Project ELoQ - Integrating Universal Accessible E-Learning in Vocational Education of Adolescents with Disabilities

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Abstract— The title of the project ELoQ stands for e-learning-based logistics qualification and sums up the main goal of the project – realizing vocational education in the field of logistics and warehousing for adolescents with disabilities or handicaps through e-learning-based activities. This paper in short describes the different parts of the project, the participating organizations and companies as well as the underlying concept of Universal Design (UD) as the guiding principle.

Index Terms—accessibility, disability, vocational education, universal design

I. INTRODUCTION

This paper aims to introduce the ELoQ project, its project lines, research questions and development perspectives. ELoQ is the acronym for “e-learning-based logistics qualification” and sums up the main goal of the project: realizing vocational education in the field of logistics for adolescents with disabilities through e-learning-based activities. As the target audience of the project is apprentices with disabilities, the e-learning methods and activities used within the project have to be fully accessible and thus usable for both disabled and non-disabled apprentices. What that means in detail will be sketched in the sections I.C and III. of this article. The apprentices will be qualified in the field of storage logistics, comprising tasks like conveying goods, working in the goods receiving department, warehousing goods and picking and packaging.

To achieve the goal of the project, based on a sector study a curriculum for the vocational training will be developed. E-learning activities and methods require learning-management-systems (LMS) and authoring tools that are fully accessible and barrier-free. Therefore different LMS and authoring tools will be evaluated for their accessibility. Furthermore, different educational methods and settings – so called educational scenarios – will ensure e-learning activities to become an essential part of the vocational training.

Another critical aspect for sustainable integration of this training program (of the long-term success) can be identified in qualifying educational supervisors. Thus, educational training personal will be qualified within the project on how to use e-learning as a teaching tool and how to create their own accessible e-learning materials and courses.

A. Project partners

The project consists of three partners: Department of Vocational Education and Rehabilitation, Department of Rehabilitation Technology, both within the Faculty of Rehabilitation Sciences at the TU Dortmund, and the CID Dortmund, a vocational training unit for people with disabilities. These three partners will do the main work within the project.

While the TU Dortmund will perform the scientific research and development as well as the evaluation of the project, the CID Dortmund is responsible for the practical development and implementation.

B. Additional partners

In order to disseminate the project’s results and to evaluate results, additional partners will support the above named three main project partners. Those additional partners are: Josefsheim Bigge, a vocational training unit in Bigge-Olsberg; Bethel proWerk, a sheltered workshop for people with disabilities and also industry service provider located in Bielefeld-Bethel; and DACHSER GmbH & Co. KG, Dortmund branch, a large European logistics provider.

These three additional partners will field-test the educational scenarios, e-learning activities, and materials developed within the project. Additionally, these partners will also actively support the projects research and development through providing their professional expertise in logistics as well as the qualification and vocational training of young adolescents – both disabled and non-disabled.

Finally the project is supported by an advisory board, consisting of professionals from the fields of vocational training, science and practice. The advisory board will meet twice a year and give feedback to the most recent developments and ideas of the project partners.

C. Universal Accessibility of E-Learning

Our understanding of universal accessibility is an approach of designing e-learning that is usable by all people, regardless of any disability. In literature a large number of projects can be identified focusing on special needs of single groups of adolescents with disabilities; consequently designing e-learning materials only to match the needs of this particular group. However, such approaches lead into the contrary direction to current
developments in web accessibility, disability studies and diversity studies.

The project ELoQ tries to develop e-learning according to the new German disability legislation, especially the BGG (Behindertengleichstellungsgesetz – Law on Equal Opportunities for People with disabilities) and the BfTV (Barrierenfreie Informationstechnik Verordnung – accessible information technology enactment). Accordingly, accessibility can be defined as follows [1]:

“Accessible are structural and other facilities, transportation, engineering goods, systems of information processing, auditory and visual information sources and communication facilities designed and other areas of life, when they are usable by and accessible for disabled people in the usual way, without much of a burden and, in principle, without external help.”

In accordance with this understanding, universal accessible e-learning is usable by and accessible for everyone, for apprentices with and without disability, for those who acquire their training in vocational training units with sheltered workshops added or in vocational schools. The impact of such understanding of accessibility not only takes the accessibility of the information technology into account, but also requires educational scenarios, learning materials, teaching aids and learning activities that are suitable for a versatile range of apprentices, regardless of their cognitive abilities, any disability or motivation.

II. ESSENTIAL PARTS OF THE PROJECT

A. Module 1 – Development of a curriculum for vocational training

After introducing the project’s background, overall objective, and defining universal accessibility, this section aims to present module 1 with its content, challenges, and goals.

As stated above, module 1 “Development of a curriculum for vocational training” is a concept module commencing the project by providing a thorough understanding of the economical sector of storage logistics. Accordingly, module 1 supplies profound information about vocational training related theory and practice. The overall aim of this module is to outline recommendations of how to improve vocational trainings of adolescents with disabilities to facilitate labour market inclusion. On the one hand, based on these recommendations old training curricula are revised. On the other hand, these findings inform at a later stage of the project the development of training content to be implemented into e-learning solutions. Along the lines of revising out-dated curricula and developing e-learning content, a major requirement is to account for the needs and abilities of people with disabilities and, of course, to serve the labour market’s demands in order to establish remunerative, fully taxable employment opportunities.

To match the requirement of relating high level detail in various aspects of storage logistics (labour market) to vocational training development (needs and abilities), Module 1 utilized different research methods of vocational training sciences. The concepts of those research methods were drafted by Becker and Spöttl [2] and adapted in order to match the scope of the project.

1) Module 1.1 – Sector Analysis and Case Studies

To begin with, a sector analysis was performed. Sector analyses in general investigate for example employment structures, employment situations, human resources development, characteristic job-tasks and work-processes, trends in societal, economical, and technological development, and best practice companies. Utilized research tools comprised of literature reviews of current projects, statistical data, and other publications relating to logistics and expert interviews. Within ELoQ project we sought contact to logistics and related disciplines, e.g. researchers, employers, senior employees, employment consultants, educators, and labor union and industry representatives, using structured interviews. Interviewees chose between face-to-face, telephone, or email interviews. At the current stage (April 2010), interviews are transliterated and evaluated.

Subsequent to the sector analysis, identified best practice companies will be enquired to contribute to case studies. In addition to the previously performed sector analysis, case studies depict real life labor environments in order to verify the sector analysis’ findings. Again, structured interviews are the core tool of this method, complemented by on-site inspections to breathe the shop floor atmosphere.

2) Module 1.2 – Work Process Analysis

The last and most detailed method of investigation is the so called work-process analysis. Aiming at a highly detailed insight into how every day work is performed, work process analyses also collect data about legislation, customer demands, company guidelines, or operated tools, which simultaneously impact on the way employees execute single actions and accomplish job tasks. Methods applied to record data are again structured interviews, standardized questionnaires to match an employee’s abilities to the demands of the workplace, and prospectively video-taping job tasks to identify smallest steps of actions. To name exemplary instruments to assess data ranging from smallest steps of actions to superior job tasks are IMBA (German, for “Integrating people with disabilities into the labour market”; [3]) and the webcam based Software “ErgoLab” (http://www.ergoneers.com), for example featuring questionnaires based on FEBA (German, for: "Questionnaire to assess individual perceptions of workloads at the workplace” [4]).

At this stage, a great challenge is expected to occur. The previously described work-process analysis provides investigators with comprehensive data about the meticulous processes of job tasks, along with data about postures and work related strain. However, the mediating step relating back this data to vocational training poses that great challenge: since vocational training is not only about imitating demonstrated actions and behaviour. Above all, vocational training is about the ability to work independently – to elaborate on learnt skills. It is also about generating new skills, about developing new and more efficient processes, and permanently redefining one’s personal professional behavior, based on skills adopted during initial training. Recapitulating: the faced problem comprises off deducing meticulous and ergonomical processes of job tasks in order to elaborate those to random strings of actions and, at large, to enable vocational trainees to manage random workloads.

A feasible solution may provide Volpert [5] by dividing work tasks in a hierarchy of actions: so called generative actions, or cognitive planning actions, and process actions,
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or the actual execution of that generation. Volpert’s action regulation theory is based on ergonomical assessments of learning in vocational rehabilitation programs amongst adults with cognitive disabilities [6]. Additionally, the theory draws from early endeavours into artificial intelligence [7]. Even the fundaments of Volpert’s theory of action regulation appear little out dated, a combination of the theory with ICF [8] may possess a great potential to support a holistic description of work tasks by generative and executive actions to be included into the development of vocational training curricula. In that context, the rather medical classification of functioning, disability, and health (ICF) informs the global background along with providing the organizational structures of activities. Subsequently, these results are utilized to revise current training curricula in the professions of “Fachlagerist” and “Lagerfachhelfer” at the level of learning areas and learning situations. The last part of module 1 comprises of the differentiation of previously identified generative and executive actions into learning situations and, superior, learning areas. Both are curricular elements used to structure the way trainees study. Compared with the results of the sector analysis, this part of module 1 recommends revisions to current vocational training curricula to responsible agencies. Previously, module 1 was introduced briefly outlining the theoretical foundation it provides the realization of ELoQ project with. However, the content is only one side of the coin. The next section presents the other side to the project: e-learning tools used to provide didactically correct and accessible learning materials.

B. Building up the infrastructure – Module 2

Activities comprised by module 2 are intended to build up and test the e-learning infrastructure. This includes for example tools for the editing of learning materials, the content creation and the learning environment learning management system (LMS). Module 2 is structured in four major sequenced work packages as described in the following sections.

1) Module 2.1 – Investigation

To ensure the quality of the used tools and learning contents we start up with a sophisticated investigation phase. This phase is intended to cover four different elements:

1. standards for sharable learning content like e.g. SCORM or IMS;
2. tools for creating and editing learning materials;
3. available commercial and non-commercial learning content relevant for training within the field of logistics; and
4. Open Source learning management systems (LMS) as frame of the e-learning experience.

As a result of this module we expect a synopsis reporting about different ongoing standards for e-learning content and state of the art LMS and editing tools. The expected report about available learning content, respectively the learning content itself, will be used in module 2.4 later on.

2) Module 2.2 – Selection and Adaptation of tools

Based on the previous investigation phase, 6 of the located LMS and 4-6 editing tools will be evaluated during the current phase. To achieve this goal, evaluation methods will be developed for both sets of tools. In both cases accessibility will be the top-most criterion. Additionally, a software’s perceivability and usability will be determined, along with the range of functionality these software systems offer.

After evaluating the different LMS and editing tools, evaluation results will be discussed and finally one LMS and one editing tool will be chosen for the future project activities. Nevertheless, it is expected that even the tools with the best accessibility evaluation will still need modification to meet all accessibility requirements. To provide transparency, these requirements will be defined within a “requirements sheet” or “specification”; which is a typical process in software engineering. In addition, detected accessibility problems within the software systems will be reported back to the Open Source community working on the software.

3) Module 2.3 – Building the technical infrastructure

Within this module, technical infrastructure will be developed and tested. According to the specifications developed in module 2.2 necessary modifications will be applied to the chosen LMS and editing tool. The (documented) modifications will be reported back to the community responsible for developing and maintaining the Open Source software systems. So accessibility related problems may be avoided in future versions of the software systems.

For testing the infrastructure several exemplary learning materials and templates for course structures will be developed and implemented into the system. Encountered problems and corresponding solutions will be documented to inform future development processes of learning materials during the project.

To allow all participants, e.g. authors of learning materials, technical person in charge, trainee etc., to find specific information easily, the documentation separates information about the applied editing tool and learning management system (LMS) In addition the used tools and the developed templates for course structures and learning materials will be published.

4) Module 2.4 – Developing learning modules and content

This part of module 2 addresses the development of e-learning materials, equating an amount of around 20-30 hours per year of training, adding up to 60-90 hours in total. The results from modules 1 and 3.2: learning content and non-commercial / license free materials developed by other projects will be used to serve this purpose.

To start constructing a pedagogical design and specify scripts defining required learning modules and materials, the development of e-learning materials will start from scratch. Subsequently, the technical development process, containing implementation, production of media etc., will be finalized. However, the production of some content elements, e.g. movies, graphics, or animations, will be delegated to external professional service providers.

According to [9] it is very difficult to estimate the time required to produce the e-learning content. Perspectively, we expect to realize the intended amount of 90 hours of training in around six months.

Finally the produced learning materials and the whole technical infrastructure will be exhaustively tested and evaluated. Therefore a procedure for evaluating both
levels – the LMS and the e-learning materials – will be developed, based on usability tests in a lab environment and participant observations. The evaluation report will be published and simultaneously serve as “to-do-list” for a probably necessary redesign or modification of the learning environment or contents.

The lessons learned producing e-learning modules and materials will be summarized in a guideline document helping future teachers in designing and implementing e-learning materials for trainees with disabilities. This guideline document will be used by project partners – e.g. DACHSER GmbH & Co. KG, an industrial logistics company – to develop learning materials in an amount of four hours of training, based on specific learning situations within the company.

C. Developing educational scenarios – Module 3

In Germany vocational training usually takes place in both, vocational schools and companies training apprentices. In opposite, apprentices with disabilities might attend practice and theory courses only in vocational training units, as these units normally include both a sheltered workshop or small company and a vocational school for students with disabilities.

Accessible e-learning materials and activities have to be consolidated within the educational policies of both vocational schools and a trainee’s company. Therefore it is necessary to develop educational scenarios that incorporate e-learning as an essential part of teaching and as a core aspect of an apprentice’s individual learning experience.

Another aspect of educational scenarios is the connection of the two places of learning: the vocational school or vocational training unit and the company the apprentices work at. It is the designated objective of the vocational training unit to enable apprentices with disabilities to be sustainably and fully taxable employed after successfully completing training. Therefore it is necessary to develop educational scenarios, activities, and materials that are comprehensible enough and serve the demands of companies providing those employment opportunities.

1) Module 3.1 – Educational Approaches and Best Practice

E-learning based activities and materials have to be integrated into the educational approaches of vocational training. New approaches to the integration of self-learning should integrate seamlessly in the established forms of training and still have an innovative moment. In this part of module 3 developed educational concepts will be based on established educational approaches and integrate best-practice procedures.

Those educational approaches and best practice procedures will be derived from an extensive literature review about e-learning-based training as well as current educational approaches in training and vocational education. Additionally the different approaches of the vocational training units involved in this project as well as the approaches of logistic companies will be examined.

A result of this module will be a synopsis of established and best practice educational approaches. The synopsis will be used in further modules as a stimulus for training supervisors, who are interested in integrating e-learning into their training.

2) Module 3.2 – Development of the learning content and activities

The learning content and activities developed within the project will mainly pursue the approach of a computer-aided learning system, combined with elements of resigning teaching. This approach is well suited for the target audience of the project, because apprentices with disabilities, especially those with learning difficulties, are challenged by approaches demanding high levels of self-organization, as for example pursued in online teaching-learning networks.

The learning modules and contents will use appropriate tools, e.g. eXeLearning or RELOAD, as web-based training and information modules, SCORM compatibly prepared. SCORM compatible modules own the advantage of easy integration into LMS. In addition, those modules are reusable within other LMS than the one used for ELoQ project. This ensures long term usability of developed contents. In addition to text, such modules can include audio and video elements as well as interactive exercises. This feature supports approaches of Universal Design for Learning (UDL) as described below. More complex learning activities will be developed using appropriate tools (e.g. HotPotatoes) or features of the chosen LMS in module 2.

The total volume of learning content and activities will accumulate to 60-90 hours total learning time, which equals 20-30 hours learning time per year of vocational training.

3) Module 3.3 – Developing educational scenarios

Educational scenarios for e-learning are often to technocratic, focusing on the use of different and the most recent technologies instead of innovative and learner centered teaching and learning approaches. Hence within ELoQ project we want to use an approach that is guided by the work processes in logistic companies and provides a positive learning experience to the apprentices. Such a model centers on:

• joint activity-oriented problem-solving;
• communication among learners;
• adapting learning content, modules and activities to match an individual learner’s requirements and resources; and
• learning media that are used as knowledge-based teaching-aids (vgl. Severing 2003).

4) Module 3.4 – Testing and Evaluation; and Module 3.5 – Revision

The educational scenarios developed in module 3.3 will be tested and evaluated by the CID Dortmund as well as by three additional partners: Josefshem Bigge, Bethel proWerk and DACHSER GmbH & Co. KG. Hereby, usability and the success of educational scenarios will be evaluated. Based on the results of this evaluation, different scenarios will be revised within module 3.5.

D. Module 4 – Workshops for training supervisors

Within module 4, workshops to train the supervisors of participating vocational training centers will be developed and conducted. Currently there are three workshops planned; the first workshop will be about online learning and moderation of e-learning courses, the second about concepts and approaches of e-learning based qualification of apprentices, and the third workshop will educate about
III. UNIVERSAL DESIGN FOR LEARNING

The concept of Universal Design for Learning (UDL) is based on the general concept of Universal Design (UD). UDL was developed by the Center for Applied Special Technology (CAST) in the early 1990s in order to enable students with disabilities to access mainly text-based school books and to enhance the participation in classrooms. Similar to UD, diversity and heterogeneity is considered as the norm and not the exception. The concept of UDL rejects an “one-size-fits-all” approach to teaching and learning, where all students use the same material and do the same learning activities. That is because such uniform materials and activities not only hinder students with disabilities, but all students, because every individual student has an individual approach to learning, even an individual learning style that has to be considered. Students differ in their skills and abilities, their learning style, biographic background and learning preferences, which all have to be considered when planning teaching and learning. And this all is the truth for apprentices, too, whether they are disabled or not, visit vocational training centers or vocational schools. And the concept of UDL promises to fulfill that diversity.

UDL is based on recent research in neuroscience, where three primary brain networks play a major role in learning [10]:

- “Recognition networks: Gathering facts. How we identify and categorize what we see, hear, and read. Identifying letters, words, or an author’s style are recognition tasks—the “what” of learning.
- Strategic networks: Planning and performing tasks. How we organize and express our ideas. Writing an essay or solving a math problem are strategic tasks—the “how” of learning.
- Affective networks: How students are engaged and motivated. How they are challenged, excited, or interested. These are affective dimensions—the “why” of learning.”

Based on these findings, CAST developed a set of principles on how to develop educational scenarios and prepare learning materials, teaching aids and learning activities for all students, whether disabled or not. These principles are [11]:

1. Provide Multiple Means of Representation
   a. Perception
   b. Language and symbols
   c. Comprehension
2. Provide Multiple Means of Action and Expression
   a. Physical action
   b. Expressive skills and fluency
   c. Executive function
3. Provide Multiple Means of Engagement
   a. Recruiting interest
   b. Sustaining effort and persistence
   c. Self-regulation

Educational scenarios based on these principles of UDL require flexible teaching aids, learning materials, and flexible teaching and learning methods in order to meet the multiple needs of students. Anyhow, a curriculum based on UDL also renders a lot of individual accommodations redundant, because of the flexibility and diversity of materials and methods provided to students. That makes UDL a well suited foundation for the project ELoQ, because we don’t want to develop e-learning for just one single target group, but for all apprentices, whether they are disabled, have special needs, or not.

The principles of UDL will therefore be part of the evaluation of LMS and authoring tools for e-learning content and materials, for the development of educational scenarios and also play an essential part in the workshops to train supervisors. It is not a completely new approach to teaching and learning, but can provide valuable input to current ways of teaching and learning in German vocational training workshops as well as for vocational training of apprentices in companies and training schools.

IV. FINAL THOUGHTS

Because ELoQ is one of the few projects taking universal accessibility into account and not aiming at one single target audience, the success or failure of the project could have quite an impact on further e-learning supported vocational training projects and maybe on the vocational education of adolescents with disabilities in Germany in general. The three main modules described in this paper are the core parts of the project, but when it comes to long-term success it very much depends on whether the training supervisors consider universal accessibility as an issue that is important for their jobs.

As the project just started half a year ago (November 2009), there is still not much to report back about the possible success or failure. But with a view to the current situation of vocational training for adolescents with disabilities, it will be well worth the effort considering Universal Design as a major part of both educational scenarios and as a general approach on bringing young people with disabilities to work. Universal Design and its educational siblings Universal Design for Learning, Universal Design of Instruction, Universal Instructional Design or Universal Design of Education are a quite common in the US or GB. But the vocational education system in Germany yet very much relies on fragmentation and on separate vocational training workshops for different kinds of disabilities instead of mainstreaming apprentices with disabilities into regular training schools. So the project team is quite confident that the project ELoQ can have an impact on the discussion on how to integrate adolescents with disabilities into the regular training, something that also has to be considered with a view to the UN Convention on the Rights of Persons with Disabilities [12].

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