Technological aids to the efficient Assessment of Prior Learning

Desirée Joosten – ten Brinke, Marcel Van der Klink, Wendy Kicken, & Peter B. Sloep
Open University of the Netherlands
PO box 2960
6401 DL Heerlen, the Netherlands.
Telephone +31 (0)45 5762 758
Fax +31 (0)45 5762 800

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Abstract
It is generally acknowledged that learning and education plays a prominent part throughout employees' careers across their entire lifespan. In our era of lifelong learning Assessment of Prior Learning (APL) is a powerful means for enhancing employees' further professional development and learning, formally and informally. Though there is a growing attention for APL, the procedures, design, development and maintenance of APL remain a quite costly and time-consuming experience. After a description of the background and features of APL, this chapter examines the possibilities for re-using and interoperability by means of e-technologies. The chapter discusses the major components of the APL procedure, including the current possibilities for exchange and operability (e.g. specifications of QTI, IMS). The chapter concludes with a description and validation of an educational model of assessment for APL

Introduction

At present, we are witnessing what according to some amounts to a digital revolution. Information and communication technologies intrude ever deeper in our society to the point that they have become inescapable (Sloep et al., 2008). Examples abound, ranging from online banking and shopping to the keeping of records of our medical histories or mobile phoning behaviour. This digital revolution can only continue to flourish if people possess the skills and knowledge to design, build, operate, maintain and, indeed, use the technologies that sustain this information society. According to De Haan and Van 't Hof (2006, p. 225, translated from the Dutch by the authors), while quoting a European study (EMCC, 2003): 'Technological innovations have brought new opportunities to communicate and collect data within reach of increasing numbers of people. It is to be expected that this trend will only become more intense and ever stronger influence our lives in a variety of ways'. This trend is often referred to as the arrival of the information society. However, in its connection also such terms as post-industrial society (Toffler, 1980), knowledge society (WRR, 2002), and networked society (Castells, 1996) are used.

Setting aside the nuances of the distinctions between them, three different undercurrents to this trend may be discerned. First, there is an increased need for more and deeper knowledge; second, the half-life of existing knowledge decreases; and third, as our society at large changes, we as its participants need to continuously adapt to it. These aspects can be directly translated into an equal number of challenges for society: How can we educate more people better? How can we educate people faster? How can education keep pace with the changing society? Meeting these challenges requires people to be educated not once in their lifetime, but throughout their life; and this applies to almost everyone. This means that educational programmes must be efficiently and effectively developed, tailoring the programme to the competences people already mastered through previous learning experiences. To tailor educational programmes, recognition of such prior experiences, however acquired, is important and the key to successfully meet the three challenges discussed.

In this chapter we will elaborate on this line of reasoning. To that end, we provide insight in the effects of the changing society on the needs of lifelong learners. We will also look into ways to meet these needs, particularly the re-use of educational materials for faster adaptation will be discussed. In this discussion, we include the current possibilities for exchange and operability by means of specifications like IMS ePortfolio and IMS QTI. First, the consequences of the transition towards an information society for learning and training on employees' competence development and, with that, on the importance of the recognition of prior learning are described. Second, we zoom in on procedures for the Assessment of Prior Learning and on the conditions that have to be met for assessment of prior learning to be a viable solution. Finally, as assessment of prior learning tends to be both expensive and time consuming, means are discussed to overcome this.

Trends and challenges

In this section we describe three trends that seriously impact many aspects of our contemporary society. A first trend is that the information society needs more knowledgeable people, meaning that more people than ever before should receive more education than ever before. All venues of life, all professions, and ever more countries have increasingly come to rely on the technological artefacts to run society. Many examples are available and here we present two of them. Some 40 years ago, cars were still predominantly mechanical appliances, nowadays they are a mixture of mechanics and electronics. Clearly, this requires a different expertise to design, build and maintain them, and even to drive them. The car mechanic now needs to understand the output of the computerised diagnosis system and the owner needs to be able to interpret the various messages shown by the car's display. Something similar applies to the medical profession. This profession has always been a profession that heavily relied on technology. However, with the advent of computers technology has invaded virtually all walks of a medical professional's life. This again means that multidisciplinary teams will research, devise and implement new systems to provide

diagnostic or therapeutic medical care. Consequently, technicians should be educated to operate the new equipment, physicians should know how to use it wisely, and patients should be able to understand how it affects them.

The consequences of the information society described for these two professions, apply widely. What is more, and this represents the second trend, is that it seems that the pace at which new knowledge is required increases. The pace at which existing knowledge becomes obsolete quickens. To some extent, the increased number of people who are involved in researching new technologies plays a part in this. However, the increase of obsolete knowledge seems to be mostly driven by the speed with which computer chips become faster: every 18 months their speed has doubled (Barnes, 2005; based on Moore's law (Moore, 1965). Faster chips are able to perform more calculations and thus take more complex decisions. Innovations that for some time were imaginable but not realisable, all of a sudden become feasible with the advent a new generation of chips. At the same pace at which computer chips increase their speed, the artefacts that use them can become more complex. The computers from the 80s were simply not fast enough to do in real time the calculations that a motor management system needs to adjust the fuel mixture that it injects into the engine to the changing demands that are made on the engine. Similarly, processing images consisting of several millions of pixels each 32 bits deep has been beyond the capacity of computer chips but for the most recent generations. The increased computing speed requires an update of knowledge about existing artefacts, roughly at the same pace. Parenthetically, the problem of knowledge obsolescence is especially grave for those whose job it is to maintain artefacts, those with a lower vocational education. As artefacts change, their knowledge may become fully obsolete and in need of complete replacement.

Regarding the third trend, society at large changes through the introduction of technology. Not only does set our changing society sets demands for more and deeper knowledge at an ever increasing speed, technology changes the very fabric of our society. It is a mistake to view technology from a functional perspective only, as aids that behave according to our commands and wishes, optional, as something one can choose to use or ignore. Technologies have a tendency to affect society beyond their intended usage. Technology changes our culture, as always it has and always will, where culture is understood to be the complex whole of knowledge, skills, beliefs, laws, values, habits, and preferences of the people that make up some society. The arrival of the steam engine dramatically changed society, as did the introduction of electricity and as now does the advent of the computer (Thurow, 1999, Steyaert & De Haan 2001). Although some elect to try and avoid sharing the blessings of modern artefacts, for instance the Amish in North America (Kraybill & Olshan 1994), for most people this is not an option. Indeed, many in so-called developing countries actively strive to attain the level of development that the information society affords. For this majority, the impact of technology transcends the instrumental functionality for which it was designed. For them, technology mediates between the human being and its environment and in doing so reveals latent, unintended uses of technology (Borgmann, 1984; Hickman, 1990). However, this kind of ease in dealing with technology, at the purely instrumental level but certainly at a supra-instrumental level, requires that people are sufficiently educated. And again, as artefacts become more complex and more numerous, education needs to respond to a digital divide between those who are conversant with technology and use it to enrich their lives and those who have no clue about it and are consequently left behind.

Therefore, the aspects that are brought about by these three trends will seriously influence learning and education in the 21st century. From a labour market perspective, the sketched transition towards an information society indeed increases its dynamics and upsets the content and security of occupations (Schmid, 1998). Lifetime employment within one company is replaced by the notion of employability throughout the career. Some knowledge and skills become obsolete and at the same time, large groups of employees will experience that their work requires continuous learning across the life-span. Whilst in the 20th century learning equalled formal learning offered by educational providers, learning in the 21st century will need to be increasingly characterised as informal and non-formal. Indeed, there is a growing recognition that formal learning represents only a minor fraction of all the human capital gathered.

Informal learning in various daily-job situations is at least an equally important source of learning (see for example the work of Tough (1979) and Lave & Wenger (1991)). Studies have shown that informal learning already has become the most important type of learning within organisations. Marsick (2006) estimated that 60-80% of the learning in today's workplace occurs informally. Canadian national surveys revealed that 82% of the employees considered themselves to be engaged in job-related informal learning with an average of six hours a week (Livingstone & Eichler, 2005).

However, such job-related learning does not suffice. Remaining attractive and employable in the 21st century requires that employees themselves must take responsibility for their own learning and career development, which, in turn, presupposes a high level of employee self-directedness. Unfortunately, there are several problems attached to the concept of the self-directed employee. Research shows that not all employees are willing or able to take up the responsibility to consciously steer their own learning and career. Employees differ strongly in their willingness and ability to utilise learning opportunities in their own work setting (Van der Heijden, Boon, Van der Klink, & Meys, 2009). This also applies to highly educated professionals (Raemdonck, 2006; Van der Klink, Schlusmans, & Boon, 2007).

If we really want employees to take charge of their own career and hence learning, we need to develop a (digital) learning infrastructure that supports them in this respect (Van Merriënboer, Kirschner, Paas, Sloep, & Caniëls, 2009). Recognition of prior learning will be a major cornerstone of such an infrastructure. After all, collecting, classifying and judging informal and non-formal learning will support employees in the process of making informed decisions about their future learning endeavours.

Assessment of Prior Learning
Assessment of prior learning (henceforth indicated as APL) supports lifelong learning by assessing and recognizing someone's competences obtained in informal and non-formal learning environments. It is a procedure that assesses competences independently of the attended learning path (Joosten-ten Brinke, 2008). In APL, it is important that learners make visible what they have learned in the past. To this end, they have to provide authentic evidence of their competences. In general, APL procedures consist of four phases, (1) candidate-profiling phase, (2) evidence gathering phase, (3) assessment phase and (4) recognition phase. These phases will be described in more detail hereafter based on the findings of various research projects,, like the dissertation of Joosten-ten Brinke (2008), and the research scans that were conducted by Van der Klink, De Bie, Evers and Walhout (2007) and Schlusmans, Joosten-ten Brinke and Van der Klink (2006), respectively. This section concludes with a table that provides a condensed summary of the main challenges and obstacles for successful APL procedures.

The candidate-profiling phase
In this phase, the institution gathers information about the candidate's personal characteristics and needs. The candidate gathers information about the steps, procedure's expectations, the standards, possible learning sources and possible outcomes of the APL procedure. The standards in APL are crucial. These basic competence profiles act as a mirror to the prior learning experiences. What prior learning matches with which part of the competence profile? Or the other way around, which competence profile fits best the candidate's prior learning? A basic self-assessment is mostly available for candidates to assess whether APL might be suitable or not. This suitability depends on the level and amount of prior learning, but also on the possible outcomes of an APL procedure. The outcomes may be identification and/or recognition of competences that can be used for entry into one of the stages of a formal educational programme (entrance, positioning or certification) or for further development in the labour market.

At the end of the first phase, the following must be clear for APL candidates: (1) the prior learning that is required described in terms of competences, knowledge and skills, (2) the possible outcomes, (3) the form in which evidence should be presented, (4) the assessment method and assessment standard, and (5) the support that is offered to candidates by the institution for self-assessment and portfolio construction. Personalised advice during the entire APL procedure and offering this advice face to face is time consuming (Kalz, Van Bruggen, Rusman, Giesbers, & Koper, 2007; Joosten-ten Brinke, 2008).

The evidence-gathering phase

In this phase, candidates collect and classify evidence about previous qualifications and experiences in order to support a claim for credit with respect to a specific competence profile. In this phase, a portfolio is used. The portfolio should be structured. Educational programmes within the same subset can use a similar structure. The structure of the portfolio should suit the candidate's prior informal and non-formal learning and the competences required by the institute (Baume & Yorke, 2002; Bjørnavold, 2001; McMullan et al., 2003). Therefore, an institute must be aware of the possible prior learning experiences a candidate will use and the evidence the candidate will present of his/her prior learning. In line with Livingstone's (2001) conclusion that the kinds of sources for prior learning are broad, but related to the study a candidate wants to start, Joosten-ten Brinke, Sluijsmans and Jochems (2009) recommend to inform candidates in the portfolio's template about the relevant sources. Also in this phase a self-assessment on the standard by the candidate is required. Self-assessment involves learners taking responsibility for monitoring and making judgments about aspects of their own learning. It requires learners to think critically about what they are learning, to identify appropriate standards of performance and to apply them to their own work. The results of the self-assessment, evidence and arguments are stored together into the portfolio.

A variety of difficulties are present in this phase. Candidates experience tremendous difficulties in their search of relevant and reliable evidence of their prior experiences. Quite often, they misunderstand the criteria about what is regarded as sound evidence. Support of candidates during the collecting evidence activities occurs in practice by mentors. Sometimes some preliminary checks are performed to inform the candidates whether the evidence is sufficient and appropriate. However, this is time consuming. In tracking the development of competences in learning networks, a large amount of competence information can be gathered from diverse sources and diverse types of sources, which is subject to uncertainty and unreliable (Miao, Sloep, Hummel, & Koper, 2008). There is often no one-to-one relation between items of evidence and a particular competence. In practice one item may be related to several competences. Storing these kinds of evidence in a paper-based portfolio causes often difficulties for candidates as well as for the assessors who need to judge the evidence. In most cases, candidates are required to indicate to what extend they already posses a particular competence by rating its level. Practice shows that many candidates have trouble in choosing the appropriate competence level, often resulting in overestimating their own mastery of competences. Advice (of mentors) and the presence of clear examples are interventions to support candidates during the process of classifying the evidence. There is also a strong need for some kind of 'organizer' that supports candidates in keeping overview of the pile of evidence.

The assessment phase

In this phase, assessors review the quality of candidate's evidence using assessment standards and rubrics. The assessment helps to establish whether the candidates have attained the standards and provide prescriptive feedback to assist candidates in reaching their goals. A combination of methods (simulations, knowledge tests, performance assessments, interviews) is used to assess evidence of prior learning (Fjortoft & Zgarrick, 2001). The most common instruments are portfolio assessment and a criterion based interview. Interview protocols, scoring rubrics and scoring forms are used for a valid and reliable assessment. The assessment results should be an answer to the question whether the candidate should gain recognition of prior learning.

Difficulties in this phase are abound. Not in all APL procedures there is a check on the candidate's portfolio before it is handed over to the assessors. This check assures that the portfolio meets all the criteria and prevents that costly assessors' time is spend on incomplete portfolios. Lack of clear and specified standards and rubrics hamper the assessment of the candidate's portfolio. In some cases, APL is performed by a single assessor instead of two or more assessors. This seriously harms the reliability of the outcomes of the procedures. Not in all procedures assessors were trained for their task as APL assessor. Time constraints diminish the possibilities for scheduling activities that require two or more assessors

performing assessment activities simultaneous. Though criterion-based interviews are very often used, this is not always the most appropriate instrument to assess a candidate's competency level. Simulations, demonstrations, on-the-job performance assessments are in many cases much more appropriate instruments.

Table 1. Challenges and supportive instruments for successful APL procedures

Stage of the procedure	Clarification of challenge	Supportive instruments
Candidate-profiling phase	- Need of personalised advice is time consuming	- Competence profile - Self-assessment instrument - Personal Development Plan - Website with APL information - Interactive FAQ-lists
Evidence gathering phase	- Difficulties with collecting appropriate evidence. - No check on portfolio - Very diverse evidence - The amount of evidence - Misinterpretation of competences and standards - Need for advice, clear examples and some kind of 'organizer'	- Support system for composing portfolio - Portfolio template (with good and bad examples) - Electronic seeking and presenting of analogous cases - Competence profile
Assessing the portfolio	- Lack of clear and specified standards and rubrics - Sometimes one in stead of two or more assessors - Lack of training assessors - Time constraints - Appropriateness of assessment instruments	- Rubrics and scoring forms - Interview protocol - Criteria overview - Database with jurisprudence on assessment results
Validation phase	- Lack of clear instructions to report the outcomes - Difficulties in describing competence levels - No national/sectoral agreement on format	- APL certificate - Dynamic overviews of recognisable programme elements

The validation phase
In this phase, the verification by the department responsible for awarding the assessment outcome takes place and will result in an APL certificate. The worthiness of this APL certificate varies in different contexts. Sometimes, the outcome is an overview of recognized competences, but in other contexts, the outcome is a general learning plan or specific credit points. At the end of this phase, the candidate's dossier has to be stored.

The interpretation of the results is a problem in this phase. Clear instructions on how to report the outcomes of the APL procedures into a certificate reduces its value. Educational providers experience difficulties in describing a candidate's competence level in a non-educational language, which decreases the use of the certificate for other than educational purposes. If there is no clear format agreed (on branch level or national level) upon how to describe the APL outcomes then the descriptions of candidates'

competency levels will vary significantly.

In designing and developing APL procedures, quality criteria, such as authenticity, meaningfulness, fairness and educational consequences are essential (for a full description of assessment quality criteria for competence assessment, see Baartman, 2008). The question is how to combine these quality requirements with the limited resources, like persons and time, that are usually available. After all, the development of reliable and valid assessments is time-consuming and expensive (Bélanger & Mount, 1998).

Table 1 summarizes the obstacles as they occur in the various stages of the process of APL. The table also describes the different instruments that support a particular phase of the APL procedure. As mentioned previously the research findings that we presented in this section are mainly applicable to APL procedures that are common in educational settings in which employees consider attendance of an educational track preceded by participating in an APL procedure in order to determine size and content of their study program. Reliable research findings related to other applications of APL procedures outside the educational domain are, to our knowledge, until now not available.

Challenges resulting from the design and implementation of APL

APL readily becomes a time-consuming and hence costly exercise. To avoid this, one had better re-use APL procedures once they have been developed. However, because of essential differences between procedures, not all aspects are re-usable. To find out which are and which are not, a further elaboration of these aspects is needed.

If we require that developers of APL procedures can exchange parts of these procedures in electronic form, using whatever software and hardware systems, Interoperability enters the scene. It comes in two flavours, syntactic and semantic interoperability. Syntactic interoperability is the capability of two or more software systems to exchange information and then act on it. Semantic interoperability builds on syntactic interoperability and guarantees that the information exchanged is actually used the way it is intended. As a result, different software systems may effectively provide the same service, in whole or in part, to the end-user. This way, parts of assessments, like the rubrics or the competence profiles, can be exchanged between developers. They all can edit, store and re-use them. In a computer-interpretable (machine-readable) form, this assessment information might be delivered to a candidate by a computer. The key issue here is to create and manage information in such a way that opportunities for exchange and re-use, either within or between institutions, are maximized (Miller, 2000). To reach such an ambitious goal a specification for exchangeability and interoperability of assessments is required. Generally speaking, a specification prescribes, in a complete, precise, and verifiable manner, the requirements, design, behaviour, or characteristics of a system (Beshears, 2003). One of the main benefits of a specification is that it offers a shared (controlled) vocabulary in which core concepts and ideas about a specific topic area can be expressed. Using open specifications means that the specification has many more people who look critically to another's work, resulting in a more stable, and ultimately more satisfactory result. Obviously, APL stands to profit immensely from the use of open specifications. A few specifications are available. Technologies can be used to improve the efficiency of APL at two levels: task level and process level. Software tools can help the user to perform tasks easier and quicker. For example, as described, management of cross-referenced evidences in a paper-based portfolio is difficult. A portfolio editor with a repository will make it easy to manage them. Process level support means that computerized mechanisms coordinate actions and exchange artefacts. Because of the well-structured process of APL support at process level seems easy. The difficulties are at task level and some problems can not be solved by technologies. In the following, we will successively describe the obstacles and hurdles to the task level in which competence profiles, self-assessment instruments, portfolio templates, interview protocols, rubrics and scoring forms and APL certificates play an important role. A good understanding of these instruments is necessary in order to understand what could and should be re-usable in the development of APL procedures. Hereby, we give the existing developments on interoperability improvement.

Competence profiles
A competence profile provides an overview of competences and skills in relation to a job profile. It describes the most relevant and important competences and skills an employee needs in order to adequately perform job related tasks and activities. In order to assess the candidate's prior learning, the evidences for prior learning needs to be compared to competence standards represented by competence profiles. The development of these competence profiles is a complex task. However, when fulfilled, the next step is to create an interface in which the competence profile is placed and can be used for the self-assessment. Figure 1 depicts a screenshot of an interface used by a web-tool to identify e-competences. Such an instrument can for example be used as input for development plans, as a communication tool about and clarification of visions and interpretations regarding required competences and the opportunities and threats (Stalmeier, 2006)
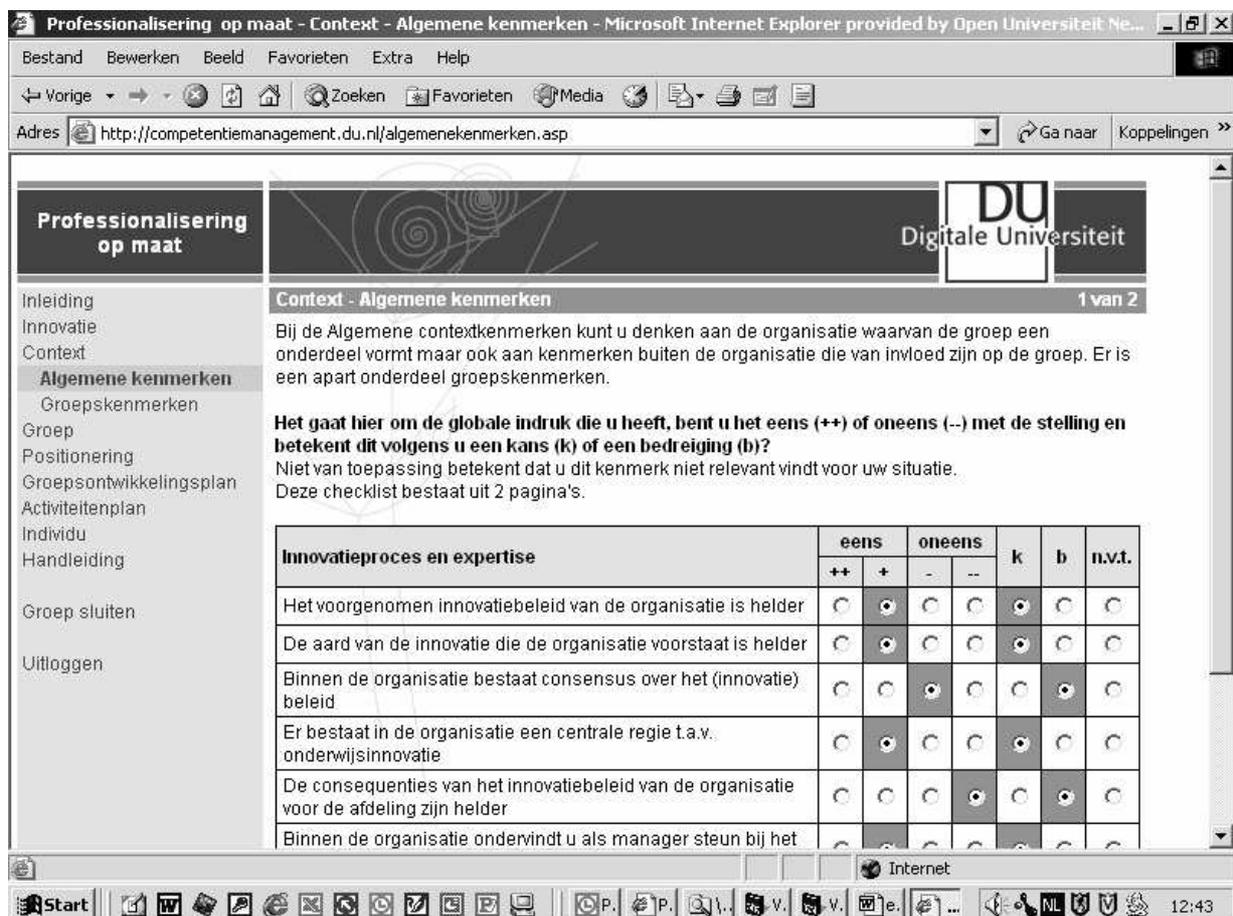
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Context - Algemene kenmerken   1 van 2

Bij de Algemene contextkenmerken kunt u denken aan de organisatie waarvan de groep een onderdeel vormt maar ook aan kenmerken buiten de organisatie die van invloed zijn op de groep. Er is een apart onderdeel groepskenmerken.

Het gaat hier om de globale indruk die u heeft, bent u het eens (++) of oneens (--) met de stelling en betekent dit volgens u een kans (k) of een bedreiging (b)?
Niet van toepassing betekent dat u dit kenmerk niet relevant vindt voor uw situatie.
Deze checklist bestaat uit 2 pagina's.

Innovatieproces en expertise	eens ++	eens +	oneens -	oneens --	k	b	n.v.t.
Het voorgenomen innovatiebeleid van de organisatie is helder	○	◉	○	○	◉	○	○
De aard van de innovatie die de organisatie voorstaat is helder	○	◉	○	○	◉	○	○
Binnen de organisatie bestaat consensus over het (innovatie) beleid	○	○	◉	○	○	◉	○
Er bestaat in de organisatie een centrale regie t.a.v. onderwijsinnovatie	○	◉	○	○	◉	○	○
De consequenties van het innovatiebeleid van de organisatie voor de afdeling zijn helder	○	○	○	◉	○	◉	○
Binnen de organisatie ondervindt u als manager steun bij het	○		○	○	◉	○	○

Internet

Start   12:43

Figure 1. Screenshot of a webtool to identify competences (from Stalmeier, 2006, p. 43)

One of the premises is that APL only can become successful if it is firmly grounded in a competence-based approach to learning. The advantage of a competence-based approach is that it allows describing the learning outcomes gathered through different learning settings (formal education, non-formal and informal learning). Van der Klink and Boon (2003) signalled that the competence-based approach is widely applied in various types of education as well as in companies' human resource management policies. Though the rise of competence-based approaches is evidently this does not imply that all approaches are based on a similar concept of competences. Van der Klink and Boon point at the confusion surrounding the concept

of competence, which is clearly illustrated in Table 2.

As this table shows notions on competences differ strongly which harm the exchangeability of competence profiles. For example, profiles applied in companies for performance assessments cannot be easily transferred into profiles for educational purposes. It goes without saying that the further attuning of the various competence profiles is not going to happen easily but at the same time this is a prerequisite for the ultimate success of APL. Especially for this reason, it is important to define competence profiles in such a way that others understand the meaning of the profiles. Different people may interpret the same competence of the same person at the same time differently. The question is, which interpretation is correct/reliable (Miao, Sloep, Hummel, & Koper, 2008). Metatags for competence profiles may support this understanding.

Table 2. Various perspectives on the concept of competences

Perspective	Position	Difference in definition
Geographic	USA	*Competency* refers to behaviour and personal traits that contribute to excellent performance
	UK	*Competence* refers to collectively agreed occupational standards such as national vocational qualifications
	Germany	*Kompetenz* refers to the capacity of a person to act. It is more holistic than *competency* or *competence*, comprising not only content or subject matter expertise but also more generic abilities
Field of application	Training and education	Competences are defined as clusters of skills, attitudes and knowledge that can be learned
	Selection and recruitment	Competences are perceived as partly trainable and as partly rather stable traits that are difficult to change.
	Performance assessment	Competences are mainly defined as the output of tasks and jobs
Underlying learning theory	Cognitivism	Emphasis on observable and measurable performance. Stronger focus on top-down development of competence-based systems
	Constructivism	Stresses values and beliefs as important components of competences. Stronger focus on employees' participation in the development of competence-based systems

To match the candidate's prior learning with a competence profile, a bottom-up or top-down approach can be taken. Bottom-up, the prior learning of the candidate is compared to and matched with a competence profile. Top-down, a competence profile is compared to the candidates' prior learning.
Technical specifications of interest in this context are the IMS Learner Information Profile specification (IMS LIP, 2001), the Human Resource-XML (HR-XML consortium, 2007) and IMS Reusable Definition of Competency or Educational Objective (IMS RDCEO, 2002). IMS LIP is of importance to declare the information of the learner in a population. HR-XML supports a variety of business processes related to human resource management. IMS RDCEO is developed to create common understandings of competencies.

Self-assessment instrument
Assessment of Prior Learning is not always useful or beneficial for all candidates. The level and amount of prior learning might not be relevant or sufficient to start an APL procedure, because the outcomes will not provide any benefits for the candidate's career choices and career development. To assess whether an APL procedure will be beneficial for a candidate, a webbased self-assessment instrument can be provided

to candidates who consider participating in an APL procedure. This self-assessment instrument (a) helps candidate to rapidly identify their competences, (b) compare these competences with competence profiles, and (c) decide on the usefulness of an APL procedure, given the outcomes of the self-assessment. The self-assessment instrument can be part of the PDP, but in APL it is often a separate instrument.

E-portfolio

After a candidate has decided to start APL, the evidence-gathering phase is initiated. In this phase, the candidates visualise their prior learning in an e-portfolio. The e-portfolio is one of the most common instruments in APL and is usually a database of collected evidence for competences. Examples of international initiatives that stress the important role of e-portfolio are EuroPortfolio (Eifel, 2009), which is a European consortium for the digital portfolio and Europass (Europass, 2009), an initiative of the European union to stimulate mobility and learning in Europe.

An e-portfolio is a collection of artefacts or evidence (e.g., documents, products) of attainment and achievement in formal, informal or non-formal learning contexts, reflecting the candidates' competence development. It is a synthesis of the personal, social and occupational experiences to highlight competences (Colardyn & Bjørnavold, 2004). In their portfolio, candidates collect and classify authentic evidence of their competences to support a claim for credit with respect to a specific competence profile. Whether the evidence is sufficient for this claim is decided in the assessment phase by the assessors. They decide whether the standards (i.e., the competence profiles) are achieved. The e-portfolio can contain any evidence the candidate can provide. In this way, the portfolio takes into account the individual differences between candidates and acknowledges informal and non-formal learning.

An e-portfolio has many advantages over a paper-based portfolio and is therefore highly recommended to make APL more efficient. The e-portfolio is virtual and can be accessed anytime from any place if it is a web-based portfolio, it is easy to maintain, edit and update (Heath, 2005), and evidence can easily be checked by cross references (Canada, 2002)

Portfolio template

The diversity of evidences in e-portfolios, makes the assessment of portfolios for APL a complex task for assessors. Moreover, the APL is influenced by the ability of candidates to construct a well structured e-portfolio with relevant artefacts and by the assessors' ability to objectively assess the competence level based on the content of the portfolio. The high competence level of a candidate might not stand out due to an ill-structured portfolio with badly selected artefacts or ill-developed ict-skills, or the assessor can be prone to base his assessment on subjective arguments. It is thus important that both the candidate and the assessor are supported in the use of an e-portfolio for APL (Kicken, 2008; McMullan et al., 2003). A portfolio template can support candidates to prepare their portfolio for the APL procedure. To support candidates in the construction of their e-portfolio and to structure the diversity of evidence in the portfolios for assessment purposes, candidates should be provided with a portfolio template. This template should guide candidates to (a) gather relevant evidence, (b) present the evidence in a structured self-explanatory manner, and (c) self-assess their competences based on the selected evidence and the competence profiles. By using hyperlinks the candidate is electronically guided through the template (see Figure 2 for an example of an interactive portfolio template. The use of hyperlinks in word-documents is a simple way to guide learners in their portfolio construction.
A more sophisticated way to guide learners through a portfolio might be the use of support systems. These systems use an interactive dialogue to compose the important information in the portfolio.
To gather relevant evidence, the template could provide a checklist of relevant contexts in which competences could have been developed by the candidate, including informal and non-formal learning contexts. For each context examples of relevant and irrelevant evidences should be provided to help the candidates select evidence in their situations. The template should also help candidates to present their evidence in such a way that an assessor understands directly how the evidence is related to and reflects the candidates' competence development. The portfolio template should prompt the candidate on what

additional information should be provided about the evidence. The template could contain short instructions telling the candidate what to write about the evidence. An existing example of such instruction is STARR, which instructs candidates how to describe their experiences in such a way that it becomes evident that this experience has contributed to the candidates' competence development. STARR asks candidates to describe the Situation, the Task(s) they performed in this situation, the Activities they undertook and the Result of these activities. Finally, they are asked to Reflect on this experience and explain how it has contributed to the development of their competences.

Competence description:
The candidate has profound insight in modelling of information systems and the context of use.

Self-assessment:
0 None (By choosing this option you continue automatically with the next competence)
0 A bit
0 Quite well
0 Very much
0 I don't know (read the subcriteria to get a better self-assessment

	Example evidence	Your evidence
Criteria 1 U are known with: - use case descriptions, - domainmodels, - communication diagrams, - class diagrams - …	**Example evidence** - een ontwerpdocument	**Your evidence**
Criteria 2 It seems that you: - are experienced with structured analyses methods, - are experienced with the transformation with a relational model to an object oriented model.	**Example evidence** - publication - projectdocumentation **Suitable evidence** Experience with Yourdon, CommonKads, Niam	**Your evidence**
Criteria 3		

[…]

Update your portfolio

Figure 2. Example of an interactive portfolio template

After helping them to present their evidence, the portfolio template should assist candidates to self-assess their competence level. This can be done by providing candidates with a comprehensive overview of the competence profiles and scoring rubrics. The competence profiles inform the candidates what level of competence is expected from them for specific occupations. The scoring rubrics help

candidates to judge to what extent they possess the required competences. In this self-assessment functionality of the portfolio, the candidate is provided with the same information the assessors are provided with. This makes the APL procedure more transparent, which has a positive influence on effective use of the portfolio by the candidates (Baume & Yorke, 2002; Black & Wiliam, 1998; Kicken, 2008; Stiggins, 2001). Beside a well developed portfolio template to help the candidates, several examples of both well structured and ill-structured portfolios are also effective in supporting candidates to develop their skills to prepare their portfolios for an APL procedure.

Another important issue regarding the use of an e-portfolio, is its compatibility across systems. Most of the e-portfolios do not reflect accepted open standards, and have no facilities for importing and exporting e-portfolio information conform accepted standards. To move e-portfolios between systems a specification for the re-use of portfolios is needed. There are a few Interoperability standards for e-portfolios available, such as IMS e-portfolio, LEAP2A, IMS-LIP and HR-XML8. These standards support the possibilities of portfolio assessment in a technical way. It enables exchange of portfolios from school to work or from organization to organization. It allows educators and institutions to better track competencies, it enhances the learning experience and improves employees' development. This will all be related to the portfolio as an artifact and not yet in relation to candidates in an assessment. The simplicity of the standard is key to its success, and to its ability to allow data to move between very different systems (Horner, 2009).

Relevant technologies
In addition to e-portfolios, a personal development planner or personal development portfolio could be used for the process of APL (Brouns & Firssova, 2008). In this type of portfolio the learner does not only reflect on his competences but uses the outcomes of this reflection to plan for personal, educational and career development. This takes the APL even one step further. A Personal Development Plan (PDP) is preferably a software tool by which people determine their progress on their own competence development. The software supports the user by gathering and sorting evidence and by (self-)assessing the level of mastery (Brouns & Firssova, 2008). Most of the times a PDP is not an instrument used within the APL procedure. However, the content of the PDP might be the basis for the self-assessment and after the APL procedure, the PDP can be used to record the results of APL and encourage learners to formulate new goals. Webbased PDPs have the possibility to share information with colleagues, tutors, executives or customers. An example of such a PDP is Personal Development Planner Web client V2.0 (Georgiev, 2009).

Scoring rubrics and scoring forms
The assessment phase of the APL procedure involves a complex task for assessors. Due to the diversity of evidence and descriptive, qualitative nature of the evidence, the assessment can be influence by the assessor's subjectivity, which negatively influences the reliability of the APL procedure. To increase reliability, assessors need to use scoring rubrics during the assessment phase. Providing assessors with scoring rubrics and scoring forms can support them in the assessment of the diverse portfolios. Scoring rubrics include one or more criteria on which performance (as presented by the evidence) is rated and a rating scale or levels for each criterion. Descriptors and examples are provided to illustrate the criteria. The levels of each criterion are illustrated by examples. The criteria and levels are derived from the competence profiles. Scoring rubrics and forms not only make the assessment more reliable and easier, but also increases its transparency.

A specific specification for rubrics is given by IMS Rubric (2004). The Rubric specification deals with the assessment of a portfolio, no other assessment types are addressed. In case documents in the portfolio have to be assessed, the use of Latent Semantic Analysis techniques may facilitate this process (Van Bruggen et al., 2004)

The interview protocol

The interview protocol is the leading scheme for the criterion-based interview with APL candidates that takes place after the portfolio assessment. A criterion-based interview aims at assessing a combination of skills, knowledge, behavior and personal qualities by means of questions related to specific examples of how the candidate behaved in different situations. This information is gathered and weighed against a criterion. The basic information for assessors for this interview is the portfolio. Assessors should be trained because the interview involves several complex aspects. The assessor has to interpret the portfolio in a correct way before the start of the interview. During the interview, the assessor has to manage the time and has to evaluate constantly whether he or she gets all the information necessary for the competence assessment of the candidate. In this phase, the use of standard evaluation questions that steer the interview into the desired direction is desirable. These kinds of protocols can be re-used by colleague assessors.

APL certificate
Finally, the results of the assessment (i.e. the candidate's competence level), has to be described in a non-educational language, which increases the use of the certificate for other than educational purposes. Agreements upon the format used for APL certificates will enhance its societal acceptance, value and applications.

The development of thorough e-instruments for APL is a good step in the direction of reuse. However, it is important to have a digital learning infrastructure in which these instruments are easy to use in combination with each other. In line with the reasoning on steps to be taken after the process of APL, the e-infrastructure is the basis to transfer the outcomes of the APL.

Promising perspectives
In this section, two promising perspectives will be presented.
In the description above, specifications for Interoperability are given for different instruments. All these specifications are specified for a single component of the whole procedure. The leading specification for the exchange and interoperability of entire assessments is the Question & Test Interoperability specification (IMS QTI, 2004). One of the core concepts of this model is the assessment structure model that defines Assessment, Section and Item layers. The QTI specification includes a set of XML bindings to describe questions and tests. It does so by (a) providing a well documented content format for storing items independent of the authoring tool used to create them; (b) supporting the deployment of items and item banks across a wide range of learning and assessment delivery systems, and (c) providing systems with the ability to report results in a consistent manner (Joosten-ten Brinke, Gorissen & Latour, 2004). The primary goal of this specification is to enable the exchange of questions (called 'Items') and tests (called 'assessments') between Learning Management Systems. QTI supports different types of questions and it is split up in two parts, the content of the evaluation part and the results from the evaluation part. Both parts can be used separately or together. The QTI specification is more or less limited to those assessment types for which an unambiguous definition in technical terms can be specified. Interoperability is limited to classical multiple choice items and their variations (Gorissen, 2003). The structure of multiple choice items proved to be well-suited for storage in item bank systems and delivery in digital format as the structure was not complex. The QTI specification offers good opportunities for exchange of items in standardized assessments. Though IMS QTI can be regarded as the leading specification for the exchange and interoperability of assessments, the question remains to what extend this specification adequately supports emerging new and complex assessment forms like APL. Miao et al (in press) argue that QTI does not posses sufficient expressiveness, since it only addresses the task aspects of APL, but does ignore process-oriented aspects such as who performs what kinds of assessment activities in what sequence. Thus QTI can not independently support APL. However, as Miao et al (in press) propose, combining QTI and IMS Learning Design (LD) seems to increase significantly the level of expressiveness to represent complex assessment forms, but even then, serious issues need to be addressed. Apart from technical issues

there is the issue of the user-friendliness, since average teachers are not able to model their teaching and assessments with QTI and LD; they need a high-level assessment modelling language that can be transformed into an executable model represented in LD and QTI.

One way out of this dilemma is to design assessments in such a way that they can be shared amongst assessment developers and re-used in other contexts (Williamson, Bauer, Mislevy & Behrens, 2003). A model for re-use in assessment is the educational model for assessment (Joosten-ten Brinke, Van Bruggen, Hermans, Burgers, Giesbers, Koper, & Latour, 2007). This model gives the opportunity to understand others' assessments by using the same concepts of assessment and to exchange parts of an assessment. The educational model for assessment is built on several sub models, each fit to the following stages in the assessment process: assessment design, item construction, assessment construction, assessment run, response rating and decision-making. In Figure 3, the model for the assessment design part is given as an example. For the entire educational model for assessment, we refer to Joosten-ten Brinke et al. (2007).
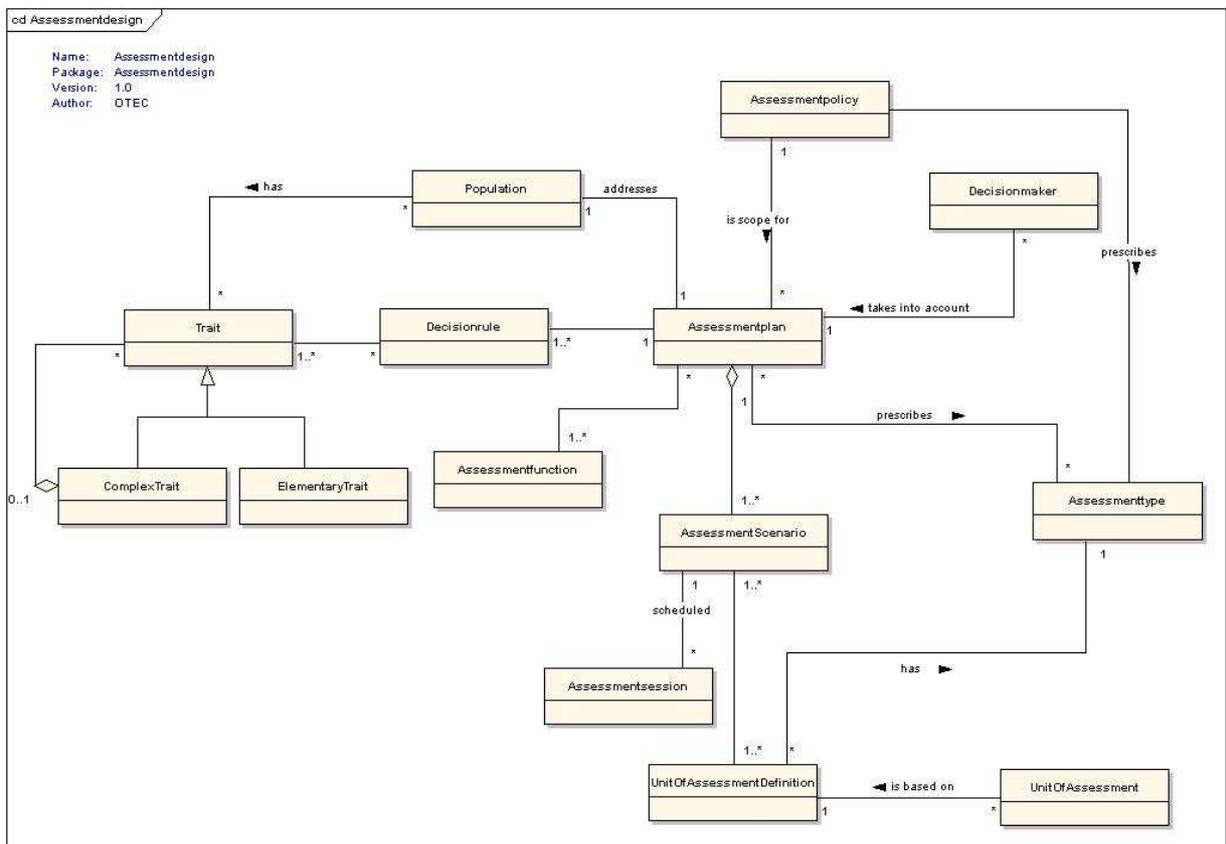

Figure 3. UML class diagram for the assessment design

The educational model of assessment is cast in terms of UML class diagrams (the UML classes are the squares and the lines indicate the type of relation between the UML classes) and complies with the requirements of a complete conceptual model as defined by Koper and Van Es (2003):
- Flexibility: The assessment model must be able to describe assessments that are based on different theories and models.
- Formalization: The assessment model must be able to describe assessments and their processes in a formal way, in order to be machine-readable and to enable automatic processing.
- Reusability: The assessment model must make it possible to identify, isolate, de-contextualize and

exchange useful objects (e.g. items, assessment units, competencies, assessment plans), and to reuse these in other contexts.

- Interoperability and sustainability: Separation between the description standards and interpretation technique, thus becoming resistant to technical changes and conversion problems.
- Completeness: The assessment model must cover the whole assessment process, including all the typed objects, the relationship between the objects and the workflow.
- Reproducibility: The assessment model must describe assessments so that repeated execution is possible.

The question is whether this educational model for assessment is a sufficient solution to alleviate the burden of following the entire workflow of APL. In case of APL, does the model fit the above-mentioned requirements? Therefore, the educational model for assessment is validated for APL. For this purpose, use cases and scenarios are used. In Table 3 one of the scenarios is given. The corresponding concepts of the assessment model are placed in italics between brackets.
Based on this validation, we conclude that the model fits APL.

Support system for learners in learning networks
It goes without saying that institutes like to offer personalized learning arrangements to the candidates that finished their APL procedure. However, composing personalized learning arrangements is a time-consuming process for which Kalz (2009) has proposed a technological solution that reduces time and costs and even improves the quality of APL. His technical solution consists of a web-service for lifelong learning that pre-analyses documents and consequently assists in deciding the relevancy of these documents for the further course of the APL procedure. Katz applied Latent Semantic Analyses (LSA), which is a method for extracting and representing the contextual-usage meaning of words by statistical computations. The technologies Kalz developed appear to be very promising and therefore should be further developed in future research.

Table 3. Scenario for APL

Actor	APL candidate
Pre condition	Assessment policy is available in the system. Standards for APL are nationally established for formal educational programs in the vocational domain. On the labour market, standards are available for some professions, like assistant professor or management assistant, and for some general competences, like presenting or organizational sensitivity. These standards are the basic assumption for an APL procedure (*assessment policy*).
Scenario description	1. APL candidate (*candidate*) assumes having competences in domain of management. 2. APL candidate selects in the system the domain and searches for the standards for management *(trait)*. 3. System delivers standards (*trait*) with lower level standards (*complex trait)* and indicators for these lower level standards (*elementary trait*). 4. APL candidate starts self-assessment for these standards (according to *assessment plan*) 5. System delivers e-portfolio template after the self-assessment. 6. APL candidate has to provide evidence with argumentation (*item*; *demonstration item*) in portfolio template. 7. APL candidate uploads portfolio.
Post condition	Portfolio template and self assessment are stored and send to assessors.

Conclusion

In the contemporary information society people are best seen as lifelong learners. However, if we want people to act as lifelong learners then we need to assure that there is an e- infrastructure to support their learning endeavours. This learning infrastructure does not only offer more, better and faster education, but most importantly should fit people's learning needs. One of the key components of this emerging learning infrastructure consists of people's recognition of their prior learning, since it will shorten their education tracks and will motivate them throughout their learning life-histories. Assessment of Prior Learning (APL) however is time-consuming and expensive.

In this chapter we have described the workflow of APL and the instruments needed in this procedure. We also explained how re-use of these instruments can contribute to decreasing the expensiveness of the development of APL. Re-using seems to be possible for existing instruments such as competence profiles, e-portfolios, and rubrics specifications. The educational model for assessment seems to be a promising approach that will increase the efficiency and effectiveness of APL procedures. However, further elaboration on this model resulting into more advanced metadata for general descriptions of the objects is definitely needed.

Considering the question of technical solutions from a more aggregated level result into at least two challenges that need to be considered in the development of effective APL (see for a more comprehensive discussion Miao et al, 2009). First, APL allows the storing of various information from different sources and different types of sources in a candidate's e-portfolio. It is likely that information fusion technologies may support the (human) assessors in their task of accurately assessing one's portfolio. Second, if we want to support candidates in the process of matching their own prior learning to one or more competence profiles then the application of spatial index and browsing structures together with visualization of competence information objects need to be seriously considered. These techniques provide accessible information that make explicitly clear how one's personal competency profile match to a profile applied in an APL procedure, which will definitely support candidates in making informed decisions on enrolment in APL procedures.

Unfortunately, although some technical solutions are available, the absence of generally accepted competence profiles inhibits the exchange and re-use of some of the main APL instruments. If educational institutes and associations like federations of employers and unions are not able to adjust competence profiles to one another, the issue of maximizing Interoperability becomes an insurmountable problem. Nevertheless, with the educational model for assessment, we are one step closer to fulfil our life long learners' needs.

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