Choosing for learning objects: The possible deployment of learning objects with eight educational ambitions of Dutch institutions of higher education

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Learning objects in practice 1

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1 Overview

1.1 Introduction

Learning objects are hot. Many institutions of higher education are considering whether they should 'do something' on learning objects, and how to get started. The aim of this document is to offer help with this choice. In this document, eight educational ambitions are formulated in which learning objects could play a role. These eight educational ambitions have been established in a process in which we alternately investigated the educational ambitions that are currently of importance in Dutch higher education and in which we analysed and made explicit the educational ambitions that underlie existing successful cases in practice in which learning objects are deployed. These eight educational ambitions are not necessarily the most important or urgent educational ambitions an institution can have. But they are educational ambitions in which the use of learning objects can contribute strongly to or can even be a prerequisite for realisation.

The eight educational ambitions consist of:

1. Creating independent learning pathways, for example for lifelong learners
2. Making education more flexible
3. Responding to differences between students
4. The joint development of learning materials together with other institutions or external parties
5. Attuning to professional practice
6. Attuning to students' expectations by using digital interactive learning materials
7. Making available existing learning materials
8. Contributing to the acquisition of information skills by making resources available

It is clear that the eight educational ambitions exist on different levels, and that they can co-exist within one institution. But, notwithstanding the differences, these ambitions have in common that educational institutions could strive for them, or they could not strive for them. That is why this document is not a general plea for the deployment of learning objects, but it rather aims at showing how a well-informed decision can be made, given a specific educational ambition.

Learning objects are part of the deployment of information and communication technology (ICT). Therefore, some of the arguments in favour of the deployment of learning objects will at the same time be arguments in favour of the deployment of ICT in general in realizing the educational ambition involved. This is inevitable. But, in addition to this, the arguments always refer to two characteristics that are specific to learning objects, namely that they are made up of *digital learning materials* which are made available *in a collection*. These two characteristics will be discussed more extensively below.

Determining the institution's own educational ambitions and the role that learning objects can play in realizing these ambitions is the first step in an entire process that ultimately should lead to the concrete deployment of learning objects. In a following step, one should determine how, following which scenario, the development and sharing of learning objects will be organised. This second step is described by Hermans and De Vries (2006). The appendix of the current document offers help with the process of development and sharing by calling attention to a number of points of special interest.

This document is built on the eight educational ambitions. First, the surrounding context is sketched for each educational ambition. The importance of each ambition is explained: why should

institutions strive for this ambition, what is the underlying problem or wish? Next, we discuss the role of learning objects in realizing the ambition, and we refer to existing, successful cases in practice, in which the educational ambition has been realised using learning objects. From these cases, a number of points of special interest can be derived, which are presented in the appendix.

1.2 What are learning objects?

First of all, we discuss in more detail what learning objects are. We start by giving four examples of successful cases and we indicate which characteristics of learning objects are of importance in these examples.

> The degree programme Psychology at the Erasmus University Rotterdam is followed by some 450 students. The virtual learning environment *Psyweb*, developed in 2001, has been extended in 2003 with a collection of learning objects, called *LCMS Psychology*, which fit in closely with the educational model of problem-based learning which is used at the department. To all relevant educational materials - papers, book chapters, lectures, animations, video clips and power point presentations - useful but non-standard metadata has been attached, such that students can get an overview from different perspectives on the materials that fit in with their specific learning goals. A web page shows them the result of their query and an estimation of the time it takes to download the material. Overviews of available materials can be provided for each problem, period or for the whole degree programme. The collection of materials is successful; soon after delivery, around 65 % of the students used the materials regularly. The collection has expanded rapidly: by the end of 2004 it contained around 4500 objects.
> Source: LCMS Psychologie (2004).

> The collaborative project *Digital learning materials on small subjects in teacher training secondary and further education* has been executed by the universities of professional education of Fontys, Rotterdam, Amsterdam and Utrecht and the Open University of the Netherlands. In this project, digital learning materials have been developed for three subjects of the teacher-training programme, which are attended by a small number of students, namely Physics, Geography and German. The result is a three subject knowledge bank, filled with materials in a limited number of domains. In the follow-up project ‘Knowledge bank small subjects in teacher training’ (same partners except for the Open University of the Netherlands), the knowledge bank is extended to include a complete curriculum on the subject and teaching methods (a minimum of 90 ECTS points for each curriculum). This project aims at both developing a complete knowledge bank for all science subjects (Physics, Chemistry, Technology and Biology) and implementing and evaluating the materials that had already been developed (also for German and Geography).
> Source: Rasenberg (2005).

The project *Thesaurus*, executed by the universities of professional education of Fontys (School for Communication) and Utrecht (School for Communication Management), is a project funded by the Dutch national SURF foundation. This project has resulted in a knowledge bank for students of Communication, named *Com2Know* (www.com2know.nl). Part of the knowledge bank is a digital thesis bank, containing for both institutions bachelor theses of the last few years of students of communication.
New graduates are obliged to offer their bachelor thesis to the thesis bank. Students use the thesis bank in finishing their studies. Full text search enables students to search the thesis bank for any piece of material that is relevant to their own research. Besides this, they can search for specific elements, for example the research problem. This makes it possible for students to build on existing research. By now, one quarter of the theses in the thesis bank is re-used by students; ten percent of the newly published theses expressly builds on information from existing theses.
Source: Thesaurus (2004).

The *National Teaching web Knowledge engineering* (NTK; www.ou.nl/lok) has been operational since 2001. It contains over 100 study tasks for students of knowledge engineering. The study tasks have been developed by experts from Dutch universities. NTK is a partnership of the Open University of the Netherlands and the State University of Groningen, CIBIT Consultants | Educators, the Free University Amsterdam, the University of Amsterdam and the University of Maastricht. Institutions showed overwhelming interest in joining the project, which doubled the number of study tasks developed, compared to the original plan. In the first two years of its existence, around 1000 students have used the NTKweb. The average study load of the study tasks is 15 hours and the tasks can be deployed in a variety of educational formats. On NTKweb, teachers can select study tasks and make them available to their students.
Source: LOK (2003).

These examples show two characteristics of learning objects that are central in this document. Firstly, a learning object is a digital piece of learning material. Although some definitions of learning objects include non-digital learning materials, these do not play a role in this document. This is related to the second characteristic, which is that the pieces of learning materials are stored as separate pieces in a collection. The exact set-up of the collection is less important, but its presence is. In this document, we will not consider for example a separate chapter in a book, but we will consider the book chapters as they are stored in the *LCMS Psychology*. The collection itself needn't necessarily contain the objects. It is equally possible that the collection contains references (for examples URLs) to the objects, which are themselves stored elsewhere. Currently, these collections are always digital; if they refer to objects elsewhere, then these objects can be non-digital, but in practice this occurs only rarely. Therefore we state that non-digital learning materials do not play a role in this document. The collection can be searched by teachers from departments or institutions looking for learning materials they can use in their courses; institution may grant access to their students as well, if this fits their educational model. Searching has been enabled by attaching metadata to the learning objects, such as title, subject, description, level etcetera. Such a collection is also called a repository.

Perhaps surprisingly, the size of a piece of learning material is not a criterion for distinguishing learning objects. It is generally assumed that learning objects can be widely different in size, make-up and origin (for a more detailed description of the divergent types of learning objects, see

Schoonenboom, 2006). Our definition of learning objects includes for example not only collections of study tasks and collections with a variety of learning materials, but also test banks and image banks. Materials can be made by teachers, but can also originate from publishers.

Another common criterion in distinguishing learning objects is whether the object has been specifically developed for use in education, has learning goals, and is passed through by the student in reaching these learning goals. This criterion is at the basis of a distinction between learning objects (which meet this criterion) and information object (which do not meet this criterion). By this criterion, the objects in *LCMS Psychology* and those in *Com2Know* belong to the information objects. In this document, by contrast, we will count them as learning objects. We will sometimes use the term 'information object' as a subclass of learning objects if this is useful. Because of the wide diversity among learning objects, there is also a wide diversity of definitions of what a learning object is. Not everyone uses the same definition as we do. Especially the storage in a collection is not often considered part of the definition.

2 The eight educational ambitions and the possible role of learning objects

2.1 Creating independent learning pathways, for example for lifelong learners

Problem/wish

Society becomes ever more complex and therefore there is a growing need for people with a degree in higher education. To realise this, the participation in Dutch higher education has to increase. The Dutch Higher Education and Research Plan (HOOP) (2004) uses the term 'maximal participation'. As the participation by traditional groups (young people with a degree in secondary education) is already almost maximal, attention is focused on new target groups. According to the Actieplan Leven Lang Leren (2004), the Dutch government aims at an increase in the number of students aged 25 to 64 in the year 2010 by 20 to 30 percent compared to 2004. In this context, the EU eLearning programme (2003) mentions the realisation of 'a European area of lifelong learning'.

Beerkens et al. (2005) add to this that the Dutch government aims to widen the participation of non-traditional groups such as people rejoining the workforce, ethnic minorities, older students, and those who do not opt for a full-time degree course but instead take a course in the context of lifelong learning. Also, rising the influx of employees and job-seekers into higher education is seen as a prerequisite to increasing the proportion of people with a degree in higher education within the work force. One specific target group are employees or job-seekers with a degree in vocational education who take part in higher education by following a work-study programme or a part-time study programme.

Starting from 2006 the Dutch government will grant subsidies aiming at the strategic use of e-learning. The E-learning notitie (2005) – an elaboration of HOOP 2004 – states that ICT can contribute to realizing these ambitions.

For these lifelong learners, learning pathways will have to be created that can be worked through by students on their own. Often, lifelong learners are not in a position to attend regular lecture, because of problems with travel distance and/or time scheduling (Schoonenboom, Roozen & Sligte, 2004).

Solution

Learning objects offer opportunities for creating learning pathways that fit in with specific needs of individual learners and which can be worked through by learners on their own. A repository containing a large enough amount of learning objects enables students and teachers to make different selections of learning materials that fit their specific needs.

In itself, self-study by students, without supervision by a teacher, is very well possible using traditional, non-digital, learning materials. Yet, digital learning materials, including learning objects,

largely extend the possibilities for students to work on their own. Unlike traditional learning materials, digital learning materials can provide feedback dependent on the student's actions, for example faulting an answer or providing extra help in solving a problem. This opens up possibilities for self-testing.

Digital learning materials increase opportunities for collaboration as well. Working together on digital learning materials is much easier, as the materials can very easily be exchanged and modified. Digital exercises may include competition between learners, and different learner roles can be distinguished, each with its own tasks and feedback.

Digital learning materials, and thus learning objects, largely increase the possibilities for learners to work at a distance. This is very important to these learners, as they very often are not able to attend regular lectures. In contrast to paper materials, digital materials can be made available, downloadable, at a distance, which relieves the student from coming to the institution to work with the materials. Examples include the growing number of scientific papers that is made available full text through library catalogues.

2.2 Making education more flexible

Problem/wish

The creation of independent learning pathways for lifelong learners, described in the last section, is a specific form of individualisation. Another form of individualisation is flexibilisation. This term refers to the opportunity for students to follow different, individual, learning pathways. Unlike independent learning pathways, flexibilisation is especially relevant to the existing student population.

Dutch higher education is characterised by an increasing flexibilisation. Students have an increasing influence on their own learning pathway. In the ultimate case, students choose an entire individual learning pathway, in which they themselves entirely determine the learning pathway and the learning pace (Frissen, Pennings, Van Staden & Pierson, 2004).

Flexibilisation will receive a new impulse with the new funding mechanism which will be based upon learning entitlements. In this system every student will acquire eight to ten learning entitlements, worth half a year of study each, which they can spend according to their own judgement on study at universities of their own choice (Beerkens et al., 2005).

Individual demands for flexible learning pathways are expected to increase explosively, and this will also contribute to flexibilisation. Examples of flexible learning pathways include more customised education, assessment procedures (for example, admission to a shortened program based on work experience), e-learning, and cooperative education that combines education and work (Beerkens et al., 2005).

Solution

Flexibilisation can be realised, among other solutions, by letting students choose an individual learning pathway out of several modules or courses which are stored as learning objects in a repository. Prerequisites for this solution are not only that the modules can be used separately, but also that modules fit in very well with other modules, so as to avoid gaps and overlap. With each module, metadata should indicate the required prior knowledge, for example by indicating which other modules count as entrance requirements. Furthermore, for each module an adequate description is needed of the learning pathways in which the module fits and the module's level should also be indicated.

2.3 Responding to differences between students

Problem/wish

There are signs that suggest that diversity among students has increased. Referring to the British student population, Harris and Higgison (2003) state that there is a growing diversity in cultural

background, upbringing, age and experience. HOOP 2004 mentions a wide diversity among young people in lifestyle. If more lifelong learners will enter higher education, the implication will be that the diversity within the student population will increase further. Furthermore, students differ to an increasing extent in their prior education. According to the E-learning notitie (2005) e-learning can play a role in removing deficiencies and testing prior learning, offering further training and virtual platforms.

Solution

Learning objects can support responding to differences between students in different ways. Firstly, repositories allow for making different selections of learning materials, which can be presented to different students. This is made very easy because materials are stored as separate elements. Furthermore, as opposed to paper materials, making digital materials available to one student or to hundred student makes only a slight difference in costs.

Learning objects make it possible to take into account preferences of the individual student, for example preferences for specific topics or for a specific type of presentation. For example, some students might be presented an object containing a textual explanation of a topic, whereas others are presented an object containing a video presentation. Furthermore, it becomes possible to take into account preferences of specific groups, and to develop learning objects for specific groups. Distance learners are an example of such a group.

A very important issue is the development of learning materials for removing deficiencies. Learning objects fit in very well with this aim, as it is possible to present students only with those learning objects that relate to their specific deficiencies. Interactive digital learning objects further enable the student to work on their deficiencies on their own, without teacher support.

2.4 The joint development of learning materials together with other institutions or external parties

Problem/wish

Costs of digital learning materials are a major obstacle. Developing high-quality digital learning materials is very expensive. Compared to the big educational publishers, institutions of higher education have too few resources for the development and exploitation of learning materials (Frissen et al., 2004). For this reason, institutions of higher education work together in consortia, aimed at scaling benefits and sharing knowledge and experience (E-learning notitie, 2005). One additional reason for the high costs of digital learning materials in higher education is that these materials usually serve as a supplement to traditional paper materials. In other words, these are additional costs on top of the existing costs of learning materials. In case digital learning materials serve to replace traditional paper materials, there needn't be a rise in costs (Pennings, Van Staden, Limonard & Frissen, 2005).

Solution

In the development of digital learning materials it is a rule that the bigger the number of users of the materials, the more advantageous the development is. This rule has a much larger effect in the case of digital learning materials than in the case of paper learning materials. That is because the costs of making the materials available hardly increase if the number of users increases. In contrast to paper learning materials, digital learning materials can be multiplied endlessly without much extra effort.

Development costs can be reduced by developing digital learning materials together with other institutions. In this case, repositories are very useful, as they can store the materials in such a way, that they can be accessed from all institutions involved. Further reduction of costs might be achieved by employing students in the development process, to whom this is a valuable learning

experience. In practice the interinstitutional development of learning materials works especially well if the development is organised by discipline. Examples of this include the projects *Digital learning materials on small subjects in teacher training secondary and further education* and *The National Teaching web Knowledge engineering*. Both projects are described in section 1.

2.5 Attuning to professional practice

Problem/wish

One of the ambitions of HOOP 2004 is the improvement of the relation between education and business. The E-learning notitie (2005) aims at orienting education more towards demands from business and ensuring that new developments in business are incorporated into degree programmes quickly, and not just at revisions of the whole curriculum. For in a constantly changing society it is desirable that developments outside higher education are incorporated into teaching at institutions of higher education as quickly as possible. Think for example of developments in research, in the field or in professional practice.

Solution

Digital learning materials can contribute to a faster incorporation of developments in professional practice into education in several ways. Firstly, digital learning materials can be adapted very easily and quickly. Changes in learning object can be made once, and from that moment they are available to anyone using the material. In contrast to paper materials, a costly and time-consuming republication is not necessary.

Secondly, in a flexible curriculum that is (partly) based on digital learning objects (see educational ambition no. 2), the replacement of out-of-date modules and the creation of new learning pathways is much easier than in a traditional curriculum. Thirdly, digital learning materials can be developed in collaborative projects, in which education and business work together.

2.6 Attuning to students' expectations by using digital interactive learning materials

Problem/wish

Students' attitudes towards ICT have changed. The E-learning notitie (2005) describes today's students as 'digital natives' who have grown up with computers and internet. These digital natives enter higher education with certain expectations on the use of technology (Harris & Higgison, 2003). According to Pennings et al. (2005) ICT is more challenging to these students than traditional materials. Frissen et al. (2004) even claim that traditional forms of learning materials no longer satisfy the needs of these users.

Solution

Today's students have grown up with ICT. They are used to digital materials in which text, images, video and sound are brought together. They are used to material that is interactive, which can respond to actions of the user. This interactivity can take many forms, such as counting an answer as right or wrong, providing help with solving problems, allowing users to input their own variables in a simulation, and offer more difficult or easier exercises, depending on the user's performance.

An essential part of the digital youth culture are computer games (see Veen & Jacobs, 2005). To today's students, computer gaming is an attractive way of learning, as it is characterised by learning by doing, feedback by the system and often also by fellow players, and the often complex tasks that have to be performed. Higher education could utilise computer gaming much more often. Currently, mostly two types of gaming are used in higher education.

The first type are simulations, which are often about physics or technology. In a simulation, students can enter their own parameter values, and see how these affect the phenomenon for which the simulation has been designed (for example, speed or current intensity). A simulation may

contain pre-fabricated, usually single, tasks, but it is also possible that teachers create their own tasks.

The second type of game is much larger and much more complex. This type is about management games, in which students have to manage a virtual company. With management games, the complex task is built-in into the game itself, and might for example be to attain the best company results. During the game, students are confronted with varying circumstances, in which they have to act as adequate as possible. Good collaboration is a necessity.

Small games can be stored as learning objects in a repository. This is not possible with large, complex games; these are not themselves learning objects. Learning objects can play a role though, for example when components of the game have to be filled in by the teacher, or when the teacher can use smaller learning objects within the game of their own choice.

2.7 Making available existing learning materials

Problem/wish

One problem in higher education is that ever more digital learning materials are developed at different places, so that these materials are hard to find (Frissen et al., 2004). One aspect of this problem is that much of these materials are developed by teacher and are stored in the teachers' courses in the virtual learning environment. Usually, courses in a virtual learning environment can only be accessed by the teacher and students participating in that course, and as a result, it is not possible to give other people access to the learning materials without violating the course's privacy.

Materials in a virtual learning environment are organised according to the structure of the specific course. For this reason and also for technical reasons, it is not really possible to move the materials to a place that can be accessed by other people. Finally, it is not really possible to share learning materials embedded in digital courses between institutions that use different virtual learning environments. As the number of teachers who use virtual learning environments is still rising, the number of 'locked-up' digital learning materials is going up. Thus the problem is getting bigger.

Solution

One solution for this problem is found in storing the digital learning materials in the form of learning objects in a repository *outside* the digital learning environment. Depending on the context, the repository can be accessed through the internet or through the network of the institution. Teachers can use learning objects either by copying them from the repository into the virtual learning environment, or by putting a link in the virtual learning environment to the learning object in the repository.

Teachers should be able to search the collection of learning objects looking for learning objects that fit their lessons. To enable efficient searching, learning objects should be supplied with metadata, i.e. indications such as title, subject, description, level, etcetera. By opening up materials in this way, they become available to others than the original developers. Yet, the developer/teacher him/herself can also benefit from putting the materials into a repository, as this enables easy re-use of old materials in new courses. Changes to the materials only have to be made only once, and then become available in every course that links to the materials in the repository.

An additional advantage of storing learning materials in a collection outside the virtual learning environment is that it will be easier for institutions to switch to another virtual learning environment. In any case, switching will not be impeded by the existence of large amounts of learning materials that are locked up into the virtual learning environment. At this moment, this is not an implausible scenario, as recently the costs for the use of several popular virtual learning environments have risen explosively.

An example of making available existing learning materials is the *LCMS Psychology*, which is described in section 1.

2.8 Contributing to the acquisition of information skills by making resources available

Problem

The knowledge economy creates new needs. The European Council has emphasised that the European educational and vocational training systems should be adapted to those needs. One of the three main components of this new approach should be the promotion of new basic skills, in particular in information technologies. (eLearning programme, 2003). The knowledge economy brings along with it the following new skills: people should be able to acquire digital skills; communicate using new media; search, find, use, and share information; compile, organise and synthesise information; draw conclusions and generalise; know where and how information can be found; learn on one's own; collaborate in groups; behave ethically (according to the Inspectorate of Education in the Netherlands, see Frissen et al., 2004). The E-learning notitie (2005) talks about 'the new network society', which asks for skills, knowledge and behaviour that are different from the past.

Solution

Working with learning objects can contribute to the acquisition of information skills, if students are requested to search for information in collections of learning objects. In this context the term 'information object' is a useful one. We use the term 'information object' in the case that the object has not been developed specifically for educational purpose, and has no learning goals, and is not passed through by students in attaining their learning goals. An information object contains 'isolated' information, which nevertheless can be very useful in education. In acquiring information skills, working with information objects can play a role. Out of the available information, students should be able to individually search, select and synthesise those information that is relevant to their learning goals of that moment. Collections of information objects can be used in this context. An example is the thesis bank of *Com2Know*, which is described in section 1.

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Appendix: Working with learning objects: points of attention

Each form of working with learning objects has its own requirements. To make the utilisation of learning objects a success, an institution will have to ensure that these requirements are met. From eight existing successful practices, several points of attention have been derived, which refer to the successive stages in the life of a learning object: learning object development; storing learning objects in a repository; making learning objects available to the users; using learning objects in actual teaching. The points of attention presented below do not enclose all thinkable requirements that could possibly be applied to learning objects. Yet they emerge from practice as being points of attention.

Development

- Start from a clear educational vision; this vision affects form and content of the learning objects, educational formats, the role of the teacher, and possible learning pathways in which students will engage with learning objects.
- Related to this: make clear to what extent there is consensus within the target group on the content and the curriculum of the discipline involved, and to what extent different views are found, for example cultural differences in an international setting.
- Work with distinct development teams.
- Make clear arrangements with the development team so as to arrive at a minimal, critical amount of materials.
- Materials should be developed by (content) experts. Give users and teachers a say in development.
- Give the experts freedom of action in determining structure and content of the learning objects

Storing / making available

- Make very strict arrangements concerning file formats, templates and delivery method.
- Separate development and storage. Developers/teachers should deliver materials to those who feed the materials into the repository using a format with which these people are familiar.
- Make materials available in such a way that they meet the technical and functional demands that are required by the target group.

Use

- Give institutions and teacher involved freedom of choice in using materials in their teaching.
- Make use of the learning objects obligatory for students, if sensible.
- Make clear arrangements on copyright.
- Be aware of costs after the project has finished, such as costs for using and maintaining software, costs for further development and costs for teacher and learner support.