Atlantis university: learn your own way

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Abstract: Nowadays, capability development requires a flexible approach and needs to consider aspects such as internationalisation, effective teamwork and learner mobility. A learning infrastructure has been developed which combines three different types of learning and teaching. It supports the adaptation of content presentation to varying learning situations. It uses a storytelling-based framework that is influenced by parameters such as current position of the learner, device used, learner-type, available timeframe and prior actions. This system enables context sensitive and Collaborative Content Manipulation and thus, helps to overcome some of the problems associated with this type of system.

Keywords: authoring; content adaptation; content manipulation; e-learning; electronic learning; extended blended learning; interactive digital storytelling; learning management system; m-learning; mobile learning; mobility; XBL.


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1 Introduction

As the successor of blended learning, extended blended learning (XBL) overcomes the pure electronic learning (e-learning) obstacles (e.g. Sheypak et al., 2007) by integrating face-to-face learning, e-learning and project-based learning (Bleimann and Röll, 2006). This is one of the basic principles of the Atlantis University, an international partnership involving universities and companies from the European Union and the USA. Its goal is to develop an innovative high-quality institution with common branding. The idea evolved from long-term experience in face-to-face and project-based teaching as well as several e-learning research projects (Furnell et al., 1998, 1999; Stengel, Bleimann and Stynes, 2003; Bleimann et al., 2004).

As current students develop into important contributors and decision makers, Atlantis University focuses on improving the teaching of how to develop students’ capabilities necessary to succeed in today’s societies. Capability goes beyond knowledge, skills and competence where it represents “an integration of knowledge, skills, personal qualities and understanding used appropriately and effectively” (Stephenson and Yorke, 1998). By contrast, competence is related to the ability to perform effectively in a specified location (e.g. in a known familiar setting) and at a specified time. Capability extends competence by implementing the capacity in an unknown or unfamiliar future context and by guaranteeing good performance at the current time.

As a result, enormous flexibility needs to be provided by the universities (Röll, 2003). This includes aspects, such as mobility, internationalisation, team performance and more. Atlantis University meets those needs in various dimensions: it defines and implements XBL methods that are used in modules of cooperating universities. Students work in international teams where most of the module tasks represent real-life problems. This process is supported by a flexible platform that provides services for communication, data management as well as appropriate module/syllabus content.

This article describes the concept, a partial implementation of the platform and its most significant services which provide flexible interfaces as well as content and version handling. It outlines how flexibility is achieved and handled in different scenarios.

In this context, a large amount of learning content within the system is necessary to offer material based on user adaptation. Creating good quality content is a time consuming task that individuals often fail to accomplish. The adaptation of the content
itself is even more difficult. To present content from different perspectives, at different locations and on various devices, many discussions and versions are needed to ensure that the content can be understood by the appropriate learner and can be presented in an accurate way. To solve this problem, many authors may create the content from their own point of view and use the appropriate input/output facilities. However, this raises the difficulty of interconnecting the content-sections in a way that adaptive coherent non-linearity arises. This article outlines a possibility to overcome this problem by merging the approaches of context-specific information (for example learner-types, position and device used), a storytelling-based coherence service and a content contribution system.

2 Changed demands on lectures

It is a current trend for nations to form international knowledge societies. This has resulted in the need to be able to effectively manage and store retrievable knowledge as well as learnable abilities, experiences and social competences. Universities need to prepare students to survive in a fast changing world, so that they are able to face the demands and to flexibly apply their capabilities.

This means that universities as a whole, including lecturers and students need to be flexible. Changes from the inside and outside should be tackled by adaptable modules in a teaching network. Learning should not be restricted to the campus or home; it is a dynamic process where resources should be accessible at any time and location. Mobile technologies are one important step to fulfill those needs, because “Handheld technologies provide access to computing where student activities and learning occur, unlike desktop computers that are often segregated from other learning activities in the classroom” (Uden, 2007). “mLearning is the acquisition of any knowledge and skill through using mobile technology, anywhere, anytime” (Geddes, 2004).

The key for adaptive flexibility is context awareness; this also includes other forms of learning and not just mobile learning (m-learning). Uden (2007) uses the activity theory for m-learning designs. This can be expanded by using interactive storytelling methods, as one main focus of interactive storytelling is the change of contexts during time towards a specific goal.

Dan Norman stated (Currin, 2004): “For teaching to be effective, cognition and emotion must work together”. Studies in neuronal sciences confirm this statement which stresses the importance of emotional engagement in learning efforts and motivation (Spitzer, 2002). The key for this can be found in stories: stories foster emotional engagement, because content is structured in a suspenseful way. Reading, or the viewing or experiencing a good story can cause the reader to be totally immersed into an imaginary world. Beside the pure facts, stories also provide a meaning that can be linked to the real world (Mateas and Sengers, 1999). This can help for learned knowledge to be transferred to new situations for better understanding (McKillop, 2005). Several AR/MR-projects address the combination of interactive storytelling and mobile edutainment, for example Geist (Kretschmer et al., 2001) and EduTeCH (Schneider, 2004).
3 Atlantis university project

The Atlantis University project was founded in 2002 as an interdisciplinary project. Ten universities and companies from England, Ireland, Poland, Hungary, Germany and the USA collaborate in order to research and implement new pedagogical concepts. Its focus is on innovative combination of different knowledge-transfer forms called XBL.

3.1 Extended blended learning

XBL combines blended learning with project-based learning, because it improves ‘communicating skills’ – a major objective in education (see Bruffee, 1999; Boud and Solomon, 2001; Batatia, Ayache and Markkanen, 2002; Neo, 2005). No other form of learning is suited to meet the requirements of professional life (Mills and Treagust, 2003, p.13), because project members gather not only the necessary specialist knowledge, but also strengthen their team ability, communication and project management experience within the scope of a project (Bleimann, 2004, p.4). Within XBL, teaching is based on three pillars (as shown in Figure 1).

Atlantis University integrates all three columns of XBL into a virtual university. The respective pillar’s part is measured by the teaching contents as well as the learner’s previous experience and general situation (Bleimann and Röll, 2006).

The real vision of Atlantis University is a smart mix of the three learning forms. A further goal is to internationally cooperate with other academic institutions in order to create an interdisciplinary and international study path for learners (this study path needs to be internationally approved) (Bleimann, 2004). The virtual university should offer online-content, modules and personal details of all universities that are involved through a worldwide software portal. Students should be able to take part in lectures at one university but attend projects all over the world. This can be achieved by using content, exams and graduation ceremonies that have been approved internationally. Atlantis University will serve as a mediator, offering communication interfaces, filters, enabling the sorting and combining of international content as well as to provide facilities to enable local administration.

Figure 1  Three pillars of extended blended learning (see online version for colours)

4 Supporting the learning process via pedagogical and technological concepts

The Atlantis University learning environment is implemented using the following well-known components:

- Moodle, which is used as learning management system. It provides all the basic functionality that might be required, such as enrolment, management of learning content and communication facilities. It is used to create modules (content), to enrol students in courses and provides basic information.

- Wiki, which is used intensively as a collaboration tool. Students describe their work in the Wiki system after completing a task. Some modules use the Wiki as documentation system – where each semester students describe some parts of a certain topic. Wiki-content is always up-to-date when compared to books that are only rarely updated.

- Moodle is optimised to handle learning content, but it is not intended to be used as document management system (DMS). Hence, for handling and versioning a large amount of revised documents, a DMS was integrated into Atlantis University. It is used for document based project work and to submit results achieved by students during the semester.

In addition to these and other well-known components (such as a calendar and a video conference system), the Atlantis University team has developed special learning-tools that are described in the following sections.

4.1 Learner-types

To further improve the XBL concept, individual learning characteristics of learners and teachers have been taken into consideration. The model developed by Franz Josef Röll merges seven preference determination models out of 70 existing models (Brückner, 2005). It defines six different learner-types (Röll, 2005). A person does not only correspond to a single learner-type, but his strong and weak developed learning preferences are distributed through all six preferences, see Figure 2. Typically, a learner develops two strong, two medium and two weak preferences.

The illustration shows exemplarily strengths in the domains of a perceptor and organiser. A person of this learner-type learns especially well if he is led step-by-step through clearly structured learning content (Brückner, 2005). In addition, the amplitude in the perceptor field shows that the learner should use audio–visually presented content to achieve the optimum learning success. Hence, the learning material prepared for this learner-type stimulates his senses. These can be not only charts, animations or videos, but also kinetic stimulation like touch or audio based stimulations such as talks and discussions. However, constructors prefer experiments and are generally assessed in a pragmatic way. Engineers often represent this type. Communicators need group work, while analysts use a rather analytical approach and achieve the best learning results by using only books. The creators learn the best if they deal with something completely new. They often lose the interest if standard operations are involved during the process.
Atlantis University is not bound to use this special learner-type theory. This is one possible way to put learners into categories. It is used intensively for typifying content-sections and to choose the best fitting learning path, because it fits well into the Atlantis University concepts.

4.2 Adjusting content: coherence

Stories and their structures provide the following essential functionality for learning environments: focussing on the teacher’s attention, provision of information and feedback about the learner’s efforts (Gagné, Briggs and Wager, 1992). Stories are not limited to a certain topic. With narrative structures complex dependencies can be explained in an understandable way (so that it can be understood by humans). Stories are fundamental to culture and human understanding. They have familiar structures that are recognisable and can be easily understood. In human tradition, stories were means for information transmission and knowledge acquisition, e.g. within families and cultural communities. “Much true understanding is achieved through storytelling. Stories are how we communicate events and thought processes” (Schell, 2002).

Lectures are often presented in a uniform way (a lecturer might write a script and then use it for several years). As a result, e-learning modules are mainly used as lecture notes. In contrast to lectures, where students work step-by-step through the content, without making use of their individual strengths and without avoiding weaknesses, the XBL concept in the Atlantis University Portal supports learning using the individual strengths of the students, being characterised by non-linearity in several dimensions. A new software approach is required in order to be able to control these processes.

Therefore, the coherence service has been developed. Its design is based on interactive digital storytelling methods that present non-linear content in a coherent way, and is user-adaptive and independent of any concrete content (Schneider et al., 2006). It is based on the StoryEngine (Braun, 2003) that uses Propp’s story model (Propp, 1958), because it is most suitable for the XBL domain (Schneider et al., 2007).

The coherence service provides coherence, so that module content-sections are not lined up pointlessly or contradictory. Students should not be allowed to process data until
they have completed the theoretical part. In any case, conclusiveness is always
guaranteed. In any situation and with any chosen path, the service is able to lead to a
successful end. Failed exams or missed exercises are excluded.

The performance of the learners and their personal learning types (Brückner, 2005)
decisively influence the path through the learning-module by using interactive content.
Content-sections that question knowledge are also conceivable. All these results
influence the learning-module. The e-learning environment works completely
independently of any concrete content. This signifies that it is not only media type
independent (for example, it is indifferent whether the content is a video or a set of
slides), but also the system is usable with any kind of learning content and learning
styles.

Therefore, it divides content into three levels: the highest level is the coherence-
model that describes the content-types and their relationship to each other. The medium
level is an abstract content-description. It defines the content-sections, their relationship
to each other and to the content-types they belong to. The lowest level includes the
content and interactions itself. These descriptions are processed by coherence and the
learning design engine coppercore (Martens and Vogten, 2005), see Figure 3.
The model provides a timeline with a flexible duration. At this timeline, the content-types are ordered. Although this order is not strictly enforced, it is a recommendation. It can be influenced by weights, contexts and loops. Each content type may typify several content-sections that refer to portions of concrete content. Figure 4 shows a simple example how content-types typify content-sections:

During runtime, the following content-sections are selected depending on the history and the current context. Contexts provide coherences and dependencies between the content-sections. They describe the state of the content, the user and the environment, and serve as variables for the communication between content-sections, module-contents and systems. In contrast to usual computer languages, every context defines the range of two values. For example, a context $\text{acceptedAge}$ might have a minimum value of 18 and the maximum value of 30. Contexts can be organised in nested groups. Thus, a context tree can be formed. In this way, several contexts can be checked logically interrelated by calling a context-group.

Currently, the context $\text{duration}$ and the context group $\text{learnerType}$ are mandatory. With the help of these contexts, it is guaranteed that certain content is presented in the best fitting way to a learner-type within a specific duration. In addition, coherence is assured as well, since decisive content-sections have been presented.

Further, contexts can be used to help to categorise the content. A content group is purposed for localisation data. Currently, this data can consist of not only coordinates that are streamed from a GPS-receiver, but also descriptions such as lecture room, laboratory, at home or maybe a specific university; combinations are also possible. Other context groups are prepared for internationalisation, including preferred (and provided) languages, measurement units and time zones. Other contexts specify input- and output-devices. These enable the adaption of content-sections to concrete devices such as a PC with monitor and keyboard/mouse or mobile devices including a multi-touch screen.

Because of its flexibility, this service is able to merge learning-modules of different lecturers to provide the optimal learning path for a specific learner-type. This includes modules from different universities. Beside the ability to choose the content that best fits the current circumstances (for example devices used and locations) by using context information in conjunction with the history and possible future paths, Uden’s demand is fulfilled that it “is important not only to include current time but also past time (a history element of context) and future time” (Uden, 2007, p.93). This is either done during the initial planning stage carried out by the author or during the runtime stage by the coherence engine.
4.3 Merging content

The coherence service provides the ability to merge content created by different persons during runtime. The key to this process is the context belonging to each content-section.

The coherence service creates coherent content out of many content-sections that is annotated by context. The context may be added explicitly, but most of the mandatory context can be set on the fly. For example, the author’s learner-type is a context that must be set. But as it is known to the system because of preceding learner-type tests, no additional action is needed by the authors.

Lecturers might use content that suits their individual teaching style provided that everyone teaching the same module does agree upon the same coherence-model. According to Röll’s theory, students learn the best if a lecturer has created the content whose learner-type is close to theirs (Röll, 2006). Therefore, the coherence service compares the content’s learner-type (that is in fact the content creator’s learner-type) with the learner-type of the actual content consumer and chooses the content-section that is best suited.

The following example demonstrates this. In Figure 5, the student’s learner-type is split into fragments and lined up individually.

Figure 6 illustrates the learner-type for one content-section created by three different authors (framed). The student’s learner-type (non-framed) is compared with them and the most similar (the third) is chosen.

This concept also enables the coherence service to explain the same topic from different points of view by looping the content-type. Doing this will not repeat the same content-section, but presents the same topic that has been created by another lecturer. This increases the probability of the student understanding the topic he learns about.

Figure 5 Splitting up the learner-type (see online version for colours)
4.4 Mobile aspects

The selection of content-sections is not limited to the context-group learner-types. Location based services (LBS) are also context relevant. It is possible to bind locations to designated locations or movements by defining valid areas that are compared to incoming position data like Gauß-Krüger coordinates. Instead of the exact position, the nearest location could also be chosen as shown above.

The usage of LBS gives great possibilities in choosing the content and defining the path through the content. In the simplest case, the content is adapted to different locations, for example to being at home, in a laboratory or a lecture room. The coherence service might choose the content that has been created by a lecturer working at this university in order to tailor the position of a university to the content.

Especially programmes that require fieldwork, such as soil science and civil engineering but also typical indoor studies like mechanical engineers (Lipovszki and Molnar, 2007) have great advantage from LBS enriched modules. For example, standing at a bridge, the content-section might be able to explain facts about this special bridge. Or it might compare this bridge with others. Pedagogical reasons may require the explanation of the bridge at a certain moment, even though it is not possible to visit the bridge at that moment. The content can be fitted to new situations.

As an example, the use during civil engineering lectures can be mentioned, see Figure 7: presenting right learning content due to position tracking. The link between practical work and theory is done by integrating the forces that act within the building (Köhler, 2003). This can be used together with LBS that ensures that the right building is pre-selected based upon geographic coordinates.

The devices used can be taken into account by assigning a context group that enhances mobility. Special content-sections for PDAs or smart-phones can be created and used whenever they fit.
4.5 Weights and path creation

The content-section is not only chosen in regards to the current context, but also factors in the content’s dependencies. The whole possible path to the content’s end is taken into consideration. All the time paths through the content are created and adjusted depending on what has happened already and the possibilities (content-sections) that remain for further content presentation. Each situation and action influences not only the present content-section, but also the whole path until its end. Hence, a content network is build up and adjusted during runtime. Therefore, the contexts normally do not force but propose a special action. Of course, a specific content-section can be explicitly bound to a concrete situation such as a location, a language, a device or a learner-type. But normally the content-sections are weighted in a way that leaves freedom. For example, a content-section might be presented that does not fit very well to the location but is necessary from a pedagogical point of view.

This flexible approach has a huge demand for content that has to be kept up-to-date. The storytelling-based approach provides a user-friendly approach for non-linear interactive content creation. Nevertheless, Atlantis University currently lacks an integrated authoring environment (Schneider, Braun and Habinger, 2003). But a first step in this direction has been done by developing cooperative content manipulation (CoCoMa).

4.6 Learning by contribution: cooperative content manipulation

When traditional teaching forms are used, the backward channel to the lecturer is limited and learners have little influence on the learning content, since knowledge in sciences as computer science continually loses relevance. In conditions of fast changing information, a new approach to impart knowledge is necessary. This approach involves students more actively and increases their direct influence on the learning content (Figure 9).
Figure 8  Screenshot of cooperative content manipulation (edit mode) (see online version for colours)

Figure 9  Cooperative content manipulation update circle (see online version for colours)
The Atlantis University concept does this by allowing students to generate learning content using WIKI systems and semantic networks. In addition, within the scope of the project, a system called CoCoMa has been developed (see Figure 8 for a screenshot). With CoCoMa, students are able to directly update learning content provided in an initial form by a lecturer. Lecturers do not lose the control of their content (Pieke, Russell and Bleimann, 2007). In contrast to normal versioning tools such as used by WIKI systems, the initial author must actively accept amendments to replace the original version. This way the content is always kept up-to-date (see Figure 9).

Currently, development has started to expand CoCoMa with an alternative-button in combination with recording all context information that is available at the moment of editing. This button graduates students from correctors to co-authors. Instead of accepting the revised version and dismissing all other revisions (including the original), the revised version becomes alternative content. Typically, this will not be a different content but a different view on the topic. Because the added content includes all needed contexts to build new path variants (for example position information, device used and learner-type), the module becomes more and more adaptable on the fly. Hence, the content update circle would become a content enrichment circle.

CoCoMa gives great advantages to both learners and lecturers. Learners may adapt the learning content to their need. They are able to identify themselves with the content that consists of parts of their own work. This results in better learning abilities and results. This approach has been named ‘learning by contribution’.

On the other hand, for many lecturers CoCoMa is the enabler for e-learning like online-content presentation. Students are encouraged to cooperate while lecturers do not lose control. This decreases the reluctance of the shy and anxious about putting content online in an editable manner. CoCoMa will have a positive impact on students and lecturers work with other e-learning components like Wiki.

5 Experiencing the Atlantis concept

Since the academic year 2004/2005 the concept has been tested in several modules within the computing and social didactics faculty. One of these modules is international project-based learning with its aim to develop the Atlantis University platform. Due to the enormous effort that is necessary for this challenging task, this can only be done in a network of universities like the Atlantis Network. This network unites students and lecturers of the faculties of pedagogy, computer science, engineering and design into a multi-national and interdisciplinary research team.

As an XBL module, international project-based learning is structured as follows:

1 The kick-off meeting at the beginning of each semester is held as a typical face-to-face event to prepare the following project phase: all participants meet at one university for four days. The first day is used for introductory purposes. New participants are introduced to the Atlantis University Project and to ongoing and future tasks. The following two days are normally used for social events. Each participant should become acquainted to the other participants. Teams are formed during the last day with a focus of one task for each team. First steps are discussed during the kick-off meeting.
During the longest phase, the teams work collaboratively on their sub-project using the provided e-learning tools of the Atlantis University Portal, for example DMS, Wiki, calendar and chat. Once a month, a videoconference is held to synchronise the teams. The topics processed are: the status of the project, the difficulties and the next steps.

At the end of each project phase again a meeting is held for presenting the results, face-to-face collaboration of the teams and brainstorming of the project’s future tasks. After this project-end-meeting, the teams summarise their work in reports that are due to be submitted to the project management team. The core project members rate these reports and the overall work of the individual student project members so that a mark for the students’ study-module can be provided.

This XBL approach has proved to be very successful for students and project, because of the following reasons:

1. The students learn real-life international and interdisciplinary project work.
2. Students are encouraged to design their own and other students’ future learning.
3. Many ideas are contributions from postgraduate students, for example the CoCoMa (Collaborative Content Manipulation) sub-project and the coherence sub-project. Both projects have been implemented with the help of student groups, researchers and lecturers. The employers’ feedback of the graduated students is very positive: they are impressed by the project itself, its processing and the results achieved by the students.
4. Flexibility in this project requires mobility which plays a decisive role in the learning process. Mobility has several aspects in the context of this project.
   - Mobility – as a requirement for meetings of students and lecturers from different countries. The contact with foreign countries and cultures is a very motivating component. Internationalisation opens the mind for new ideas, other cultures and different approaches. It enables social contacts between the project members and increases the commitment between them. This results in higher commitment to the project and improves team ability (Bleimann and Roell, 2006). The students and their thinking become mobile.
   - M-learning – as a possibility to support learning in mobile contexts (Nyiri, 2002; Seppälä and Alamäki, 2002). An example for this is a traffic guidance system (TGS) whose representation is linked to a simulation. The data generated by the TGS is imported, evaluated and used in the simulation of the TGS. Parameters can be changed, so that the behaviour based on real data can be analysed. The selection of the object is done using geographical coordinates. In this way, the traffic light nearby to the learner has been chosen. More details can be found in Tank (2007).
   - ‘Location-based translation support’ in an m-learning context. Since learning may take place at locations in different countries, technical terms may produce communication problems. This can be mitigated by offering a support for the translation of the technical terms or measurement units depending on the object and its geographical location (Köhler, 2003).

M-learning plays a decisive role as shown during this international learning process.
6 Conclusions

The aim of this approach is to effectively support the development of student capabilities. This is a complex process that requires flexibility on both sides: students and the university. The suggested approach represents a comprehensive package which addresses the needs of this process on various levels.

Based on the ideas of the Atlantis University project, modules like international project-based learning have been introduced. They merge various learning forms in flexible combinations. Students work on their tasks in international teams and they are encouraged to contribute to the lecturer’s module content. Adopting this flexible approach to the delivery of modules leads to the development of skills associated with internationalisation, mobility and effective team work.

A flexible learning system has been developed to support the students in this process. Its presentation of module content is influenced by many adjustable factors that describe the current circumstances by using context-specific information such as location, learner-type and input/output device. To minimise the need for explicit input, much of the information available is recorded in the background.

An interactive storytelling-based service has been developed that manages different contexts (and associated variables) and their influence on the presentation of the content. It affects not only the current presentation but each context also influences the overall creation of learning paths. Furthermore, associated past and current actions as well as future possibilities all influence the creation of learning paths. The algorithms responsible for this task are based on interactive storytelling and their coherence and conclusiveness are assured.

Providing interactive and adaptable content requires a substantial amount of effort related to the organisation and structuring of such content and providing appropriate and sufficient content-sections. The workload to create the appropriate amount of content and the difficulty to adapt this content to various situations means that it is nearly impossible for one person alone to fulfil these demands. The coherence service has been designed to build paths in a very flexible way. Hence, it is also possible to merge learning-modules that have been created by different authors/lecturers. This includes modules from different universities.

A Collaborative Content Manipulation service called CoCoMa has been designed to enable students to propose revisions of content elements/sections. It is as easy as using a Wiki systems. But in contrast to Wikis, the original author has to authorise the revised content. This way the content can easily be kept up-to-date.

By merging the suggested services and methods, a solution is provided which overcomes the problems associated with creating and maintaining the amount of content necessary to provide an interactive and adaptive environment. Accepting such contributions as alternative content instead of the originator having to carry out revisions, means that content can quickly be developed and enriched. The concept is still under evaluation and needs refinement but its first results are very promising.

Currently, the coherence service uses propositional logic algorithms for the fuzzy task of finding the most suitable content-section. Hence, it has well-known problems associated with complete representation. This is, because of the so-called combinatorial explosion, too resource intensive in terms of memory and computing time. Currently, other solutions are being explored. The structured array-based logic (Davidrajuh, 2007) seems to be a promising approach.
Another problem relates to the use of all the context information which is recorded on the fly. Participants need to agree that individual contributions can be used and a way has to be found that satisfies the legal situation. This process is complicated because of the international nature of the project.

Although the initial ideas and concepts which led to the Atlantis University project did not include aspects relating to m-learning, AUP’s flexibility and inherent characteristics relating to internationalisation, team work and mobility have been important considerations from the beginning. M-learning aspects have been incorporated as a matter of course, because they were also required in this context. Hence, the developed methods and services have always been designed in a way which will allow m-learning to be integrated.

References


