iSELF: an Internet-Tool for Self-Evaluation and Learner Feedback

N.C.M. Theunissen & H.E. Stubbé
Dep. Training Innovations, TNO, Soesterberg, The Netherlands
nicolet@ntheunissen.nl
hester.stubbe@tno.nl

Abstract: This paper describes the development of the iSELF: an Internet-tool for Self-Evaluation and Learner Feedback to stimulate self-directed learning in ubiquitous learning environments. In ubiquitous learning, learners follow their own trails of interest, scaffolded by coaches, peers and tools for thinking and learning. Ubiquitous learning solutions include on- and off-line, formal and informal learning. To benefit from its possibilities, learners need to develop competencies for self-directed learning. To do so, a self-evaluation tool can help the learner to get insight in his/her own development, to manage and monitor his/her own learning process, to collaborate in learning, to relate the learning to 'real life' needs, and to take control over educational decisions.
The iSELF is developed in an iterative process in three phases, complying to the following high level requirements: (1) Enabling learning anytime, anywhere; (2) Supporting self-directed learning; (3) Evaluating learner, learning solutions and job-needs; (4) Assessing learner competencies; (5) Using card-sort method for questionnaires; (6) Facilitating questionnaires 'under construction'; and (7) User-friendly design. The resulting online tool contained a card-sort module, looking somewhat like a 'solitaire' game, a profile module to evaluate core competencies, and a feedback module to suggest learning possibilities in a ubiquitous learning environment.
The iSELF was developed to be not only a learner tool but a scientific tool as well. Using the tool, two self-evaluation questionnaires were developed and psychometrically tested: competencies for multidisciplinary cooperation in a Network Centric Organization and self-directed learning competencies. They are used in various populations: e.g. students, employees from small and medium enterprises, crisis management organizations, and the military. Usefulness and usability of the self-evaluation tool were valued positively. It contributes to an adaptive ubiquitous learning environment in which the learner can make the educational decisions according to self-directed learning principles. The iSELF will stimulate self-directed learning in a ubiquitous learning environment and will help to create learners for life.

Keywords: self-evaluation, self-assessment, internet-tool, ubiquitous learning, self-directed learning, feedback.

1.   Introduction

1.1   Ubiquitous learning needs self-directed learners

Technology is very much part of everyday life and work. Information and knowledge is handled and shared by using ubiquitous technology; ICT that makes it possible to access information 'anytime, anywhere' (Adkins et al. 2002). A learning environment that makes use of this technology is often referred to as 'ubiquitous learning'. This is a way of learning in which learners follow their own trails of interest, scaffolded by coaches, peers and tools for thinking and learning (Dieterle & Dede 2007). Ubiquitous learning solutions include on- and off-line, formal and informal learning.

The availability of ubiquitous learning possibilities might assume that learners are able to learn and will develop themselves anytime, anywhere (Chen, Chang, & Wang 2008). However, this assumption might be too ambitious. Since the ability to manage one's own learning is becoming increasingly important, one of the goals of education should be to create learners for life (Du Bois & Staley 1997). Learners for life can be described as learners who have a flexible and pro-active attitude toward learning and developing themselves. In this context the concept of self-directed learning is often mentioned and intensively discussed (Collins 2004). In a review study of Stubbé &Theunissen (2008), five crucial elements of self-directed learning were identified:

1. *Learner control:* Control over educational decisions and learning process.
2. *Self-regulating learning strategies:* Skills that support the learner to manage and monitor his/her own learning process (e.g. setting goals, planning, problem solving, and strategy use).
3. *Reflection:* The combination of self-assessment and self-evaluation on both the performance and the learning process that gives the learner insight in his/her own development.
4. *Interaction with the social environment:* The interaction with others, learners and teachers/coaches, in order to determine what goal should be set, discuss in what way this goal can be achieved, cooperate and collaborate during the learning process and ask for help.
5. *Interaction with the physical environment:* The learning experience should be set in the 'real world' and should relate to 'real-life' (work)situations.

Reality shows that some people develop a self-directed attitude toward learning, especially in relation to work or a hobby, others do not (Collins 2004). Explicitly teaching self-regulating learning strategies or reflection and stimulating (perceived) learner control, helps learners to become more self-directed (Stubbé & Theunissen 2008). Therefore, a ubiquitous learning system must not only provide the learner with learning resources anytime and anyplace. It must also actively provide the learner with the appropriate learning assistance for self-directed learning (Hiemstra 2006;Wang & Wu 2011).

To become a self-directed learner, one should get insight in one's own development. A self-evaluation instrument might be helpful. Self-evaluation (also named 'self-monitoring' or 'self-assessment') refers to an individual's systematically observing his/her own behaviour and performance. The learner makes a comparison between the noted behaviour and some designated standard. Although self-evaluation presumes higher order cognitive skills, it is proven to be possible even in populations of people with mild cognitive retardation (Hughes, Korinek, & Gorman 1991). Self-reports have their limitations, but there are indications that self-reported abilities and competencies have some concurrent validity (Kelso, Holland, & Gottfredson 1977). Above that, 'People may not be right about themselves, but their self-evaluations are the ones that most powerfully affect their future behaviour' (page 45, (Byrnes 1984). As a result, self-evaluations are relevant for learner behaviour. However, peer or expert observation can help learners to evaluate their own opinion about themselves.
Thus, self-evaluation will help the learner to get insight in his/her own development, to manage and monitor his/her own learning process, to collaborate in learning, to relate the learning to 'real life' (work)needs, and to take control over educational decisions. In this way, all five elements of self-directed learning, mentioned before, will be stimulated.

1.2   Assessment of competencies

For the question: 'What to evaluate?' we specifically look at the fifth element of self-directed learning: *Interaction with the physical environment.* Learning needs to be related to 'real-life' (work)situations. In our rapidly changing society, initial training alone cannot meet the need for the development of working individuals. Training results become obsolete the moment they are obtained. A flexible and innovative economy requires permanent adaptations of knowledge, skills and attitudes, also called 'competencies'. Competencies are indivisible clusters of skills, knowledge, conduct, attributes and notions. They are context dependent, connected to activities and tasks, but also flexible in time (van Merriënboer, van der Klink, & Hendriks 2002). In their essence, competencies can be used in more situations than the current task. This means that when one's job changes, the acquired specific skills become obsolete, but the acquired competencies can still be useful. Nevertheless, in our fast changing society it is possible that competencies themselves become obsolete or less important.
Another characteristic of competencies is that they can be acquired by learning and development. Competencies can be valuable to match individual performance and career planning with organizational job needs (Whan Marko & Savickas 1998). In that context the concept 'core competencies' is used, competencies which are essential for certain tasks or positions (Case 2003) and as such will provide the content for the relationship with 'real-life' work situations.

Reporting on one's behaviour poses a difficult cognitive task and participants' reports are influenced by question wording, format, and content (Schwarz & Oyserman 2001). A self-evaluation instrument in a ubiquitous learning environment needs an easy to use, reliable method to gather information on selected competencies. A card-sort method is such a method, with good psychometric characteristics (Lievens & Sanchez 2007). Card-sorts involve the placement of cards onto piles, based on how each participant feels the concepts or statements on them are related. When using this method for evaluation of competencies, competency statements can be placed on the cards. Former research

with this technique showed that people are able to sort a large number of separate cards in a relatively short time (Caldwell & O'Reilly 1990), which will increase learners' motivation to use it for evaluation. The technique is particularly useful for identifying the common ground between a larger and diverse collection of competencies with a large and diverse group of participants (Caldwell et al. 1990).

There are two approaches in card-sort: the free and the restricted procedure (Harper, Jentsch, Berry, Lau, Bowers, & Salas 2003). In the free sort, a participant is allowed to make as many piles of related cards as necessary, and label them. In the restricted sort, a participant uses piles that are already defined (e.g. questionnaire Likert scales like 'not applicable at all' to 'totally applicable'). This enables the use of statistical techniques to cluster related competency statements into core competencies. The restricted card-sort relies less on the categorization skills of the participants. This makes it useful for a sample with various levels of education and experience, as is the case in a ubiquitous learning environment. Moreover, a standardized categorization makes it possible to make learner profiles that can be related to peers and that can show development over time. The same categorization can also be used to evaluate job-needs or the available learning solutions. An automatic match of the learner profiles with the learning solution profiles will show if they are beneficial to the learner. The results should be presented as suggestions so that the learner can make the educational decisions according to self-directed learning principles.

The aim of this paper is to describe the development of the iSELF: an Internet-tool for Self-Evaluation and Learner Feedback to stimulate self-directed learning in a ubiquitous learning environment. The characteristics of the iSELF and the first experiences, based on the developments so far, will be discussed.

2.   The iSELF itself

2.1   High level requirements

With the introduction text in mind, a set of requirements was developed for the iSELF:

1. *Enabling learning anytime, anywhere:* available for every learner through internet, with the possibility to embed the tool into Learning Management Systems.
2. *Supporting self-directed learning:* helping the learner to get insight in his/her own development, to manage and monitor his/her own learning process, to collaborate in learning, to relate the learning to 'real life' (work)needs, and to take control over educational decisions. To support control and to provide a 'safe' learning environment, it is important that the learner is the only one who can see personal evaluation results, until he/she decides otherwise.
3. *Evaluating learner, learning solutions and job-needs:* possibility of using the same content: (a) to score the learner competencies of all kinds of learners (e.g. low and high educated), (b) to assess the learner competencies by the learners themselves or by peers, colleagues, coaches or subject matter experts, invited by the learner, (c) to score which competencies are trained by certain learning solutions or are relevant for a job or position. Using the same content in all situations enables a comparison between them.
4. *Assessing learner competencies:* assessing competencies that are specific for a group of learners in their (work)situations, and at the same time generic enough to remain relevant in our rapidly changing society.
5. *Using card-sort method for questionnaires:* this technique is less time-consuming and more objective than other methods. This will increase motivation to use it in a large and diverse group of participants.
6. *Facilitating questionnaires 'under construction':* with new developments in the workplace, new competencies will become important. Therefore, new questionnaires will be developed all the time.
7. *User-friendly design:* most people do not like questionnaires. A playful appearance, user-friendly operation and clear, relevant content will increase motivation.

2.2   Design

The overall structure of the iSELF is presented in Figure 1 and explained in the next paragraphs.
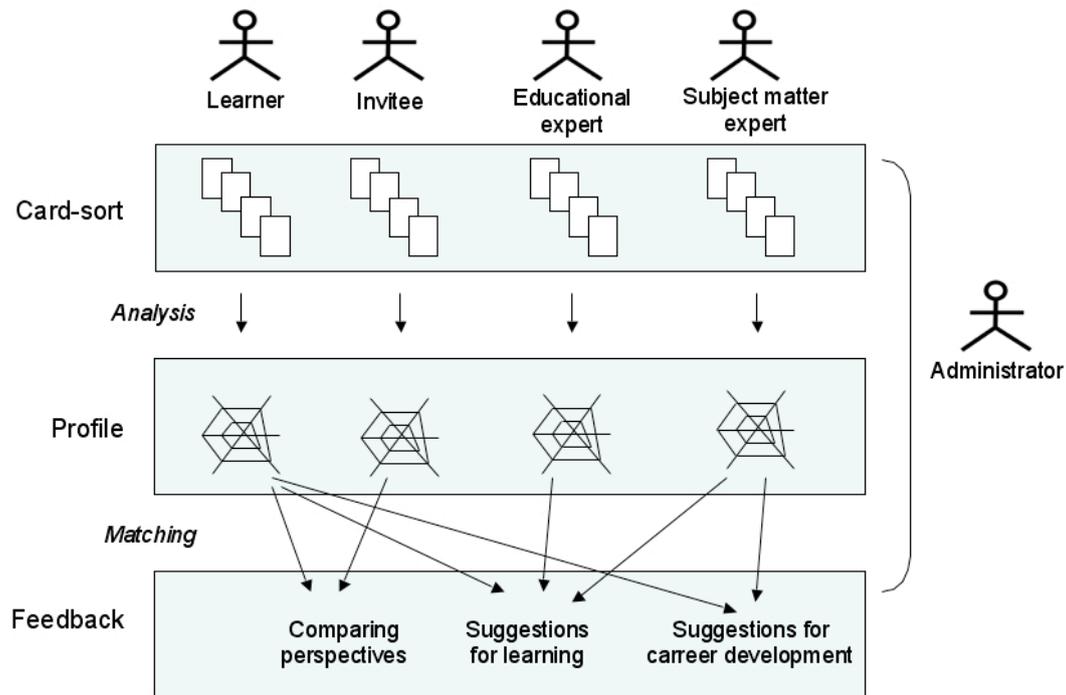
Figure 1: Overall structure

2.2.1   Users

The overall structure includes the following iSELF users:
1. *Learner*: the learner in a ubiquitous learning environment.
2. *Invitees:* peers, colleagues, coaches or subject matter experts, invited by the learner to assess the learner.
3. *Educational expert:* the evaluator of available learning solutions.
4. *Subject matter expert:* the evaluator of competency requirements for a job or position.
5. *Administrator:* administrates the tool content: competency statements, information about core competence clusters and reference group- or norm figures.

2.2.2   Card-sort

The appearance of the card-sort tool, a front-end input module, is somewhat like a 'solitaire' game (see Figure 2). Instead of sorting playing cards, learners sort competency statement cards on their importance. The tool offers the possibility to get an overview or skip a statement temporarily.
The competency statements are formulated in such a way that they are easy to comprehend for people with different backgrounds. A second person singular verb at the beginning of every statement emphasises the fact that competencies express themselves in behaviour (E.g. 'Cooperates with people from other organizations' or 'Uses ICT systems to collect information and knowledge quickly'.) These statements can be used with different overall opening questions. For the learner the opening question could be: 'In the last two weeks, was this applicable to you?' For the invitee it would be: 'In the last two weeks, was this applicable to [name learner]?' For the use with the learning solutions of job-requirements: 'Is this applicable to [name learning solutions or job]?' The card-sort module was built using Adobe Flex, an open source framework for building rich Internet applications that are delivered via the Flash Player 6.0.

Figure 2: Card-sort module in input mode

2.2.3   Profiles

The profile module shows the results of the card-sort input to the learner. After analyses, the competency statements are clustered into core competencies. The results are presented to the learner in one or more graphs. It can show learner results in combination with reference scores or scores from former sessions. The profile module was built using ColdFusion 8.0, a rapid application development platform that includes advanced features for enterprise integration and enables the development of rich Internet applications.
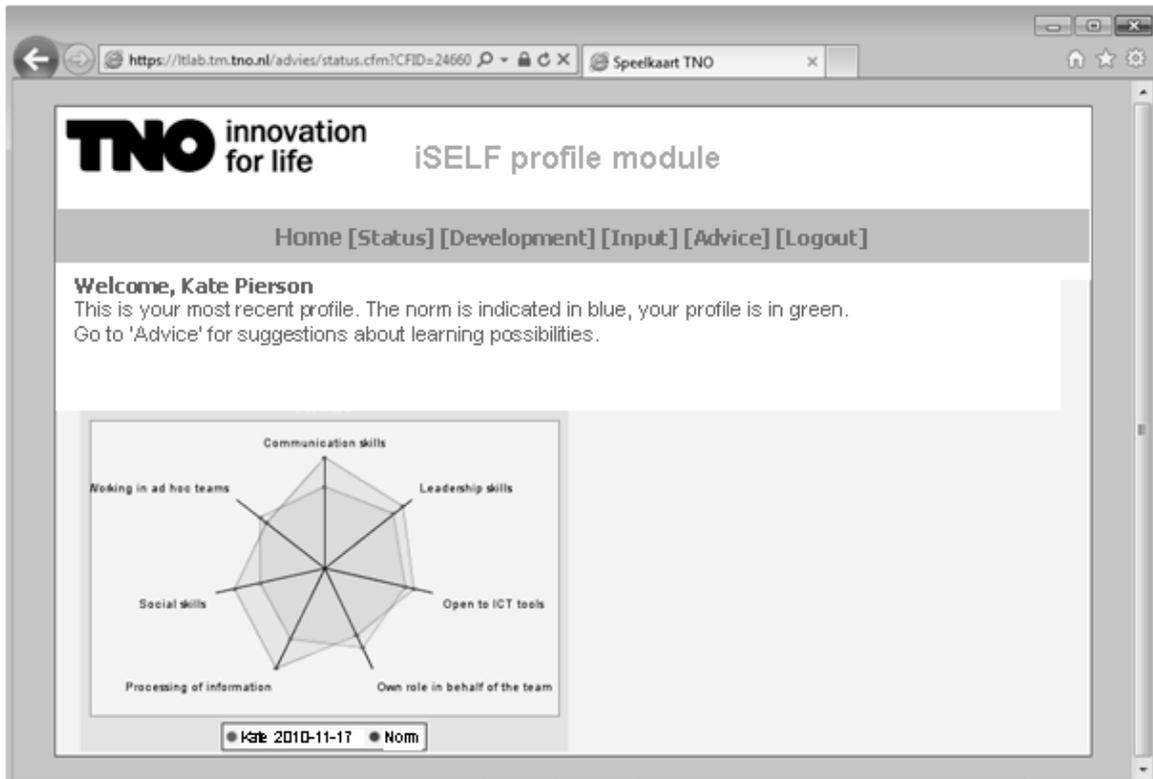
Figure 3: A learner profile

2.2.4 Feedback: suggestions for further learning

The feedback module can be used to compare perspectives by interpreting the results of both the learner and the invitee. The feedback can also be used to provide suggestion for learning solutions beneficial to the learner or for job-training and selection. The feedback is based on an automatic match of the learner scores with the learning solution scores. The feedback module was built using ColdFusion 8.0.

2.2.3 Administration

The administration module, a back-end module, combines several input functions: overall opening question, statements, number and content of answering categories, assignment of statements to clusters, personal accounts, data export, reference or norm score input. The module was built using ColdFusion 8.0 running Railo Server, the main version of Railo (a compiler) which can be integrated into standard web servers. It is suitable for production use.
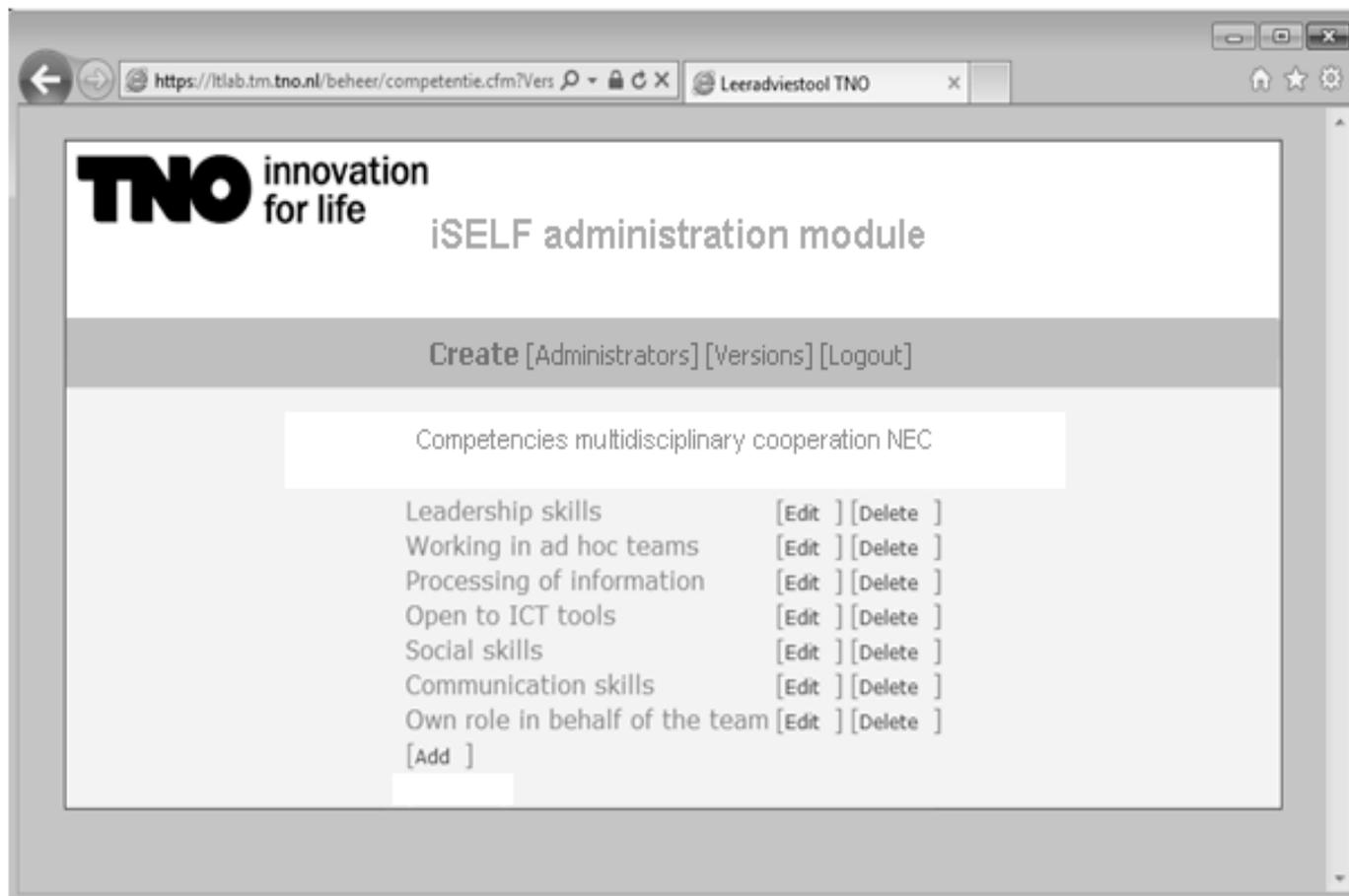
Figure 4: Administration of competencies

2.2.4   Content: psychometric sound questionnaire

The content of the iSELF card sort module is created according to social sciences standards in questionnaire construction (Schwarz et al. 01). At any moment in the development of the questionnaire it is possible to export the data for statistical analyses for validation and reliability tests. Using a.o. principal component analysis and Cronbach's alphas, clusters can be identified and transformed into scale scores. The results from these analyses can be fed back through the administration module. The data export option can also be used to perform additional statistical analyses for group comparisons and determination of the influence of background variables like age or experience. These possibilities make the iSELF not only a learner tool but a scientific tool as well.

3.   The iSELF: development in phases

The development of the iSELF was an iterative process in which the modules (card-sort, profile and feedback) were prototyped, built and tried successively. Experiences were gathered using many different studies. More information about these studies can be obtained from the authors.

3.1   Phase 0: Prototyping with a paper card-sort tool

3.1.1   The paper-based iSELF

In this paper-based version, the iSELF only contained the card-sort module. The selected competence statements were placed on a set of individual paper cards. Together with this set of cards came five envelopes with the labels 'not important', 'somewhat important', 'important', 'very important' and 'essential'. A participant could express the importance of a competency statement for a position by assigning cards to envelopes. In this way, a 5-point Likert-scale was created for each statement.

3.1.2 Context

The paper-based prototype was used for career planning using core competencies in a study group consisting of four different training-related functions in the Army. Semi-structured interviews and a document study resulted in 65 cards with competency statements. Subject matter experts sorted the cards twice for their own function: on expert and on novice level. In a group discussion both the method and the content of the cards was discussed. Using principal component analysis, five core competencies could be identified and a career path differentiation was recommended.

3.1.3 Experiences

The participant sorted the large set of statements cards quickly: each round of 65 cards took about 5 to 15 minutes. Most participants were positive about the procedure and preferred it to a standard questionnaire. The card-sort module was considered useful.

3.2 Phase 1: Learner-profiling

3.2.2 The iSELF alpha version

This version contained an internet based card-sort module and a half-automatic prototype of the profile module. The card-sort module was transformed in an online version like a 'solitaire' web-game. The prototype profile module used MS Excel to produce a graph and MS Word for handmade individual reports.

3.2.1 Context

The alpha version was tested in two steps: in ten studies the card-sort module was tried-out and in two studies the profile module was added and presented to the learners.
First, two different self-evaluation questionnaires were developed and psychometrically tested: (1) Competencies for multidisciplinary cooperation in a Network Centric Organization and (2) Self-directed learning competencies. These questionnaires were tested in several studies with the following populations: e.g. students, employees from various small and medium enterprises, crisis management organizations (fire department, police force, medics), and the military. The iSELF was presented to the participant from within a learning management system (ILIAS, MOODLE) or with a hyperlink in an email. The data-output of the card-sort module was used to identify core competencies using statistical package SPSS.
Next, two of these groups received a personal profile about their Self-directed learning competencies. A group of Navy personnel received a profile after a pre-post-test intervention study. The profile showed the individual results on three points of measurement and the overall average scores of the whole group. Afterwards they were interviewed. The other group, studying Public Management, received a profile that was discussed with them to influence their learning style.

3.2.3 Experiences

The card-sort module of the iSELF alpha version was used successfully: the technique worked, questionnaires could be validated and the participants valued the module positively. The profile prototype was evaluated as useful in the communication with the participant.

3.3 Phase 2: Prototyping the match of learner profiles with learning solutions profiles

3.3.1 The iSELF beta version

This version contained the complete iSELF. Although complete, it is a beta version because not all functions were fully tested.

3.3.2 Context

The beta version was tested in two steps: First, the profile and feedback modules were used as an addition to a 'classic' online-questionnaire embedded in MOODLE. It was developed for self-assessment and invitee-assessment of leadership competencies in employees from the Air Force. The suggestions that the participants received from the feedback module included formal (training, e-learning) and informal learning possibilities (e.g. documents, discussion, movies). The employees could choose to use the iSELF or not and could invite others to assess them if they wished. The next step was a usability pilot with the complete iSELF that was carried out with employees from crisis management organizations. Afterwards participants were interviewed about their evaluations.

3.3.3 Experiences

In the Air Force case, using the iSELF was voluntary. Many employees did use it and their numbers are still increasing. In the usability pilot, participants were enthusiastic about the iSELF. One of the conclusions was that matching the learner profile with learning possibilities saves time and will improve adaptation of the learning environment to the learner. These experiences indicate that the tool is usable and useful.

4.   Discussion and conclusions

This paper describes the iterative development, testing and evaluation of the iSELF: an Internet-tool for Self-Evaluation and Learner Feedback. The tool is designed to stimulate self-directed learning in a ubiquitous learning environment and our experiences so far confirm its usefulness.
The experiences with the *card-sort module* in a large and diverse group of participants proved that the technique was highly appreciated. When they had the possibility to use it anytime and anywhere, participants used it voluntarily. The playful appearance, the user-friendly operation and the clear, relevant content increased motivation to use it.
The *profile module* helps the learner to get insight in his/her own development in relation to the competencies important for his/her work. These competencies always need to be identified before they can be used in the iSELF. We emphasize the importance to assess competencies that are specific for a group of learners, and at the same time generic enough to remain relevant in our rapidly changing society. This helps the learner to reflect on 'real life' (work)needs.
The possibility to compare their results with previous results or with those of invited peers, colleagues, coaches or subject matter experts, seemed to improve reflection as intended. In future, it is possible to include e-coach possibilities that will stimulate reflective competencies more explicitly.
The *feedback module* presents suggestions for learning, which helps the learner to manage and monitor his/her own learning process and to take control over educational decisions. It is technically possible to use the iSELF for selection purposes by combining the job-requirements with the individual competencies. However, to support learner control and to provide a 'safe' learning environment, it is important that the learner is the only one who can see personal evaluation results, until he/she decides otherwise. Therefore, we use this tool exclusively for learning or career suggestions and not for selection. Nevertheless, it is possible to combine the individual results and present them on a group-level, for organizational purposes.

One of the requirements for the iSELF is that it should support learning anytime, anywhere. Some organizations use Learning Management Systems (LMS) to provide learning solutions like e-learning, others use the LMS as a portal and offer links to learning solutions outside the LMS. Therefore, the iSELF needed the possibility to be embedded into Learning Management Systems. The beta version was tested both inside and outside a LMS and could thus be used anytime and anywhere. LMS also offer the possibility to monitor the learner's progression. When the iSELF is used within an LMS, it is possible to make the learner profiles available for monitoring. Again, profiles should be used to show development over time and not for assessment purposes. As described in the introduction, ubiquitous learning is a way of learning in which learners follow their own trails of interest, scaffolded by coaches, peers and tools for thinking and learning (Dieterle & Dede 2007). It includes on- and off-line, formal and informal learning. To support all that, the iSELF should be available through internet independent of the learning solution chosen. iSELF was not tested for off-line learning solutions and therefore we do not know if learners who prefer off-line solutions will use the on-line iSELF. Future research should look into this limitation. However, the other way around does not present any problems: the on-line iSELF can refer to off-line learning solutions. The profile of any learning solution that is evaluated by educational experts can be included, As such the iSELF can be used for both formal and informal learning.

In a self-directed ubiquitous learning environment there is no pre-defined learning content and learners can select content from on- and off-line, formal and informal learning (Gütl, Lankmayr, Weinhofer, & Höfler 2011). Especially informal learning can help learners to collaborate with others when learning, a requirement for self-directed learning. Of course, it is almost impossible to provide profiles of all possible learning solutions. To start with, the most useful or important learning possibilities for a certain group of learners can be profiled. In addition, it might be possible to ask learners for suggestions for useful *learning* solutions, which in itself increases collaborative learning. There are interesting developments like the Automatic test item creation (Gütl et al. 2011) or the personalisation of web-based learning solutions to knowledge level, goals and other characteristics of individual learners (Papanikolaou, Grigoriadou, Magoulas, & Kornilakis 2002). These kinds of adaptations prevent the learner from getting lost in the course materials by providing personalized learning guidance, filtering out unsuitable course materials to reduce cognitive loading (Barker 2011). Perhaps in the future, they can be helpful. However, one has to bear in mind that for self-directed learners, technology must not take away control from the learner, but provide stimuli to increase competencies for self-directed learning.

A limitation of the presented work is that the development in phases was performed using many different studies and convenience samples. Some of the development iterations would have been different if a dedicated science program with sharply defined samples could have been used. On the other hand, the large amount of different studies provided many challenges that helped us to develop a better instrument. As a result the iSELF was developed to be not only a learner tool but a scientific tool as well. Extensive analyses could be made using the output of the card-sort. Plus-point of the card-sort was the absence of missing data and a good response. It facilitated questionnaires 'under construction' so one can keep up with new developments and new competencies needed in the workplace.

The European labour market is faced with challenges such as an ageing labour force, increased competition from emerging countries and on-going changes in technology and employers' demands. A flexible and innovative economy requires permanent adaptations of knowledge, skills and attitudes. Formal, initial training alone cannot meet the need for the development of working individuals to face these challenges. There is, therefore, a growing need for self-directed, flexible and innovative employees who can and will keep on learning throughout their entire lifespan. Research had shown that fostering students to become self-regulated learners is complicated and should be seen as a long-term process (van den Boom, Paas, & van Merriënboer 2007). The iSELF will stimulate self-directed learning in a ubiquitous learning environment and will help to create learners for life.

Acknowledgement

References

Adkins, M., Kruse, J., & Younger, R. 2002, "Ubiquitous Computing: Omnipresent Technology in Support of Network Centric Warfare", *35th Annual Hawaii International Conference on System Sciences (HICSS'02)*, vol. 1, p. 40.

Barker, T. 2011, "An Automated Individual Feedback and Marking System: An Empirical Study", *The Electronic Journal of e-Learning*, vol. 9, no. 1, pp. 1-14.

Byrnes, J. F. 1984, *The Psychology of Religion* Free Press, Virginia, USA.

Caldwell, D. F. & O'Reilly, C. A. 1990, "Measuring Person-Job Fit With a Profile-Comparison Process.", *Journal of Applied Psychology*, vol. 75, no. 6, pp. 648-657.

Case, D. A. 2003, *Antecedents and Outcomes of End User Computing Competence*, Air Force Inst of Tech Wright-Patterson Afb OH School of Engineering and Management, ADA415162.

Chen, G. D., Chang, C. K., & Wang, C. Y. 2008, "Ubiquitous Learning Website: Scaffold Learners by Mobile Devices With Information-Aware Techniques", *Computers and Education*, vol. 50, no. 1, pp. 77-90.

Collins, J. 2004, "Education Techniques for Lifelong Learning: Principles of Adult Learning", *RadioGraphics*, vol. 24, no. 5, pp. 1483-1489.

Dieterle, E. & Dede, C. 2007, "Building University Faculty and Student Capacity to Use Wireless

Handheld Devices for Learning," in *Ubiquitous Computing in Education: Invisible Technology, Visible Impact*, M. E. van 't Hooft & K. Swan, eds., Lawrence Erlbaum Associates Publishers; US, Mahwah, NJ, pp. 303-328.

Du Bois, N. & Staley, R. 1997, "A Self-Regulated Learning Approach to Teaching Educational Psychology", *Educational Psychology Review*, vol. 9, no. 2, pp. 171-197.

Gütl, C., Lankmayr, K., Weinhofer, J., & Höfler, M. 2011, "Enhanced Automatic Question Creator EAQC: Concept, Development and Evaluation of an Automatic Test Item Creation Tool to Foster Modern E-Education", *The Electronic Journal of e-Learning*, vol. 9, no. 1, pp. 23-38.

Harper, M. E., Jentsch, F. G., Berry, D., Lau, H. C., Bowers, C., & Salas, E. 2003, "TPL-KATS-Card Sort: A Tool for Assessing Structural Knowledge", *Behavior Research Methods, Instruments, & Computers*, vol. 35, no. 4, pp. 577-584.

Hiemstra, R. 2006, "Is the Internet Changing Self-Directed Learning? Rural Users Provide Some Answers", *International Journal of Self-Directed Learning*, vol. 3, no. 2, pp. 45-60.

Hughes, C. A., Korinek, L., & Gorman, J. 1991, "Self-Management for Students With Mental Retardation in Public School Settings: A Research Review", *Education & Training in Mental Retardation*, vol. 26, no. 3, pp. 271-291.

Kelso, G. I., Holland, J. L., & Gottfredson, G. D. 1977, "The Relation of Self-Reported Competencies to Aptitude Test Scores", *Journal of Vocational Behavior*, vol. 10, no. 1, pp. 99-103.

Lievens, F. & Sanchez, J. 2007, "Can Training Improve the Quality of Inferences Made by Raters in Competency Modeling? A Quasi-Experiment.", *Journal of Applied Psychology*, vol. 92, no. 3, pp. 812-819.

Papanikolaou, K. A., Grigoriadou, M., Magoulas, G. D., & Kornilakis, H. 2002, "Towards New Forms of Knowledge Communication: the Adaptive Dimension of a Web-Based Learning Environment", *Computers & Education*, vol. 39, no. 4, pp. 333-360.

Schwarz, N. & Oyserman, D. 2001, "Asking Questions About Behavior: Cognition, Communication, and Questionnaire Construction", *American Journal of Evaluation*, vol. 22, no. 2, pp. 127-160.

Stubbé, H. E. & Theunissen, N. C. M. 2008, "Self-Directed Adult Learning in a Ubiquitous Learning Environment: a Meta-Review", *Proceedings - 4th EduMedia Conference 2008 Special track -Technology Support for Self-Organised Learners (TSSOL08), Salzburg, Austria, 2.& 3.of June 2008*.

van den Boom, G., Paas, F., & van Merriënboer, J. J. G. 2007, "Effects of Elicited Reflections Combined With Tutor or Peer Feedback on Self-Regulated Learning and Learning Outcomes", *Learning and Instruction*, vol. 17, no. 5, pp. 532-548.

van Merriënboer, J. J. G., van der Klink, M. R., & Hendriks, M. 2002, *Competenties, Van Complicaties Tot Compromis: Over Schuifjes En Begrenzers [Competencies, From Complications to Compromises; About Tuning Knobs and Limiters]* Onderwijsraad, Den Haag, The Netherlands.

Wang, S. L. & Wu, C. Y. 2011, "Application of Context-Aware and Personalized Recommendation to Implement an Adaptive Ubiquitous Learning System", *Expert Systems with Applications*, vol. 38, no. 9, pp. 10831-10838.

Whan Marko, K. & Savickas, M. L. 1998, "Effectiveness of a Career Time Perspective Intervention", *Journal of Vocational Behavior*, vol. 52, no. 1, pp. 106-119.