USER EXPERIENCE GUIDE FOR THE DIGITAL LEARNING ENVIRONMENT

FRAMEWORK AND CONCEPTS

SURF

CONTENTS

INTRODUCTION

Background

Many institutions want to make education more personal and more flexible. To ensure that the education matches the learning needs of the individual student as much as possible. This requires a feature-rich learning environment that supports a variety of teaching methods.

The list of requirements for the digital learning environment is large and flexible in its own right. No single system can match all the needs and wishes of all students and lecturers. A modular approach to the digital learning environment could be the solution. This approach combines the components (services, applications and IT systems) like Lego blocks. These blocks can be fitted together to form a digital learning environment in which the individual components as a whole meet the wishes of students and lecturers.

The memorandum A flexible and personal learning environment, from single components to an integrated digital learning environment[1], describes the architecture of an integrated learning environment. This shows that an integrated learning environment consists of three parts:

1. Different components that are interchangeable and expandable. Each component is a set of functions to enable a certain task in education.
2. An integration infrastructure that facilitates data integration and interoperability.
3. Visual integration and identity management. This ensures that the different components look and act as one.

We will discuss the third part in this memorandum: the visual integration. Part one and two lay the foundation for this. Figure 1 introduces the relationship between the three components.

By making use of components, it is possible to replace and extend functionalities. This allows the digital learning environment to easily scale and align with new educational and technological developments. For the components to work together, standards, an integration infrastructure, authorisation and authentication are required.

Examples of interaction between components are described in: a modular functional model for the digital learning environment[2]. The integration infrastructure is also described in this functional model. The model identifies: which data is usually available in which components, what data is exchanged between components, and lastly the prevalent standards on which the exchange is based.

The overview of the components that make up a digital learning environment and the description on how these components work together explain how data and system integration can take place within the digital learning environment. The framework for the design of the “backend” of a modular digital learning environment is thereby outlined. The remaining question is how you shape the third part of the architecture: the integration. How do you give users the impression of working in a single environment? How is the collaboration between the components perceived? Which information does the user want to see and in what context or time?

In short, this memorandum examines the question of how we can achieve an optimal user experience in a flexible and personal learning environment.

1. https://www.surf.nl/files/2019-04/memorandum-learning-environment_uk_web.pdf
2. https://www.surf.nl/files/2019-04/a-flexible-and-personal-learning-environment---a-modulair-functional-model_0.pdf

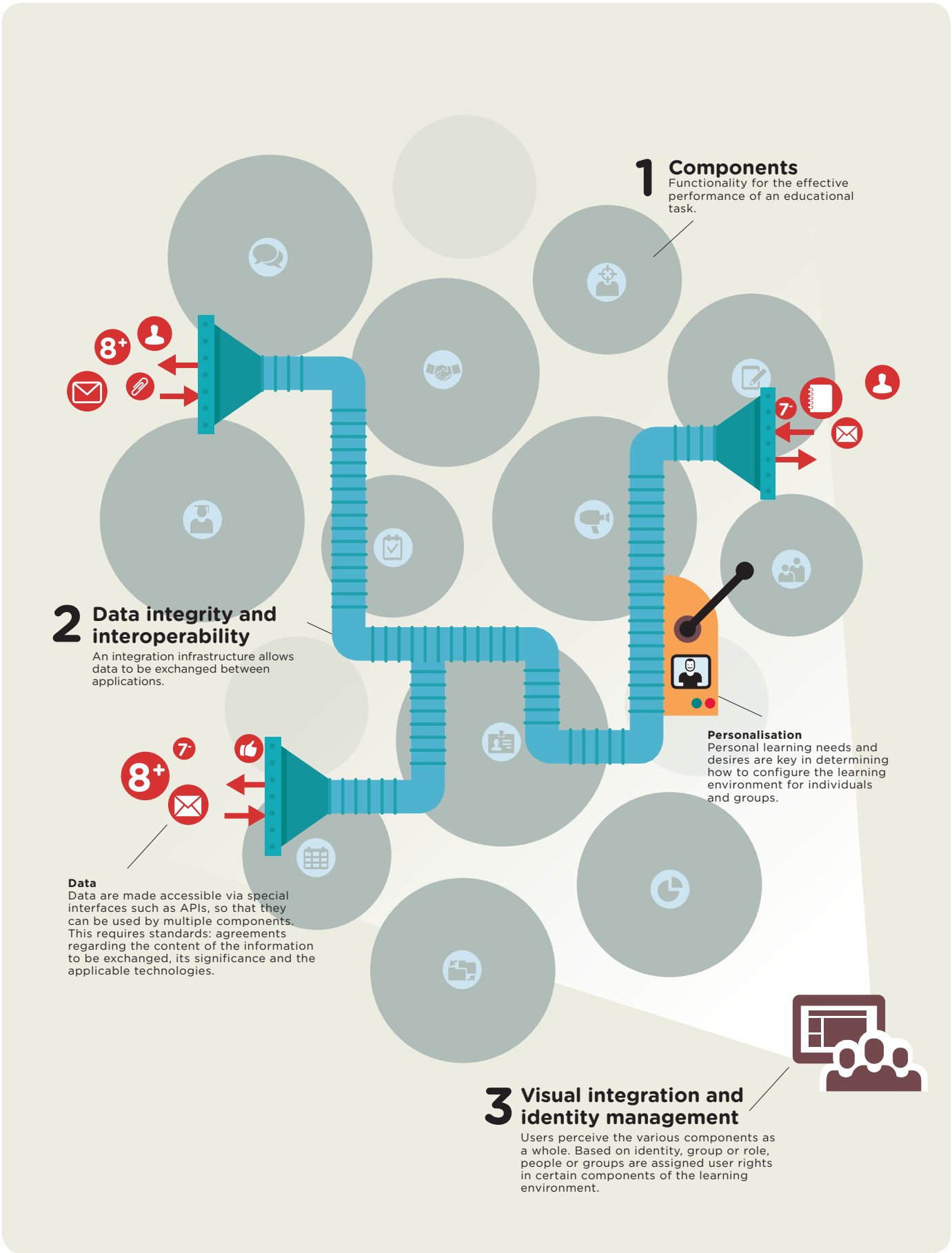

Figure 1: The integrated digital learning environment

Objective of this paper

After reading this paper, you will know what user experience is and which elements influence the user experience of the flexible and personal learning environment. In addition, the paper provides tools for institutions to create a good user experience in their own digital learning environment.

Structure of this paper

User experience is a user's total experience of a digital learning environment. This is a challenge, because the composite modular learning environment consists of different applications. The solution can be found not only in the application(s) itself (themselves), but also in the interaction between the applications.

Peter Morville's honeycomb model is often used to understand how the user experiences of websites are created. This model shows that an application only really adds value if certain conditions are met. You can read these conditions and the way in which a user experience is created in Part 1.

The way in which the application is set up, the user interface design, influences the user experience. These are the green parts in figure 2, which are discussed in Part 2.
Finally, a composite modular digital learning environment has an extra dimension, which is that it consists of various interacting applications. The conditions for availability and accessibility of these applications in the application landscape also influence the user experience. These are the orange components in figure 2, and are central to Part 3.

Part 4 discusses how the honeycomb model can be helpful in rethinking the application landscape of the digital learning environment. Part 5 describes the stakeholders in the organisation and how they influence the user experience of the digital learning environment.

Target audience

This paper is intended for people who are involved in the implementation of the digital learning environment. For example: project leaders, technical project leaders, technical/ functional administrators, information managers, information architects and user interaction designers. The paper provides insight into facets which influence the user experience of the digital learning environment, and offers tips for discussion and decision-making about this.

Figure 2: Influence of application context and user interface design on the user experience and the ultimate value experience

PART 1: USER EXPERIENCE

Students and lecturers want a digital learning environment in which they can enjoy working with ease. Educational institutions therefore strive for a clear user experience within the composite digital learning environment. But this is not always easy to achieve. Because the digital learning environment contains various applications, students and lecturers are faced with different user interfaces that do not work together in a straightforward way. The solution to this problem seems to be the aligning the user interfaces. This is just one part of the optimisation of the user experience. In this chapter, you will read that it is also about the value of the applications for the user.

The honeycomb model, as described by Peter Morville, demonstrates this based on 7 concepts that fit together like a honeycomb. The honeycomb model focuses primarily on websites and applications, but the model also helps in understanding the user experience within the digital learning environment.

Honeycomb model

The concept of **'valuable'** is central to the honeycomb model. What value or meaning does the learning environment provide for the user? How is the experience for a user? The value is the result of the experience that is created through all the other cells.

Usable - applications within the digital learning environment must be usable without the users having to read complicated manuals or attend a course. The aim is to enable users to quickly understand and use an application.

Credible - how credible are the applications that comprise the digital learning environment? This relates to the credibility of the person who conveys the message within an application. In the digital learning environment, it is the educational institution that delivers the message; credibility corresponds to the reliability of the institution. This includes technical stability, the handling of privacy and personal data protection. For the user experience, perceived reliability is just as important as actual reliability.

Useful - applications or functionalities must be useful and must meet a need. But these needs differ for each type of user. An application or functionality that is useful for a lecturer may be useless for a student. A learning environment that shows a lot of irrelevant things to a user makes it more difficult to identify the useful components.

Desirable - how desirable is the application or functionality? What impression does it provide to the user? If the environment is desirable, users will use it. If it isn't, they will start looking for alternatives and temporary solutions.

Accessible - accessibility is very important within the digital learning environment. The learning environment must be accessible to everyone within the institution. This also applies to people with a disability.[3]

Findable - information must be findable. Users who have a problem must be able to quickly find a solution. This not only requires good search functionality, but also a logical navigation structure.

Each individual factor is important, but they also influence each other. An application that is difficult to find is often experienced as not easily accessible. An unusable application is also more likely to be considered as not very useful. And an unusable and undesirable application is often regarded as being non-credible. Vice versa, of course, it also applies that a usable application quickly seems more useful. And a desirable application often seems more reliable for the user.

3. https://www.w3.org/Translations/WCAG20-nl/

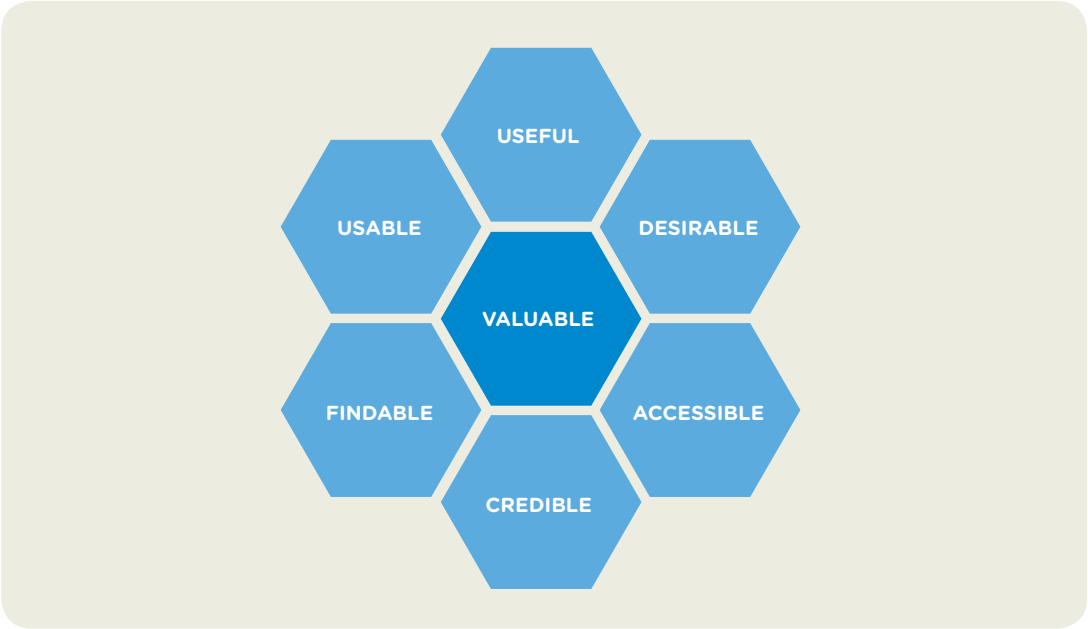

Figure 3: The honeycomb model of Peter Morville

This part explained which elements are important for the value of an application, or for all of the applications in the composite digital learning environment. Part 2 discusses how the user interface design influences the user experience.

PART 2: USER INTERFACE DESIGN

The user interface is everything designed into an information device with which a user may interact. In addition, the user interface usually also allows the user to create, edit or delete information. The quality of the design of all this has a strong influence on the user experience. Without a good user interface, a positive user experience is practically impossible, but a good user interface in the wrong context still does not provide a good experience.

We will elaborate more on user interface design in this part. This relates to specific features of applications.

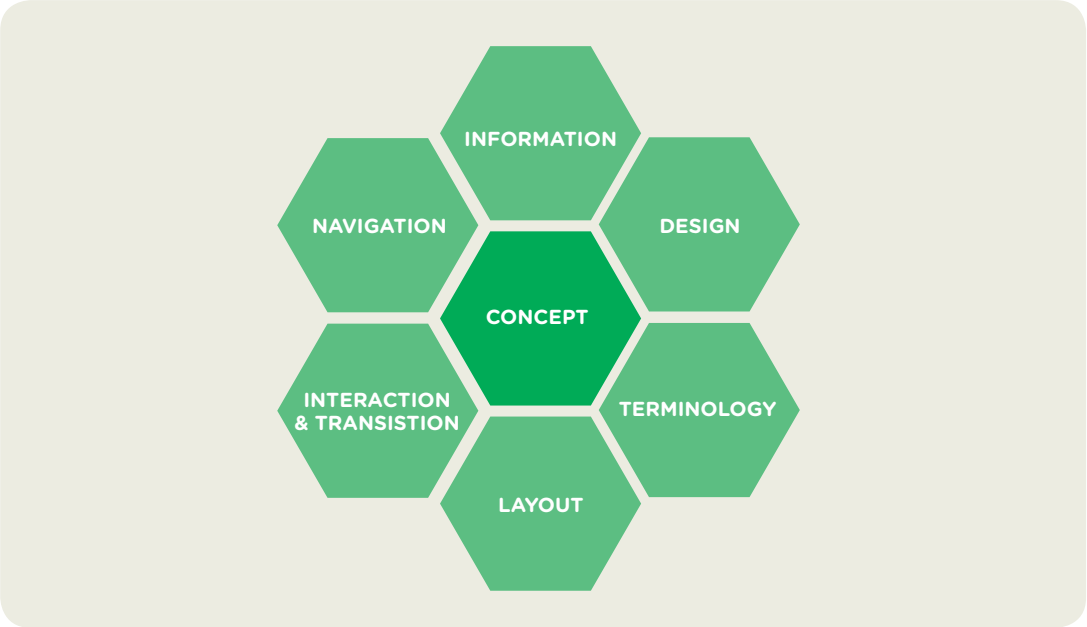

Figure 4: User interface elements represented in a honeycomb

Where 'valuable' is central to the user experience, **'concept'** is central to design. The other cells explain what the concept looks like. A good user interface is determined by the following elements:

Terminology - how well do the terms that are used match the user's perception and how consistently are they applied?

Design - think of colours, fonts, grid, and icons. How desirable, recognisable and consistent are they applied? And how clear are they to read or interpret?

Layout - the position of elements on the screen determines the understanding, but also the ease with which the content can be read and interpreted.

Interaction and transition - how do you enter assignments and information, how are users notified whether something has been successful or not, how is it indicated that the system has adapted to a user's wishes?

Navigation - the dynamic structure. How well can you find your way within the system (via a menu, with hyperlinks, or with buttons on the screen)?

Information/functionality - does the system contain the required information or functionality, and is this information or functionality available at the right time and in the right form?

Concept - this is the most elusive, but also the most important element. The concept determines the predictability of the system. The concept is the story told by all the above user interface elements. If this story is clear and simple, then the application is predictable and it is clear how it can be used in the work and working method of the user.

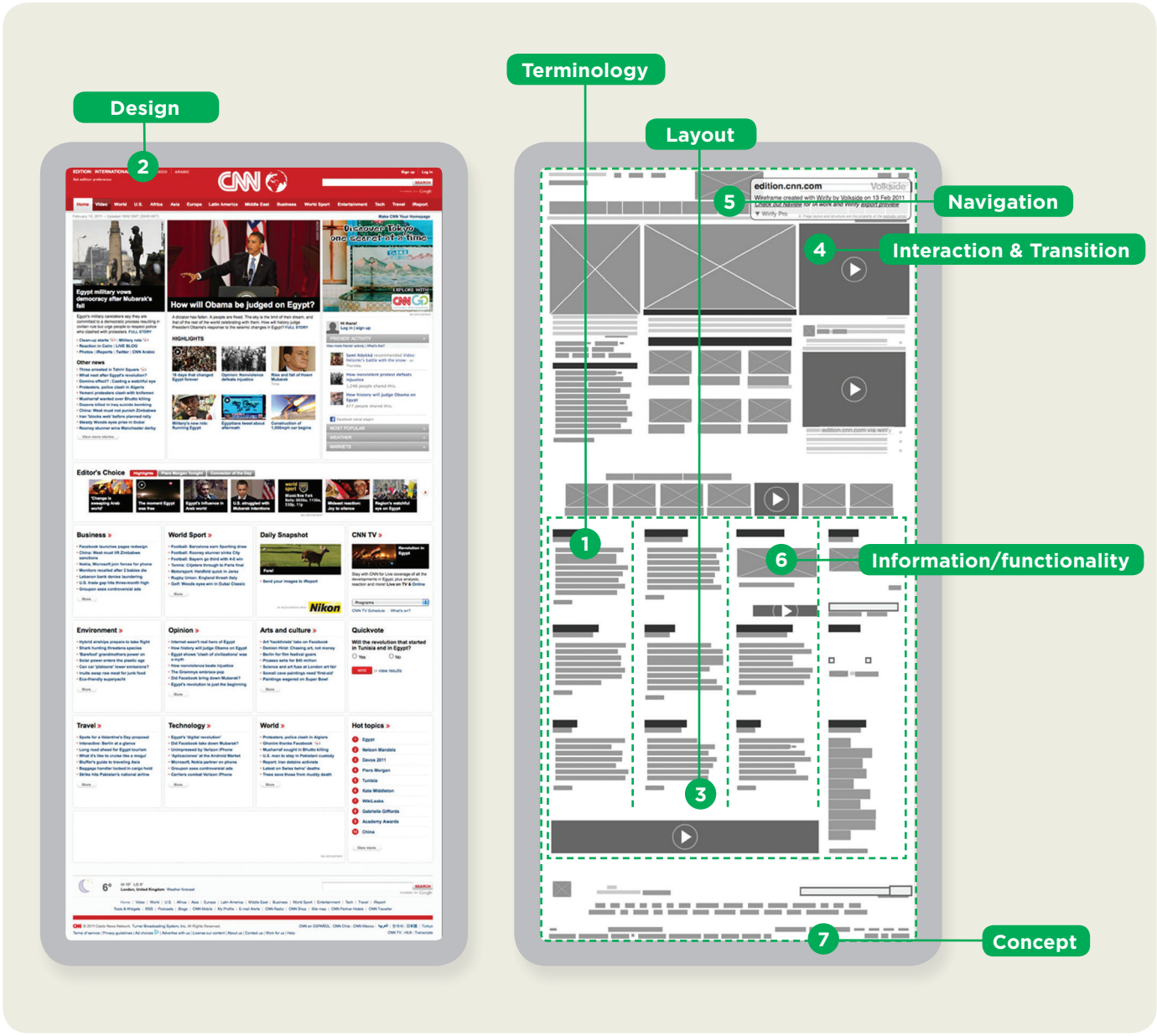

Figure 5: User interface design in practice

The relationship between user experience and user interface design

The honeycomb model contains the characteristics of the user experience. Although there is no one-on-one relationship between elements from the honeycomb model and the features of the user interface, there is certainly coherence, as Figure 6 indicates.

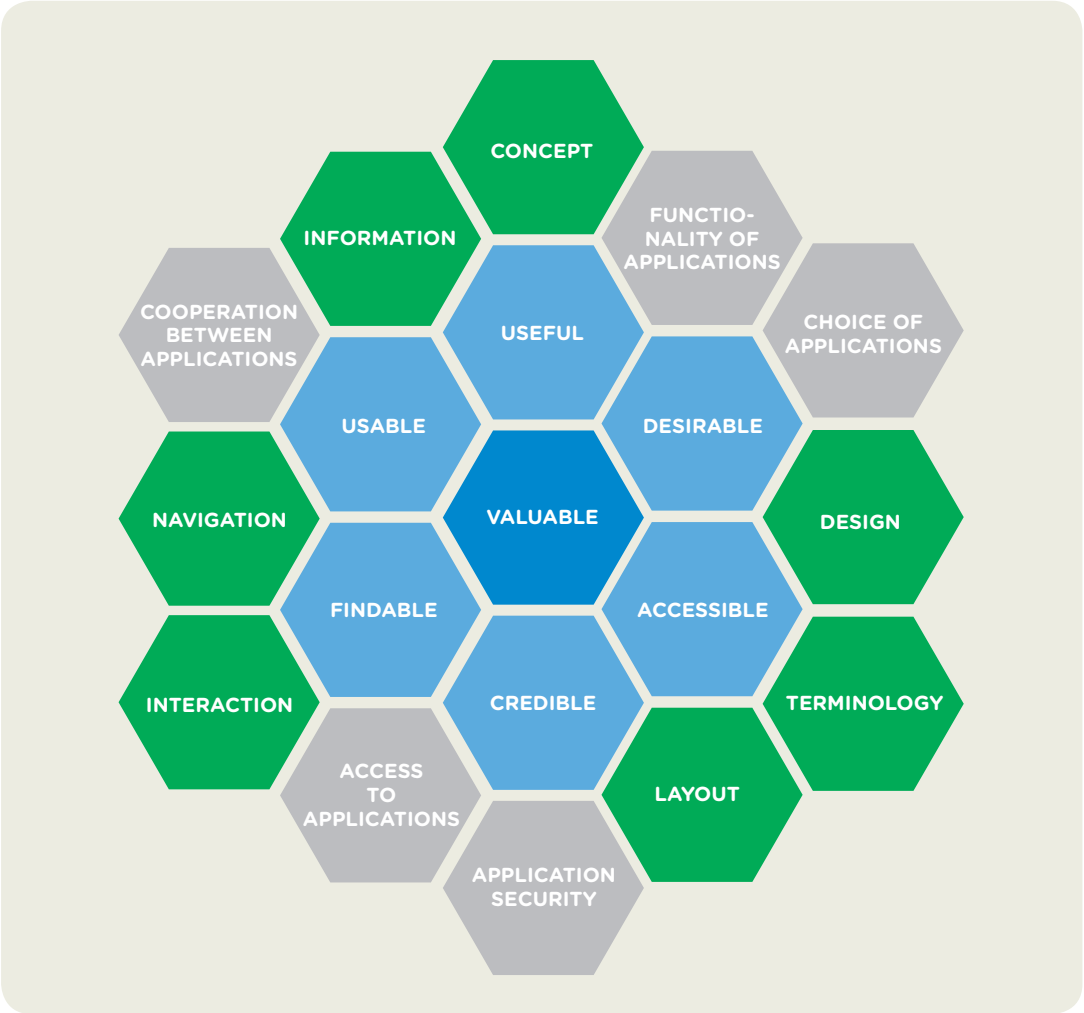

Figure 6: Influence of user interface elements on the user experience

In the relationship between the user experience and the user interface design, it is important that the goal is always to achieve the best possible user experience. The user interface elements can influence the user experience in both a positive and a negative way.

With the user interface design, designers of an application set out the operation and the possibilities and make information accessible. In practice, users will assess the user interface as a whole, and in doing so pass a value judgement on the total user experience. This arises from the fact that the elements reinforce each other, and because each element influences every other element. Yet we can perhaps say something about the interdependence between different cells.

- The user interface elements concept and information have the greatest influence on how useful and practical an application is perceived.
- The navigation, interaction and transition elements have the greatest influence on usability and findability.
- Design, terminology and layout influence the credibility, accessibility and attractiveness of the application.

When designing an application, it is necessary to always consider the effect on the aforementioned components. This also requires knowledge about what the user will find important in the context of use, so that this can be developed in all aspects of the user interface design.

Things are even more complex in composite digital learning environments. Such a learning environment consists of several applications that are designed separately from each other, therefore the design is often not cohesive. You can read more about the application context in Part 3.

What does this mean in practice?

Applications for the composite digital learning environment are usually selected on the basis of the ability to exchange information and functionality. Often, not enough attention is given to how well the navigation of the application, the layout and the design fit together.
An application that delivers a good experience in itself may not fit the big picture, and could thereby influence the experience of the whole.

This can result in a learning environment in which applications all have their own main navigation and their own profile page. Different terms can also be used to indicate the same action, for example, login and/or registration, and the designs may not match each other. All this is disastrous for the user experience. To ensure a positive user experience, it is important to use consistent terminology when reusing data and exchanging data between applications. See the example below.

Example 1: SIS and LMS

The student information system (SIS) is responsible for the student names and course names. The learning management system (LMS) (re)uses this data. The terminology used by the SIS is reused within 'underlying' systems through system integration. Uniformity in terminology and content within the various applications contributes to a consistent user experience.

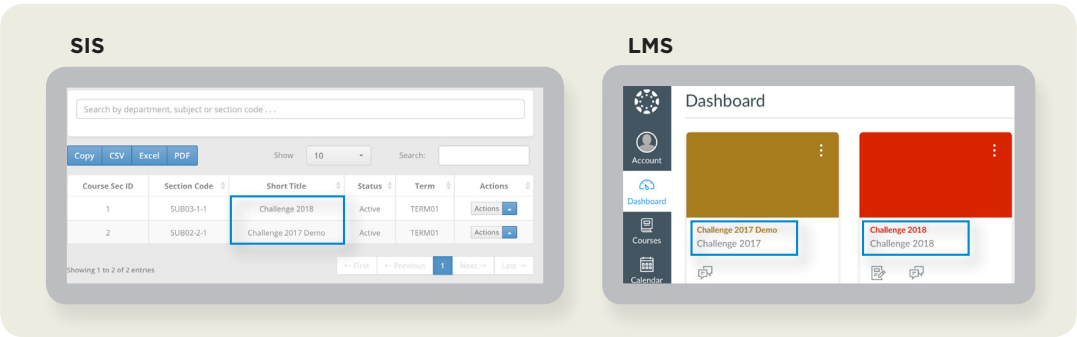

Figure 7: Reusing data between different systems

In Figure 7, a Short Title is included in the SIS, which appears as a course name on the LMS dashboard. This shows the impact that an educational support employee has on the educational process. These initially appear to be separate processes, but they converge in the user experience. This awareness is of great importance in the context of user experience.

Another example relates to the interaction between the LMS and individual applications. The Learning Tools Interoperability (LTI) standard, enables integration of apps into an LMS. However, be careful that the navigation, interaction, design and terminology also match the concept of the whole.

Example 2: the LMS and individual applications
The LTI standard makes it possible to show the functionality of one application in another application. It also ensures that student data and courses, as known in the LMS, can be used and repurposed in, for example, a feedback tool. The LMS has already obtained the course name through the SIS. The LMS now passes that name on to the feedback tool. This reuses the terminology, and allows for the SIS to serve other applications.

The use of the LTI standard not only influences the use of terminology, but also the design. With LTI, the feedback tool can be shown as part of the LMS, see Figure 8.

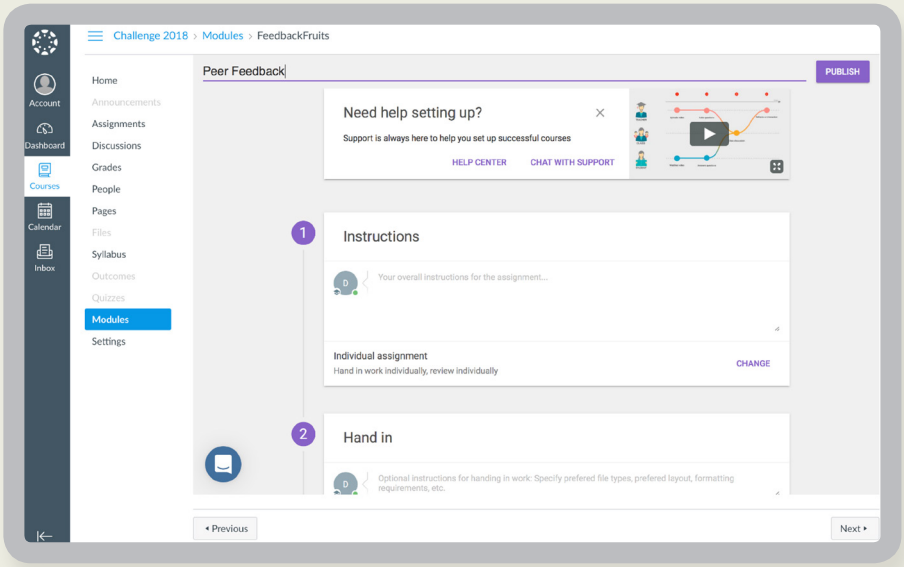

Figure 8: Tool with LTI standard integrated in LMS

This is an example of the influence that the designer of an application, which is exposed via LTI, has on the design of the institution's LMS. The user experience of the LMS depends heavily on the user experience of the application. As the application is often provided by external suppliers, it is important to include them in the user experience that the institution has in mind. Among other things, this can prevent navigational issues. An example of this is found in Figure 9, which depicts cancelling out the usefulness of the application due to the repetition of the (main) navigation.

This part explained how the user interface design influences the user experience the following chapter focuses on the influence of how applications are positioned in their landscape.

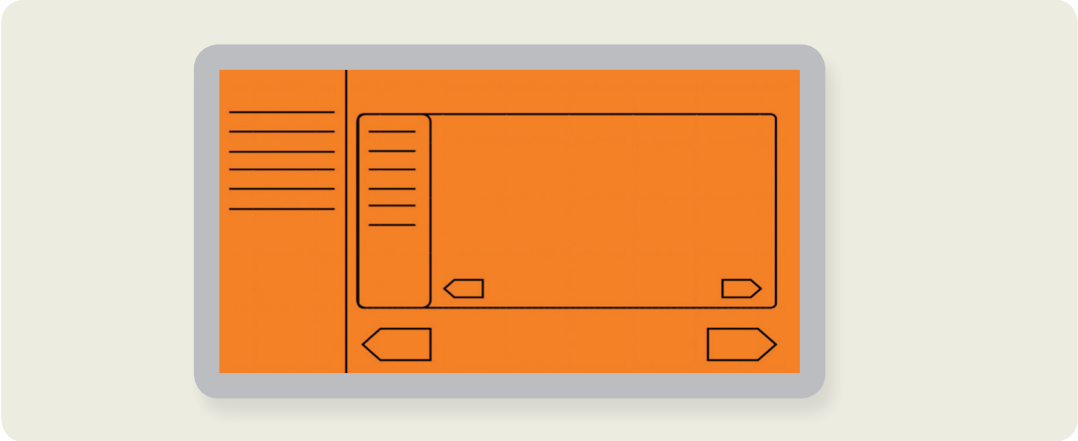

Figure 9: Tool with LTI standard integrated in LMS with double navigation elements

PART 3: APPLICATION CONTEXT

This chapter focuses on the applications in the context of a composite digital learning environment. The following 5 factors are important in gaining an insight into the context of an application:

1. What functionalities do you need to properly shape your education?
2. Which applications will deliver these functionalities?
3. How does the end user gain access to these applications?
4. What about the security of applications?
5. How do applications work together and do they have to be bundled for this?

Figure 10: Influence of the positioning of applications on the user experience

Functionality and choice of applications

A digital learning environment consists of a coherent set of tools and applications. To get to the right composition of applications, first it must be clear which processes must be supported and which functionality must be enabled. These processes and functionalities can be found in the components of the digital learning environment. How does a component relate to an application and how do you choose an application?

Components contain one or more functionalities to properly execute a certain task in education. In this paper, we define functions and functionalities to be the elements that add value to the processes within an educational institution. These functionalities are then provided by applications.

An example: The “Management and use of student information” component contains the following functions:

1. management of student information
2. curriculum/study guide/course catalogue
3. group registration
4. attendance registration
5. grade registration
6. progress registration
7. document management

These various functionalities are made possible by applications such as a student information system (SIS), a group management system, an educational catalogue system, and so on. An application can include several functions. For example, an SIS contains functions for the management of student information, grade registration and progress registration.

Applications are often initially chosen because they provide the functionality that the institution requires. An application then adds value through the user experience it provides (see Part 1). By aligning the applications to the functionality and choosing the right one, the usefulness and attractiveness of the composite digital learning environment, among other things, increases.

The placement within the entire landscape of applications also has an influence. The nature of the data within the application determines the positioning of the application. This is determined on the basis of data Confidentiality, Integrity and Availability. The higher the data score on these three elements, the closer the applications are placed in the “fortress” of the institution[4]. These are the applications that handle data for which an institution is accountable, such as exam grades and diplomas. These applications are often called source systems.

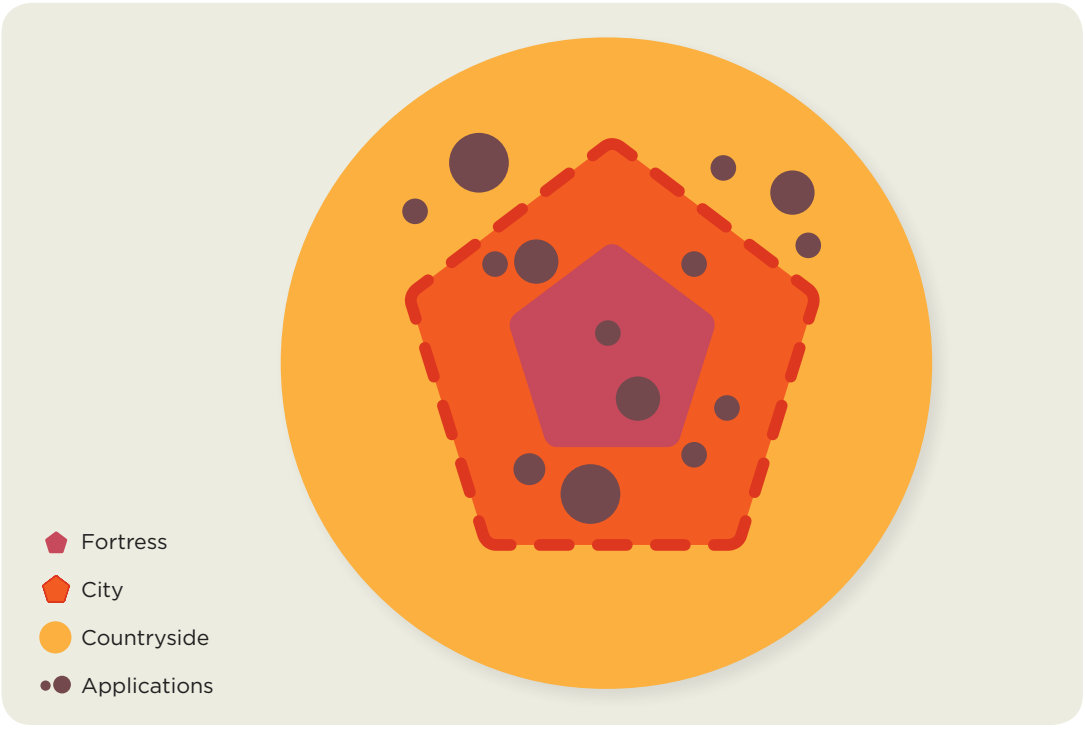

Figure 11: Applications positioned on the fortress model

4. https://www.surf.nl/files/2019-04/memorandum-learning-environment_uk_web.pdf

The fortress, the city and the countryside
The metaphor of the fortress and the open city was developed in SURFnet's workbook "Vision of DLE". It compares the learning environment to the medieval formation of a city surrounding a fortress. This metaphor demonstrates that the degree of control and management of the components varies within the institution.

The **fortress** covers everything that is subject to centralised management (across the institution), and for which the institution is accountable. This includes the functions where strategic information is processed. This information is documented in the core components. The fortress is characterised by limited freedom and an aim for standardisation. This standardisation enables a flexible approach to the digital learning environment.

In the **city**, research, studying, learning and working take place with the help of information from the fortress. There is more freedom in the city, and management is often decentralised (taking place within services, faculties, degree programmes and teams). However, the institution still sets criteria that must be met.

In the **countryside** surrounding the fortress and the city, it is users themselves who decide what they do, with no interference from the institution.

Access plays an important role in the use of applications. The SAML/VOOT standard is used in the authorisation and authentication infrastructure (AAI) to control access to applications. If this is arranged properly, the student only has to log in once (single sign-on) to be able to use all day-to-day services. The user is addressed in the same manner in each system, regardless of how the components are designed. This gives the user the feeling that he is working within a single system. The following paragraph provides details on the access to the applications.

Access to applications

Institutions can provide access to applications comprising the composite digital learning environment in different ways. Institutions can provide access to the applications:

- through a portal
- via an LMS
- separately

To be able to make this choice, it is important to bear in mind the various function domains within the institutions. Different types of information for different target groups are accessed from the different functions. A function can have its own access requirements, and thereby set specific, non-functional requirements for the portal or LMS to be used. Based on the business function model of the HORA and the functional model, we recognise 4 entities within the digital learning environment:

- the institution domain (which includes all the elements below and more)
- the educational development domain
- the educational support domain
- the execution of education domain

The educational domain includes the development and support of education (which is mainly conducted in the fortress), and the execution of education (which is conducted outside of it). In the education support and development domain, lecturers and staff manage the data that is accessible throughout the entire institution domain. The educational implementation builds a bridge to the work field of the student, where he/she starts working with applications that use this data.

If we look at the fortress metaphor again, but now also with the domains in mind, a new model is created that makes information accessible to a user. Here, we look at the fortress model from a helicopter view.

Figure 12 shows an overarching type of information retrieval: the portal. From this portal, it is possible to access the more specific domains, for example by starting the LMS. These domains can also be a part of the portal, this way the domain-specific applications can be launched from the portal. The latter often happens with information for which the institution itself is accountable, such as educational development and support.

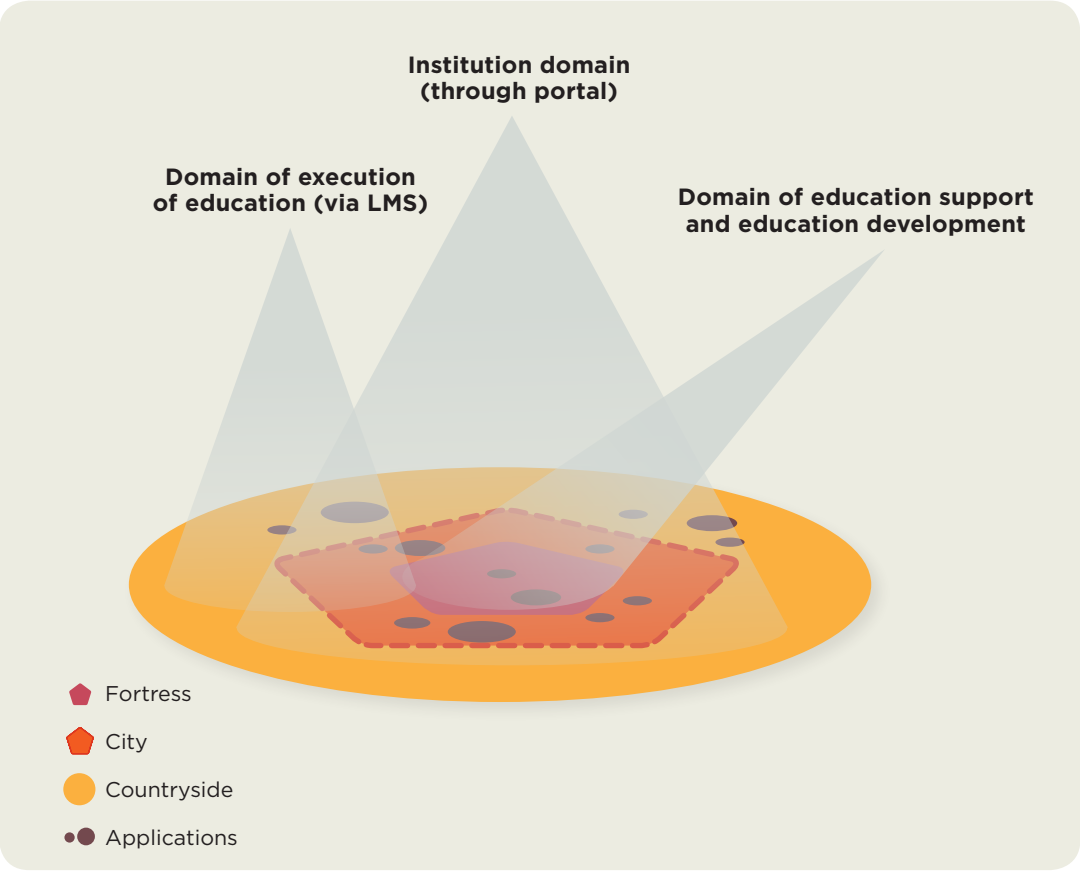

Figure 12: The different perspectives of the domains on the applications

In the execution of education domain, it is also possible to make specific agreements with students or to make specific choices that only apply to this domain. In addition, it is also possible to provide access to specific application data from your own starting point, such as, for example, an LMS. Table 1 compares the different domains on the elements that are in the left column.

	Institution domain	Function domain of education support, education development	Function domain of execution of education
Target group	student/lecturer/employee	lecturer/employee	student/lecturer
Technical implementation	portal	portal	LMS
Scope	institution-wide, including educational support, educational development and educational implementation	educational support, educational development	educational implementation
Mainly provides access to applications in	fortress and city	fortress	city and countryside
System integration	yes, LIS standard	yes, LIS standard	no
Preferred interface for data exchange	OOAPI	OOAPI	LTI
Data interaction	read only from source systems	adding and modifying data in source systems scheduling	adding and modifying data within the own source system: LMS/LTI module
Most important functionality	• show data from (fortress) applications: for example, my schedule • links to (fortress, city & countryside) applications, my apps • access to functionality across multiple applications: search and notifications	• management and use of student information • setting up the organisation of learning	• course organisation, division of students into groups: my courses • access to developing and sharing learning materials: for example, wikiwijs • access to educational applications: educational process guidance

Table 1: Comparison of elements in the various function domains

What does this mean in practice?

Applications provide a given functionality of a component. Take, for example, the feedback tool that fills in the functionality of the educational process guidance component. Educational process guidance is placed in the city in the functional model. The feedback tool is therefore also treated as a city component. The aspects that play a role in data integration and visual integration are therefore of great importance. However, this does not conclude user experience. For the user experience, it is also important how this tool can be accessed. The method of access must match how the application is used in education. For example, the question of how the application fits in with the educational concept of the institution is important, but also the scale in which an application is used, and whether there are other applications that (partially) offer the same functionality. There are several options for the access:

- **Access via a portal**: the feedback tool can be included in the overarching portal. The feedback tool can then be used for multiple purposes, ranging from feedback on courses to feedback on the institution's news provision, etc. This allows for use of the tool as widely as possible.
- **Access via LMS**: the feedback tool can be included in the LMS. This allows the tool to be used in a targeted manner to provide feedback to fellow students who have collaborated on a specific assignment for a specific course. The tool is then well embedded in the educational process.
- **Accessing applications separately**: the feedback tool can be included as a separate app. The tool is then not accessed via the portal nor the LMS. For example, a lecturer can request feedback at the end of his course by referring a student to an external tool in which he has a set of questions ready for the students. The tool can still be used in a course, but the educational experience may feel less cohesive for the students.

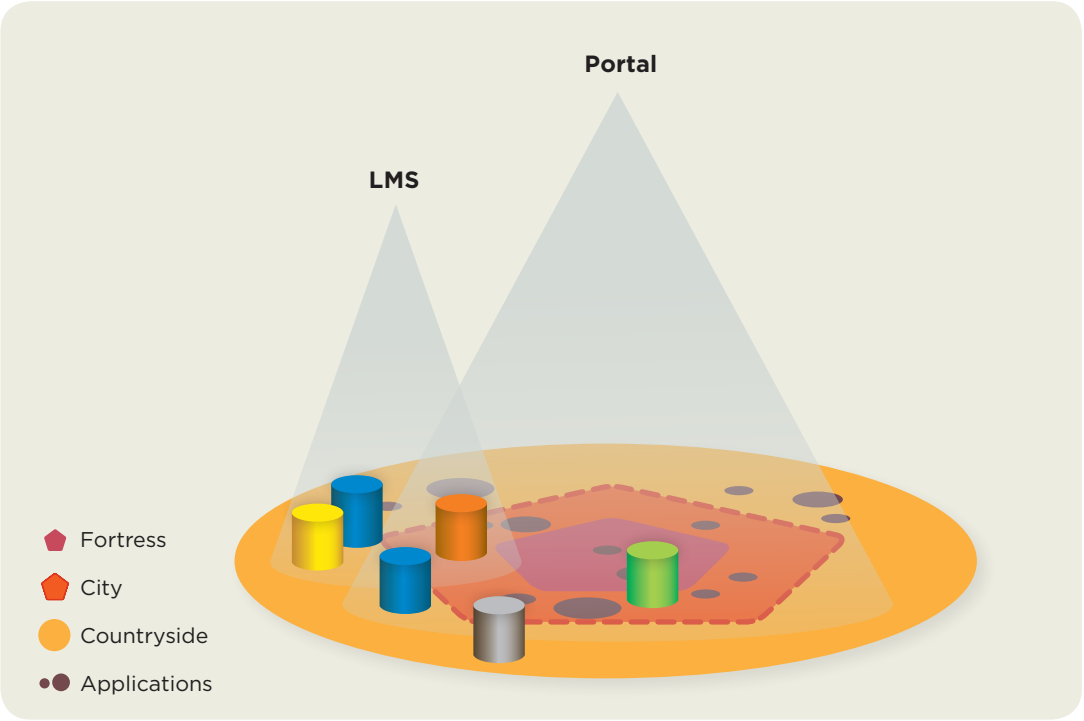

Figure 13: Overview of applications accessed through a portal or an LMS

Figure 13 shows applications that are accessed by a portal, by an LMS, by both or by neither. There is something to be said for every implementation. It is important to make a conscious choice for one of the options, which contributes to the use of the applications in a way that offers as much added value as possible for education.

The cylinders in the figure are applications. Different colour cylinders indicate different choices. The cylinders are plotted on the fortress model, depending on the functionality of the component they fulfil.

Many applications are only accessible in the portal. The green cylinder indicates such an application. Applications in the portal are diverse and generally widely applicable.

The yellow cylinder shows an application that is only accessed by the LMS, and not by the portal. These are, for example, applications that provide specific educational content, such as a feedback tool or a video tool. These are primarily important within the education domain.

The orange cylinder represents an application that is accessed by both the portal and the LMS. Consider, for example, a digital test that belongs in the education domain. This can be highlighted in the portal, because this test concludes the course.

Then there can also be applications that repeat the functionality of other applications. These are the blue cylinders. For example, a chat application can serve as a separate app, but also as a chat for a particular course in the LMS. Both have a purpose, but it is important to clearly communicate the scope of the application to the users.

Then there are grey cylinders. These are applications that do not directly affect the educational process in the domain, and that do not always have to be accessible from the portal. There are, however, enough of these applications within the institution that are occasionally used by a lecturer and/or student.

Where to position an application? That largely depends on how the application will be used in education. Ideally, the educational concept determines which functionality is needed, and how applications are deployed and interact with other applications.

Examples of a portal

A portal contains references to applications that are used generically. A portal can take on various forms. Three examples:

1. A portal website that can serve as the home page of the institution.

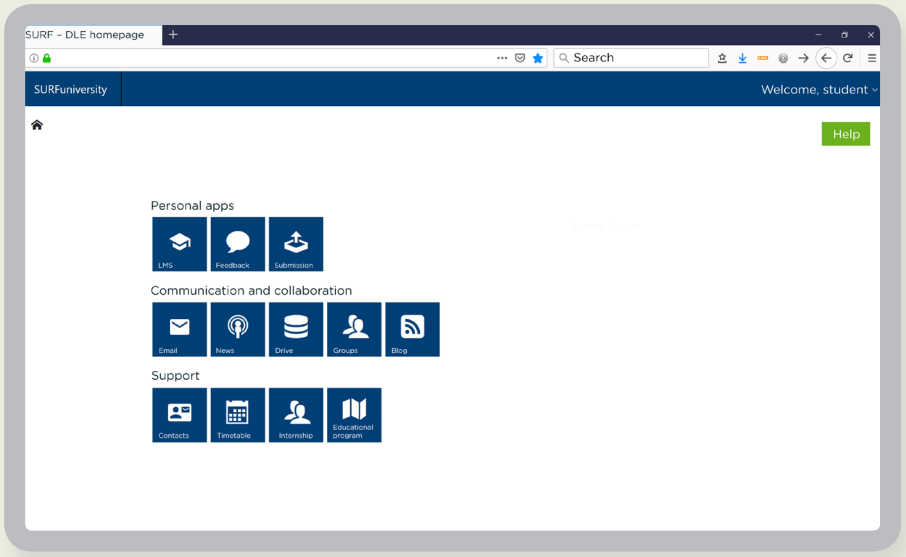

Figure 14: Portal website

2. An app bar (part of a web page) that can be repeated on multiple websites of an institution

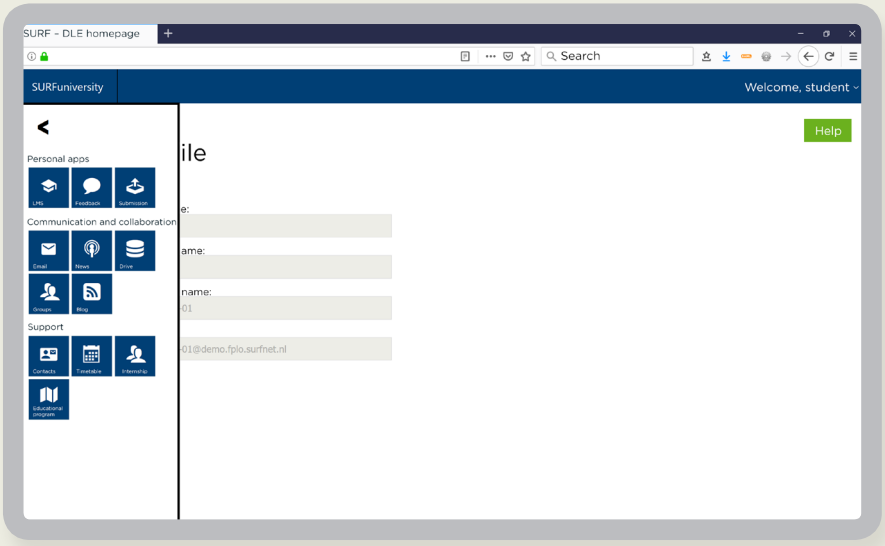

Figure 15: website with app bar

3. A browser bar that is always available in the Internet browser, and not just on the institution's websites.

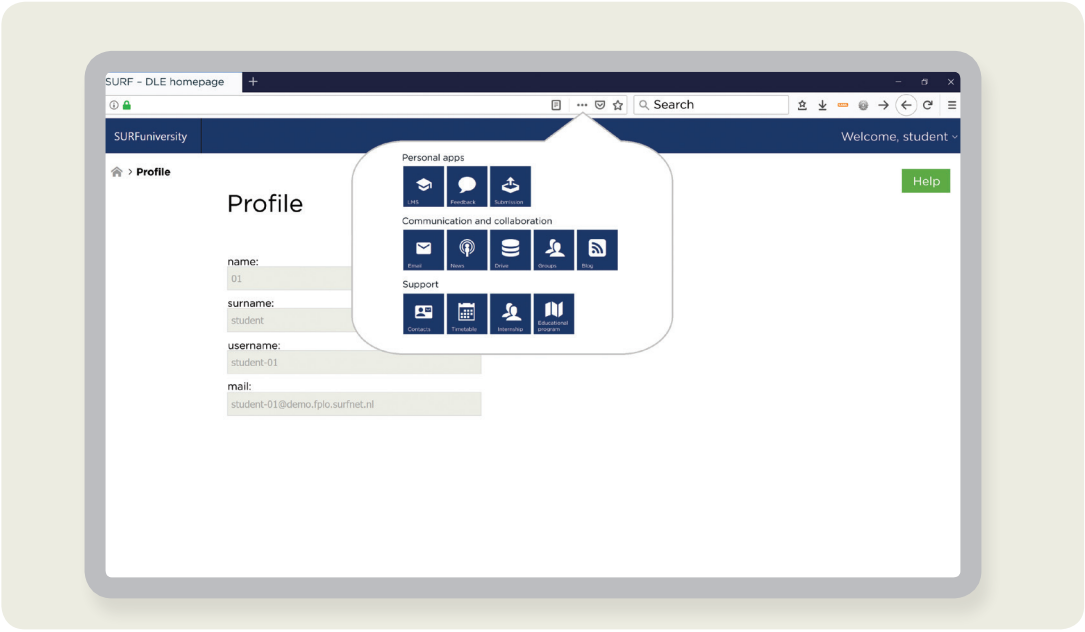

Figure 16: Website with browser bar

Portal, LMS or individual applications?
The advantage of using a portal to make information accessible is that it provides insight into the structure and findability of applications (where should I be for what).

On a portal, an LMS has the added value that it can control tasks and applications. With an LMS, tasks such as a lecture in week 1, a video in week 2 and a final test in week 3 can be put in a logical order, and results from different applications can be reused within the LMS.

If applications are not accessible via a portal or an LMS, they can be accessed as a separate application. The navigation within a separate app is often optimal (depending on the design of the app), because the app is built around a limited set of tasks.

A portal, LMS and a separate application can co-exist and even complement each other in a digital learning environment. It is important that the applications are positioned in such a way that they optimally support the education. It is also important that the portal, the LMS and the individual applications use the same system and data integration, so that they display the same data and the terminology is the same everywhere. The user must see the same information whether he ends up there via a portal, via the LMS or directly in a separate app. The concept that initially applies to one application is thus implemented across different devices.
For example, when an email has been read in an app, this can also be seen in the desktop application and in the web interface via the browser.

PART 4: USER EXPERIENCE OPTIMISATION

The honeycomb model can help in the optimisation of the user experience. It is relatively easy to bring all the cells of the model into balance when developing a new application. Within the digital learning environment, however, an institution is dependent on purchased applications with different interfaces. In this case, the fields from the honeycomb model can be taken into account in the tendering process in order to ensure an optimal connection to the user experience of the digital learning environment. In this chapter, you will read how the adaptation of applications has an influence on the user experience.

The honeycomb model shows that focusing on all 6 elements of the model gives an improved user experience for an application. The pitfall in the development of a digital learning environment is that we may pay less attention to some elements. It is important to be aware of this. The pitfall relates to how applications are positioned, and has its origins in the use of the fortress model. We look at the pitfalls for every area in the fortress model.

Figure 17: Direct influence on the user experience

With the applications in the fortress, the emphasis is often on the reliability of the data and on meeting the most important criteria of an institution. The credibility and usefulness cells are very important for applications in the fortress. For example, a timetable application must always display the correct data, otherwise students will end up in the wrong classroom. When deploying fortress applications, you should therefore pay additional attention to the other cells: usable, findable, desirable and accessible. By their very nature, they receive less attention, but they do enhance the user experience.

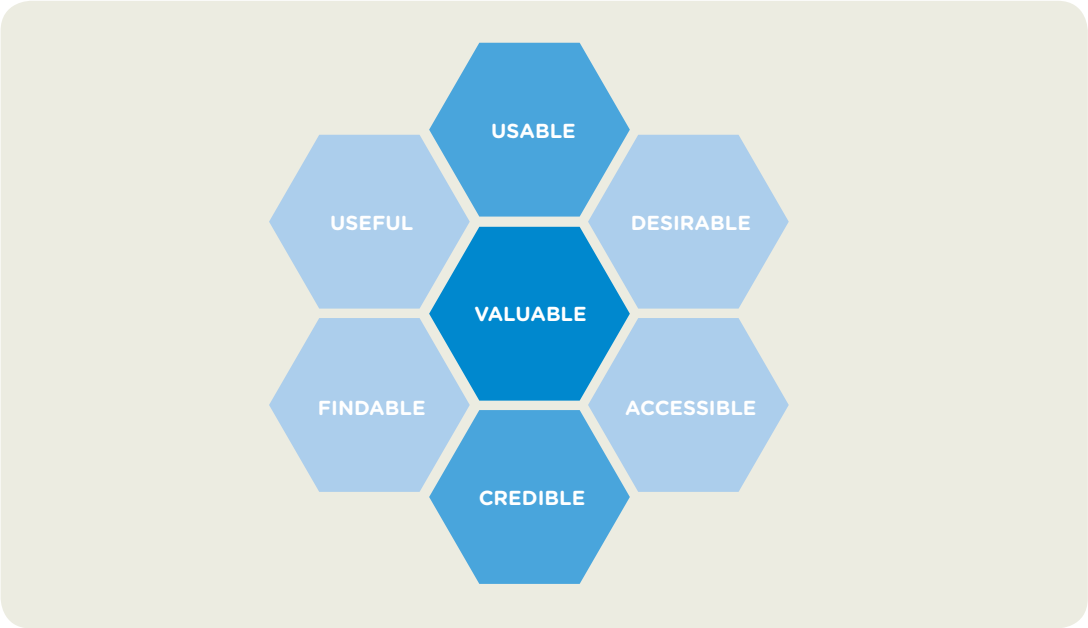

Figure 18: Make a fortress application more valuable by also paying attention to usability, findability, desirability, accessibility

It is also true that perceived credibility and utility are more important than the actual credibility and utility. The honeycomb model tells us that everything interlocks. By definition, applications with limited accessibility, or which are not findable and not useful, are hardly ever thought of as being useful or credible. See Figure 18.

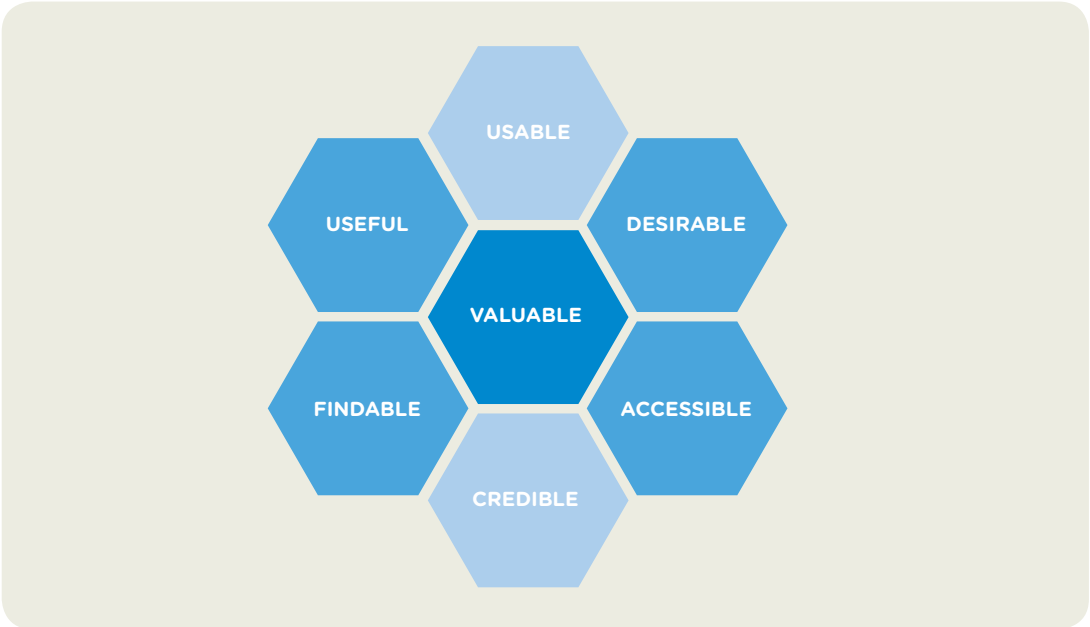

Figure 19: Make a countryside application more valuable by making it useful and credible

In the case of applications in the countryside (see Figure 19), the emphasis is often on usable, findable, desirable and accessible. These applications must differentiate themselves through user-convenience and user-friendliness. The use of countryside applications must offer added value to the education of the institution. You should therefore ensure that these applications are also credible and useful, so that they offer a complete user experience.

By their nature, applications in the city focus on all the concepts of the honeycomb model. Applications that are selected contribute to education and are often already assessed for user experience during the selection process. Therefore include all 6 elements in this assessment.

PART 5: INFLUENCE OF STAKEHOLDERS ON THE USER EXPERIENCE

In the previous part, you were able to read that focus on the 6 elements of the inner ring (see Figure 20) when creating or purchasing an application has an influence on the value of the application and the user experience within the composite digital learning environment. Different stakeholders can also indirectly influence the user experience by influencing the cells in the outermost ring.

Figure 20: Indirect influence on the user experience

There are many stakeholders who have an influence on the user experience, from the educational expert developing the education concept to the programmer at an external supplier. Each stakeholder influences the user experience, directly or indirectly.

An overview of activities and functions of people who play a role in the development of a digital learning environment, and can thus influence the user experience:

TASK	ROLE	Terminology	Design	Format	Interaction	Navigation	Information	Concept	Choice of applications	Functionality of applications	Access to applications	Application security	Interaction between applications
Development of education	Educational expert						●	●					
	Lecturer						●						
	Educational designer				●	●	●		●				
Content	Designer of learning material	●	●	●	●	●	●						
	Editor	●											
Set-up and selection	Lecturers, teaching assistant						●		●				●
	Information architects					●	●	●	●	●	●	●	●
	Software developers			●	●	●	●			●		●	
Support and management	Functional and application management	●									●	●	●
	Operational management	●									●	●	
	Helpdesk	●									●		
Suppliers and external party	Suppliers of applications						●	●	●	●	●	●	
	Consultants	●	●	●	●	●	●	●	●	●	●	●	●
	Software developer, designer			●	●	●	●			●	●	●	
	Publishers of learning materials	●	●	●					●	●			

Table 2: Possible influence of stakeholders on the components of the user experience

Please remember that some roles can also be combined with user roles. For example, a lecturer is sometimes also a designer of, or can be responsible for the selection of, educational material.

To improve the user experience, it is therefore necessary that the importance and the possibilities of the user experience should be known to this large group of stakeholders. This not only improves the user experience, but probably also the quality of the education. That is why teams must be well put together and why institution-wide design frameworks are desirable.

It is also important that every person involved shares the same vision (the user interface concept) when designing a part of the application landscape. Following the concept is more important here than working to the letter (for example, a style guide that describes what can and cannot be done for all situations), because, in practice, not everything can be precisely influenced and you have to deal with an existing application landscape and suppliers.

In other words: all stakeholders must understand the elements, and especially the concept of the user interface. And also know which components they cannot influence, so that they can maintain the overall concept with the components that they can influence.

SUMMARY

Visual integration and a good user interface are important, but many more aspects are involved in ensuring a good user experience. In practice, these topics quickly blur into one. If you make a better distinction between these two concepts, it provides more understanding and insight into the possibilities for improving the user experience.

IN PART 1 you read that user experience is much more than visual integration. ***The following elements play a role in forming an image of the user experience:***

1. The 7 elements on which the experience with an application is assessed: valuable + useful + usable + findable + credible + desirable + accessible
2. The 7 aspects that make up a user interface: terminology & language + design + layout + interaction and transition + navigation + information/functionality + concept
3. The 5 aspects of the application context: choice of + functionality of + access to + security of and interaction between the applications of the learning environment

These 3 points together depict what comprises the user experience and how it can be influenced.

This description of user experience is based on the honeycomb model.

IN PART 2, the concept of visual integration is developed and the comparison between visual integration and user interface design is made. So when we talk about visual integration, this refers to concepts such as terminology and design and the 5 other user interface design elements.

The aspects of the user interface design that are to be separately designed jointly influence the operation of the application and the concept contained therein. **In integrated systems that each have their own user interface, alignment of all aspects must take place in order to maintain the user experience.**

In addition, choices during system integration and data integration also have an influence on the user experience. For example, reusing the name of a course in different applications has a positive impact on the user experience. The name of a course is determined in the student information system, and can then be reused via system and data integration in the downstream applications, such as the LMS, for example.

The dependency between applications is set out **IN PART 3.** Functionalities and applications must match the experience of the user. Depending on the functionality, the application receives a position in the fortress model and obtains the associated rights.

Providing access to an application can be carried out via a portal, from an LMS, or the application stands on its own. The way in which access is given contributes to security, the user experience and the interaction from and between applications. In an LMS, for example, it is possible to allow applications to work together more closely than in a portal. **We argue for a conscious choice for the positioning of an application, which is determined by the perception of the user and the value of the data**. In addition, a portal, an LMS or a separate application are all 3 valid choices that can be combined in a single digital learning environment.

PART 4 examines the way in which the honeycomb model can be helpful in thinking about the application landscape of the digital learning environment (the fortress model). **It is important here that fortress applications become more valuable by also paying attention to the aspects of usable, findable, desirable and accessible. Countryside applications become more valuable by making them useful and credible.**

PART 5 indicates that a better understanding and a broader view of user experience provides a different view of the functions and roles within an educational institution that have an influence on the user experience. This influence varies from architects to lecturers, and from education supporters to the suppliers of tools. The challenge in designing a learning environment therefore lies in putting together the team that will work with it. **An unambiguous user experience requires a multidisciplinary team of experts.** For an educational institution, it is clear that work should be carried out from a vision of education that is supplemented with design frameworks for user experience for all involved.

Conclusion

This guide is the last part of a set of 3 documents, which, in 3 steps, describes the development of a digital learning environment that can support flexible and personal education. In Part 1, a distinction is made between the individual building blocks and different integrations of the learning environment[5]. In Part 2, these building blocks are merged into a functional model, and integration standards[6] are designated. This third and final part shows that the user experience is intertwined with all building blocks and integrations of the digital learning environment.

Experimenting with user experience
Concepts from earlier memos have been put into practice through experiments with institutions and suppliers within a technical infrastructure.
We would also like to test the concepts from this document in practice. Institutions and suppliers who would like to contribute ideas and/or experiment with this are cordially invited. To take part, please contact us via leeromgevingpilots@surfnet.nl.

5. https://www.surf.nl/files/2019-04/memorandum-learning-environment_uk_web.pdf
6. https://www.surf.nl/files/2019-04/a-flexible-and-personal-learning-environment---a-modulair-functional-model_0.pdf

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