly decoupled from other parts of the platform.
FO-006 exchange and connection are secure, standardised and AI enabled	<ul style="list-style-type: none"> Data exchange and connection to sector services are secure, based on nationally aligned agreements and (open/free) 	<ul style="list-style-type: none"> A secure way of sharing plans and ideas between connected parties from the region and the professional world.

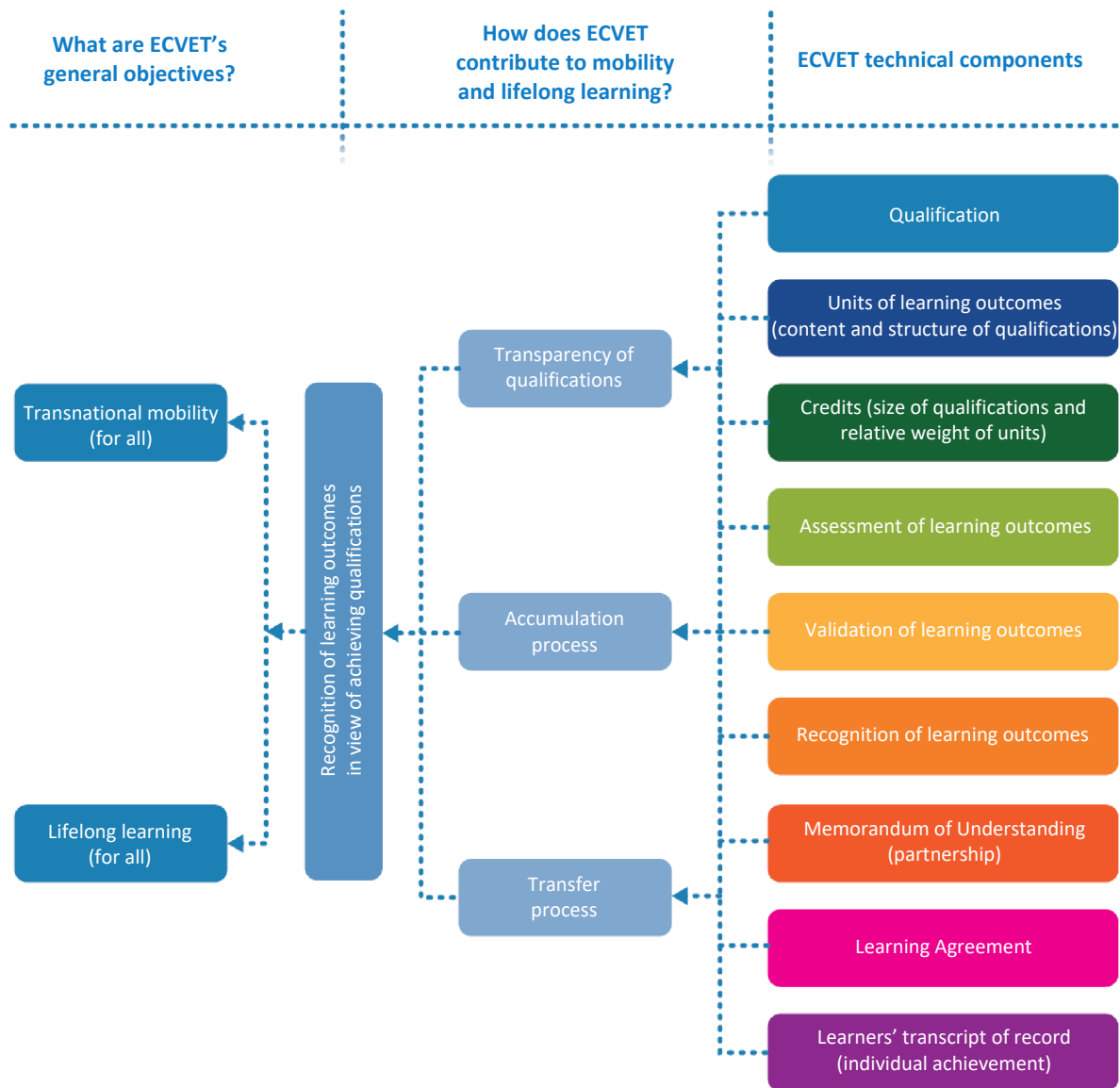
	standards, and can be used for activities such as AI.	<ul style="list-style-type: none"> Regional developments and problems are categorised within the higher education sector and exchanged based on sector services. The platform services are connected via simple, standardised interfaces and links. Data, content and services offered via the platform are managed in a clear and sustainable way.
FO-007 business process support is nationwide, secure and reliable	<ul style="list-style-type: none"> Business processes are supported at a national level by secure and reliable exchange. 	<ul style="list-style-type: none"> Mutual financial settlement for the development and use of content, lectures, modules or other building blocks in support of more flexible education. Automated execution and monitoring of service agreements and contracts. Mutual routing and handling of questions and requests from lifelong learners, students and so on.
FO-008 insight into quality	<ul style="list-style-type: none"> Insight into the quality, reliability, integrity and confidentiality of data and services will further increase quality and recognisability. 	<ul style="list-style-type: none"> The data provider determines what the data can be used for. The provider offers insight into the quality of the data. The data provider ensures that the platform metadata are kept up to date. Both the use of the data and the use of the facilities have clear and transparent licensing structures. The provider of the services, data or content also ensures that any questions about the services, data or content can be answered.

Appendix

Consulted persons and bodies

<p>FlexOw working group</p> <ul style="list-style-type: none"> - Mark de Jong (Inholland) - Tine de Mik (Studielink) - Jelle Nauta (DUO) - Patrice van der Kallen (Fontys) - Michiel Kraaij (WUR) - Jocelyn Manderveld (SURF) - Michiel Schok (SURF) - Johanna de Groot (SURF) - Ronald Ham (SURF) 	<p>HOSA Steering Committee</p> <ul style="list-style-type: none"> - Jan-Willem Brock (Leiden University) - Hans Louwhoff (SURF) - Anton Opperman (EUR) - Rose of Iperenburg (HAN) - John Kropman (Fontys) - René Schenk (Avans)
<p>Conversations</p> <ul style="list-style-type: none"> - Ulrike Wild (Wageningen University) coordinator of acceleration zone More Flexible Education - Paul den Hertog (Amsterdam University of Applied Sciences) coordinator of acceleration zone More Flexible Education - Bram Gaakeer (Information Architect, Ministry of Education, Culture and Science) - Juriaan van Kan (Strategic Policy Advisor, Ministry of Education, Culture and Science) - Femke Mors (Programme Manager, SURF) - Peter Clijsters (Product Manager, SURF) - Hans van Driel (Studiekeuze123) - Jeroen Meijerink (Studiekeuze123) - Pauline Thoolen (Studiekeuze123) - Patrick Vogelaar (Studielink, Director) - (Jennifer Moesker and Tine de Mik (Studielink, Enterprise Architects) - Christien Bok (SURF) 	<p>Reviews</p> <ul style="list-style-type: none"> - John van den Berge (Eindhoven University of Technology) - Tim van Neerbos (Utrecht University) - Frank Snels (Twente University) - Dick van der Linden (Leiden University of Applied Sciences) - Mark de Jong (Inholland) - Tine de Mik (Studielink) - Jelle Nauta (DUO) - Patrice van der Kallen (Fontys) - Jocelyn Manderveld (SURF) - Michiel Schok (SURF) - Johanna de Groot (SURF) - Ronald Ham (SURF) - Jennifer Moesker (Studielink) - Désirée Schipper (Studielink) - Zosia Botermans (Studielink) - Joris Dirks (Studielink) - Erwin Bomas (Kennisset) - Harold Teunissen (SURF)
<p>Sessions and discussion with groups</p> <ul style="list-style-type: none"> - Two presentation sessions with Coordinating SURF Contact (CSC) for higher professional education (about thirty participants) - Two presentation sessions with Coordinating SURF Contact (CSC) for higher academic education (about ten participants) - Two presentation sessions with the Higher Education Architectural Council - SURF education team - Two sessions with the core team of the Acceleration Plan for More Flexible Education (with participants such as VSNU, VH, DUO and Studielink) - Ministry of Education, Culture and Science (about ten participants) - Kennisset (about ten participants) - Two sessions with the Leiden Delft Erasmus (LDE) collaboration partnership (about ten participants) - Knowledge platform for more flexible education (with participants such as the Ministry of Education, Culture and Science, Kennisset, SAMBO ICT and DUO) 	

The European ECVET standard



Objectives structure of the higher education sector

Higher education sector

