The QUIS Requirement Specification of a Next generation E-learning System

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Abstract

The QUIS requirement specification of a next generation e-learning system was one of the main outcomes of the European project QUIS (2005-06). This article summarizes the requirement specification and the experiences the work has provided, with the aim of providing advice to system developers, content providers and researchers within the field of e-learning.

1. Introduction

The main goals of work package 6 in the QUIS project [1] were to develop a requirement specification for a next generation e-learning system and to provide experience and advice to system developers, content providers and researchers in order to enhance quality within e-learning.

The QUIS requirement specification is an attempt to clarify and concretize the vague buzz term "next generation e-learning system". Like the term "web 2.0" [2], "next generation e-learning" is often used, but there is no precise definition or common understanding of the term. Looking at research in the e-learning field, it is clear that there are many different opinions about what a "next generation" e-learning system is. The UNFOLD project claims that activity-based e-learning is the next generation e-learning [3], while others argue that mobile learning is the next generation e-learning [4, 5]. Finally the PLE project at CETIS suggests the PLE (Personal Learning Environment) to be the future within e-learning [6].

The main focus of the QUIS requirement specification is the pedagogical and the technological parts of a next generation e-learning system, not the administrative part. The QUIS requirement specification has a holistic pedagogical approach, and covers several theories of learning, pedagogical methods and learning activities. It also covers different types of learning objectives, taxonomies and assessment tools, and defines the heterogeneous student group through multiple intelligences and proficiency stages.

2. Methodology

The methodology used in the work of the requirement specification is a qualitative approach, more specifically the grounded theory approach [Glaser & Strauss, 1967; Strauss & Corbin, 1990] with data collection from brainstorming sessions and depth interviews among the user groups (students, teachers and researchers), in addition to literature review from the fields of pedagogy and educational technology. We have also conducted experiments with topic maps, online tutoring and learning object metadata standards.

3. The requirement specification

The QUIS requirement specification of a next generation e-learning system is divided into six main parts. Part 1 covers the project drivers, like the purpose, background and goals of the project in addition to the user description. Part 2 describes the project constraints and includes design constraints and definitions, in addition to relevant facts and assumptions. Part 3 presents the functional requirements and the use cases, and describes the context of the work (methods and experiments). Part 4 covers the non-functional requirements with a main focus on how topic maps may realize a personalized learning environment. Part 5 includes the conclusions and part 6 is the appendix, where the lists of use cases and requirements are to be found together with the descriptions of the experiments.

3.1. Functional requirements

The QUIS requirement specification includes about 70 functional requirements divided into the categories assessment, content, collaboration, teaching, student / learning environment and quality assurance.

3.1.1 Assessment: The assessment requirements are divided into three main categories based on different types of learning objectives to be assessed; knowledge, skill and attitude. Each category is described by well-known taxonomies to make sure all aspects of assessment are covered in the requirement specification.

3.1.2 Content: The content requirements put into concrete terms how the learning objects provided in an online learning environment should cover different proficiency stages (from novice to expert) and how the "open source" mentality should be utilized in online learning situations.

3.1.3 Collaboration: The collaboration requirements cover the need of awareness in an online learning environment, and describes how the "open source"-mentality should be utilized in collaboration. This category also covers the perspective of the learner in a producer role in addition to a consumer role.

3.1.4 Teaching: The teaching requirements put into concrete terms how it is possible and necessary to vary teaching methods and media types to meet the demands of a heterogeneous student group. It is important to differentiate to meet the requirements of future online students.

3.1.5 Student / Learning environment: This category covers how the online student / learning environment could be personalized and adapted to the individual student.

3.1.6 Quality assurance of the course level: Quality Assurance Systems (QAS) are on the agenda for most of the academic institutions for the moment. QAS are implemented in every aspect of the activities from the promotion of the courses and enrollment of students until graduating students are leaving the academic institutions. This category of requirements focus on quality assurance on a course level, with both the student and the teacher perspective. The use of e-learning systems gives us a good opportunity to create systems both for monitoring the quality and for rapidly adjust the activities in a wanted direction. The QAS should be implemented to improve the course, not to control the students / teachers. Characteristics of a next generation e-learning system should be that quality assurance of the course level should be built into all parts of the e-learning system as a spiral model [7].

3.2 Use cases

The requirement specification also contains about 30 use cases, where all scenarios are described from both a student and a teacher perspective. The use cases are based on the ten categories of pedagogical methods [8]: Drill, Presentation, Tutorial, Gaming, Demonstration, Discovery, Simulation, Discussion, Cooperative learning and Problem solving. In addition there are use cases covering collaborative annotation of tags, assessment and meta-learning.

4. A holistic pedagogical approach

The main focus of the QUIS requirement specification is the pedagogical and the technological parts of a next generation e-learning system, not the administrative part. The QUIS requirement specification has a holistic pedagogical approach, and covers several theories of learning (not e.g. solely a socio-constructivist or behaviorist learning theory). A holistic pedagogical approach also focuses on a variety of pedagogical methods, which in the QUIS requirement specification are divided into ten main categories (drill, presentation, tutorial, gaming, demonstration, discovery, simulation, discussion, cooperative learning and problem solving). The requirement specification also covers different types of learning objectives, taxonomies and assessment tools, and defines the heterogeneous student group through multiple intelligences, proficiency stages and cultural dimensions.

The holistic approach also entails that a next generation e-learning system must provide good solutions both for students and teachers. There should not be a student-centred, nor teacher-centred system, but a user-centred system, and important users of e-learning systems are both students and teachers. This requires good learning environments as well as good teaching environments. An experience in the work of developing the requirement specification has been the importance of keeping both a student and a teacher perspective in the development.

5. An eclectic learning view

The QUIS requirement specification concludes that a next generation e-learning system must be based on an eclectic learning view and not focus on a single learning view e.g. behaviorism, cognitive constructivism or socio-constructivism. An eclectic learning view can be defined as a learning view drawn upon multiple learning theories, where a behaviorist as well as a socio-constructive learning perspective is accepted in a learning situation. The student group is

heterogeneous and to be able to personalize and differentiate the learning environment and learning process, an eclectic learning view is necessary. The specific subject's distinctive characters allow a variety of pedagogical methods to be used to reach the learning objectives, e.g. to learn how to use the German reflexive pronouns different pedagogical methods can be used, e.g. presentation, demonstration, drill and practice, game etc. Variation and differentiation has been important pedagogical principles within learning for many years, and variation and differentiation is equally important within e-learning.

6. Personal Learning Environment

A holistic pedagogical approach and an eclectic learning view require an online learning environment that provides possibilities for personalization. PLE (personal learning environment) has been suggested as a future goal within e-learning, but the concept of PLE has so far a variety of interpretations.

Johnson et al. describes how different persons have different understandings of the concept "PLE", from "empowering users of informal learning resources away from institutions" or "an extended portfolio" to "a superfluous accessory to the technologies of the desktop operating systems and the World Wide Web" [6]. The variety of interpretation illustrates how diffuse the concept still is.

Our definition of a PLE is an online learning environment where the student is able to customize his / her learning environment based on pedagogical and personal choices.

The need for a PLE within e-learning also entails that a next generation e-learning system must be based on other architectures than is found in existing learning management systems (LMS) / virtual learning environments (VLE). A future e-learning architecture must handle extensive information structures. We suggest that topic maps could be one way to achieve a personalized user interface, and based on the introduced e-learning ontology we have developed PLExus - a prototype of a pedagogical-based PLE [9].

7. Discussion

Higher Education Institutions have the last years been using Learning Management Systems, and our analysis of commercial and experimental e-learning systems concludes that these tools allow for the hand-crafted construction of courses that follow different pedagogical styles and that there are no specific automated tools available to help the teacher implementing more complex pedagogical settings" [9].

7.1 The next generation e-learning

The UNFOLD project claims activity-based learning is the next generation e-learning [3], and the model of learning activity design [10] places the learning activity in the centre. Based on a holistic pedagogical approach, our opinion is that a learning activity is just one of several factors that are important within e-learning. Other important factors are e.g. learning objects, assessment activities etc.

The NKI-project suggests that mobile learning is the next generation e-learning [4]. Their argument is understandable if we agree that the technological solution is the main factor in the transition from one generation to another. We focus on pedagogy in addition to technology, and consider mobile learning to be a technological solution that like computer-based e-learning will find the pedagogical requirements in the QUIS requirement specification useful.

PLE (Personal Learning Environment) is also suggested to be the future within e-learning [6], but the term PLE has so far been variously interpreted. The QUIS requirement specification agrees that personalization is an important factor in the transition to a new generation e-learning, and we define the term PLE to be an online learning environment where the student is able to customize his / her learning environment based on pedagogical and personal choices. We concretize our definition of PLE through requirements, use cases, experiments and prototypes.

We have also experienced that a pedagogical-based PLE requires new approaches to standardization of learning objects. Pedagogical elements of the existing standards are not extensively used. The experiment of using design patterns as a new metadata approach for learning objects was interesting because it focused on pedagogical elements and uses free-text. An alternative learning object metadata standard that strengthens the pedagogical aspects is proposed.

A next generation e-learning system will also be an open system, where both students and teachers produce learning objects, learning activities and assessment activities that may be shared between institutions across Europe.

There is a need for an "open source" mentality with collaborative development of learning activities, learning objects and assessment activities within e-learning. The "open source" mentality should be built into the e-learning systems to allow sharing among online teachers and online students. Marketing of learning objects could be done via PSI (Published

Subject Indicators), available in the topic maps architecture.

The characteristics of a next generation quality assurance system (at the course level) are that it should be built into all parts of the e-learning system. A course QAS should be implemented for learning improvements, not for control, and must have both a student and a teacher perspective.

8. Conclusions

The QUIS requirement specification provides a concretization of the vague concept of a "next generation e-learning system". The project has used the Bologna process as a basis for the work and the QUIS requirement specification contributes with added value, by proposing new insights and input concerning the pedagogical quality within e-learning to the ongoing Bologna process in Europe and the e-learning field.

8.1 New insights

The QUIS requirement specification provides new insights within the e-learning research field. We conclude that a next generation e-learning system must be based on an eclectic learning view and not focus on a single learning view e.g. socio-constructivism. An eclectic learning view is important to ensure variation and differentiation, which are important pedagogical principles within e-learning.

A holistic approach to e-learning and an eclectic learning view require an online learning environment that provides possibilities for personalization. Our definition of a Personal Learning Environment is an online learning environment where the student is able to customize his / her learning environment based on pedagogical and personal choices. Like O'Reilly [2] describes Web 2.0 software as services, not products, a next generation e-learning system will be a number of services presented with personalized views. The QUIS requirement specification describes what services are needed in a teaching and learning environment.

The need for a PLE within e-learning also entails that a next generation e-learning system must be based on other architectures than is found in existing LMS / VLE. A PLE architecture must handle extensive information structures. We suggest that a semantic technology like topic maps could be one way to achieve a personalized user interface, and based on the introduced e-learning ontology we present a prototype of a pedagogical-based PLE.

We have also experienced that the existing standards for learning objects is not ideal in a pedagogical-based PLE. Pedagogical elements of existing standards are not extensively used. Our experiment of using design patterns as a new metadata approach for learning objects is interesting because it focuses on pedagogical elements, uses free-text and introduces the idea of creating the metadata in several steps.

We also conclude that there is a need for an "open source" mentality with collaborative development of learning activities, learning objects and assessment activities within e-learning.

Another experience from the developing process of the requirement specification is that a future e-learning system must focus on meta-learning ("the state of being aware of and taking control of one's own learning" [11]).

Future challenges within the development and use of topic maps within e-learning is to standardize a PSI (Published Subject Identifier) within educational technology, so that the same topics are assigned the same topic names. Marketing of learning objects could be done via PSI, available in the topic maps architecture.

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