An Approach to the Design of Pedagogical Framework for e-Learning

Andrina Granić and Maja Ćukušić
University of Split, Faculty of Natural Sciences, Mathematics and Education, Split, Croatia
e-mail: {andrina.granic, maja.cukusic}@pmfst.hr

Abstract—The paper elaborates on the design of an empirically tested pedagogical framework for e-Learning, covering pedagogies which underpin the subject matter in everyday learning environment as well as the ways in which learning material is delivered and assessed. Designed framework presents an essential part of UNITE e-Learning system conceptualization and development. Five-component pedagogical framework which, by means of its constituents, drives and guides the creation of e-Learning scenarios is presented. An insight to the framework implementation is offered as well.

Keywords—e-Learning, Pedagogical framework, UNITE

I. INTRODUCTION

UNITE (Unified e-Learning environment for the school) [1] is a 30-month project partially supported by the European Community under the Information Society Technologies (IST) priority of the 6th Framework Programme for R&D. Main objective of the project is to provide innovative services in education of the young Europeans by combining different state-of-the-art technologies in e-Learning, also taking into consideration innovation in technology and pedagogy.

Paper presents the results of comprehensive study related to the design of UNITE’s pedagogical framework which should: (i) allow the use of UNITE platform in everyday learning and teaching, (ii) offer sound concepts for the development of learning scenarios and (iii) improve learning experience of students in 14 European schools. Project UNITE is currently in its second phase (out of three) which main objective is the implementation of concepts developed in the first one. Accordingly the paper brings the results of the work done so far.

Pedagogical framework design results from first phase (the one carried out from May to October of 2006) are elaborated along with available, intermediate results of the implementation period from second phase (the one which is conducted from November of 2006 to July of 2007).

The rest of the paper is structured as follows. Section 2 introduces the design of UNITE’s pedagogical framework. The same section elaborates on framework fundamental components – pedagogical approaches and assessment techniques. Section 3 presents framework application instruments and provides an insight into the implementation example. Section 4 concludes the paper.

II. PEDAGOGICAL FRAMEWORK DESIGN

While designing UNITE’s pedagogical framework, three main aspects were taken into account. First, the existing state-of-the-art (SOTA) models of exploitation of the potential of new technologies in pedagogy as well as the list of UNITE user requirements related to pedagogical framework were thoroughly analysed. Both state-of-the-art models in pedagogy and user requirements are available in [2]. Second, in order to acknowledge local context of UNITE network of schools, national and school specifics regarding educational characteristics and existing pedagogical practices were collected and formulated. Consequently, a common framework within the context of our research could have been developed. Third, as the last but not the least, pedagogical experts analysed wider context in order to find out which components should assemble a 'best-practice' pedagogical framework.

As result of the analysis of above aspects, UNITE pedagogical framework with suitable and beneficial theories and practices was developed. The derived framework consists of five components illustrated in Fig. 1: (i) pedagogical framework context, (ii) pedagogical approaches, (iii) assessment techniques, (iv) teacher training and (v) current pedagogical practices implemented in national curricula and national specifics [3].

Fig. 1. Pedagogical framework (PF) components

Framework components along with related relationships are presented in the following.
a) Pedagogical framework context; defines areas that influence the framework itself and forms the basis for further development of UNITE’s theories. Since we need to understand traditional practices in order to challenge them, we have analysed specific aspects of learning processes that UNITE’s pedagogy focuses on, theoretical and pedagogical aspects of e-Learning and mobile learning (m-Learning). As a consequence, UNITE pedagogical framework context presents: (i) how UNITE focuses on the learning process, (ii) e-Learning theoretical and pedagogical aspects, (iii) motivational factors and (iv) strengths and weaknesses of e-Learning in addition to m-Learning and pedagogical aspects as well.

b) Pedagogical approaches; promote principles of constructivist theory, along with blended, collaborative and active learning in particular. Considering the indications of UNITE end users (teachers) on the one hand and our analysis of the broader context on the other, we have outlined above-mentioned pedagogical approaches which UNITE will introduce and promote through its pedagogical framework implementation.

c) Assessment techniques; define and support diverse types of assessments in UNITE. According to acquired user requirements, framework provides four different types of evaluation: (i) computer-based assessment, (ii) tutor-assessment, (iii) self-assessment and (iv) peer-assessment.

d) Teacher training; enables successful online teaching and thus is introduced as an important part of the pedagogical framework. Besides two interactive trainings, Teachers’ handbook for the introduction of pedagogical innovation of the UNITE framework is produced. Areas covered by the handbook include: (i) implementation of pedagogical methods for e-Learning and m-Learning, embracing all aspects of planning, assessment and evaluation as well as (ii) recommendations and practical examples for classroom communication and interaction, new roles of teachers and students in the classroom and alike.

e) Current pedagogical practices and national specifics; implementation of pedagogical changes in UNITE schools already has and will have impact on pedagogical process, assessments and pedagogical assumptions in general. To make good use of the platform potential, national and school specifics regarding educational characteristics and existing pedagogical practice are taken into account. In such context diverse aspects of national specifics were suggested like national practice are taken into account. In such context diverse aspects of national specifics were suggested like national practice and active learning in particular. Considering the constructivist theory, along with blended, collaborative and active learning in particular. Considering the indications of UNITE end users (teachers) on the one hand and our analysis of the broader context on the other, we have outlined above-mentioned pedagogical approaches which UNITE will introduce and promote through its pedagogical framework implementation.

Accordingly, combination of these five UNITE pedagogical framework components enables generation of a set of parameters which will drive and guide the production of learning scenarios. The rest of the section stresses the importance of user requirement acquisition for pedagogical framework design and offers brief insight into main pedagogical approaches and assessment techniques employed in UNITE.

A. User Requirements as Prerequisite for Pedagogical Framework Design

An extensive survey of user requirements collected and formulated in Europe-wide network of 14 schools initiated the design of UNITE system. User requirements specification phase provided a sound foundation for design and implementation/development of UNITE outcomes embracing (i) pedagogical framework (PF), (ii) e-Learning scenarios (LS) and (iii) technological platform (TP). Highly systematic and thorough approach to the requirement specification was applied involving end users, experts and developers as well. A bottom-up, data-driven method was chosen to reflect the real needs of users, whereas a clustering methodology was developed and applied in order to integrate and process (filtering, arrangement, categorization and prioritization) results from user and expert rounds [2].

List of user requirements related to pedagogical framework formed the main point of reference for the first phase of design. Requirements were classified and categorised using a simple matrix (see Fig. 2), as one of many possible ways of categorisation. Matrix rows are associated with autonomous/directed learning and active/passive learning on the one hand, while on the other its columns are related to individualised/collaborative learning. Consequently, such categorization illustrates how for example collaborative learning can take place with diverse degrees of student autonomy, either autonomous learning or directed one.

![Fig. 2. Matrix used to categorise user requirements related to PF](image-url)
and/or group learning, that is collaborative decision making process about how to proceed with learning. Scenarios will in addition engage individuals and/or groups in enquiry based learning, problem solving, case studying and similar, all of which are active learning techniques. This of course would assume a concept of student as a 'producer' or 'constructivist' of knowledge. Furthermore, user requirements related to pedagogical framework also conveyed that teachers would like to practice blended learning and/or flexible learning in their daily practice. Although this has more to do with what the teacher does or how (s)he uses available resources, we present blended learning as one of the PF approaches.

Principles of constructivist theory, blended, collaborative and active learning (all derived from user requirements) are the four key pedagogical principles, praxis or theories which represent one of UNITE pedagogical framework component. Those are the ones which PF integrate into learning scenarios and covers in the implementation phase.

On the other hand, assessment is very important part of learning process in general. Hence while analysing user requirements related to pedagogical framework, we were focused on assessment and knowledge evaluation techniques too. Concerning obtained user requirements, users would like to use four diverse types of assessment in UNITE: (i) computer-based assessment, (ii) tutor-assessment, (iii) self-assessment and (iv) peer-assessment. Those assessment techniques, which will be implemented within e-Learning scenarios, are together with pedagogical approaches main components of UNITE pedagogical framework. UNITE PF design, along with chosen approach and related outcomes, is illustrated in Fig. 3.

Because pedagogical approaches and assessment techniques directly influence and inform learning and teaching process, they are fundamental part of UNITE’s pedagogical framework. Namely, pedagogical innovation, if any, should be made clear in pedagogy or assessment applied in or out of the everyday teaching classroom environment. As every ‘best-practice’ project, UNITE draws on iterative design process advantages. Consequently continuous feedback from teachers and students will inform design decisions (both technology and pedagogy related) all the way through the later phases of the project. UNITE’s key pedagogical approaches along with employed assessment techniques are briefly described in subsequent sections.

B. Pedagogical Approaches in UNITE

Pedagogical approaches, as principles and praxis which UNITE pedagogical framework integrates into e-Learning scenarios and covers in Teachers' handbook as well, are presented in the following.

1) Constructivism

According to [4] constructivism embraces the concept where students create knowledge and meaning through their interaction with one another, their environment and with teachers. Teachers can be thought of as being coaches, facilitators or even partners with learners in the learning process. Constructivism in the classroom promotes active learning processes that lead not only to the construction of a single meaning but also to a contextual system of meaning [5]. Consequently, constructivist approach to teaching and learning forms the theoretical basis upon which UNITE pedagogical model is designed. It will be implemented in various educational contexts in diverse ways (hands-on learning, reflection, interaction, investigation and analysis, cf. e.g. [6]; [7]) requiring from teachers to design instruction accordingly, thus supporting such philosophy of teaching and learning. This emphasizes the fact that in constructivist classroom teacher and student share responsibility and decision making as well as demonstrate mutual respect.

2) Blended Learning

UNITE teachers will use the system as technological enhancement to their everyday teaching process. They will use the best of both traditional, i.e. face-to-face communication and online one according to the principles of blended (hybrid) learning. In hybrid learning one part of the educational communication takes place in a classroom, while the other online. It has been argued that up to 80% of verbal exchange in the classroom is attributed to the teacher [8]. Conversely, in e-Learning courses teachers do not ‘speak’ more than their students [9], suggesting that learners, who are too shy to contribute in the classroom, feel more empowered to do it online [10]. Therefore, blended learning seems as an ideal teaching concept for the future and its employment in UNITE will affect and empower students to considerably contribute online as well.

3) Collaborative Learning

Collaborative learning [11] is a term used for a variety of educational approaches involving joint intellectual effort by students or students and teachers together. It covers a number of approaches with variability in the amount of in-class or out-of-class time built around groups of students working and mutually searching for understanding, solutions and/or meanings. Some forms of collaborative problem solving which will be implemented in UNITE include: (i) guided design as very structured approach to group problem solving where students, working in small groups, practice decision-making in sequenced tasks, with detailed feedback at every step, (ii) cases, stories or real life situations setting up a problem for students to analyze and resolve in class or in study group session and (iii) peer writing involving students working in small groups at every stage of the writing process, formulating ideas, clarifying their positions, testing an argument or focusing a thesis statement, cf. e.g. [11].

4) Active Learning

Active learning is defined as ‘any instructional method that engages students in the learning process’ [11]. It requires from students to think about what they are doing as opposed to passively receiving information from teacher in traditional teaching methods. There is evidence of importance and effects of active learning to the quality of learning, innovations in education and alike.
Fig. 3. UNITE pedagogical framework design – approach and outcomes
Some studies find higher class scores and less variably on items presented via active learning [12], while others as benefits of active learning stress valuable contribution to the development of independent learning skills and ability to apply knowledge, preparing students for future careers [13].

UNITE scenarios will engage individuals and/or groups in various forms of active learning like problem solving, case studying and enquiry based learning, which will contribute to the development of qualities like critical thinking and problem solving. Through these activities students are able to discover new information and become self-managed learners.

C. Assessment Techniques in UNITE

Apart from introduced pedagogical principles and approaches, UNITE’s PF will also support the use of summative and particularly formative assessments in teaching and learning. Summative assessment, also referred to as ‘assessment for accountability’, through oral examinations and written tests, is still predominant way of evaluation of students’ achievements. It is usually used at the end of teaching unit to determine what has been learned by student.

On the other hand, problem solving, stimulations and project work with formative or on-going evaluation present a step forward in order to acknowledge that assessment is actually part of the learning process. Formative assessment, often referred to as ‘assessment for learning’, is defined as ‘all activities undertaken by teachers and/or by their students, which provide information to be used as feedback to modify the teaching and learning activities in which they are engaged’ [14].

Assessment techniques of UNITE’s pedagogical framework promoted in its learning scenarios are introduced hereinafter.

1) Computer-based Assessment

Implementation of online, computer-based assessment requires time and creativity to produce a good set of questions bearing in mind diverse issues: learning objectives, kind of competencies to be mediated to students, extent to which the competencies should be mastered by students, reliability in grading, prevention of cheating, exam construction and alike, cf. [15]. E-assessment enables easier and faster processing and marking of students’ responses as well as offering an immediate feedback about students understanding of subject matter. Another grand advantage of an automatic online assessment process is the elimination of subjectivity that can be present in traditional assessment process.

Quizzes are one of computer-based assessment techniques that will be introduced in UNITE. Those multiple-choice type tests or quiz type questions can be assigned: (i) at the beginning of a course for diagnostic purposes to indicate any areas where prerequisite knowledge may be inadequate, (ii) during a course in order to measure progress in understanding and/or (iii) at the end of a course to assist in revision. Online assessment and the grading in UNITE will not be realised by only by quizzes. Anyway, despite the employed e-assessment techniques, authentication of student identification and detection of plagiarised digital material will be the two obvious challenges [15].

2) Tutor-assessment

e-Learning systems offer students exceptional opportunities for individual communication with their teachers/tutors. Other than using UNITE platform functionalities, teachers can now be contacted via e-mail 24/7 and as a result students actually always have a personal tutor available. Since the assessment and the grading are not realised only by computer-based tests, teachers will use open-ended questions as well (e.g. writing essays or submitting some project work). In such case the evaluation process is extremely time-consuming and self-/peer-assessment could ease the teacher’s assessment overload.

3) Self-assessment

Student involvement in their own assessment is an important part of their preparation for life and future work. Through self-assessment, which is quite opposite to the traditional one where written tests and oral exams still prevail, students can track their personal development and deepen the learning experience. They take more responsibility for their own learning and become more aware of their own knowledge gaps (if any) too, since they assess themselves in relation to the course objectives. With UNITE students will accomplish exercises at their own pace and will receive private feedback messages. Moreover, they will be actively involved in making decisions about their own assessment criteria as well as in judging their own and others’ work as well, cf. [16].

4) Peer-assessment

In peer-assessment students are engaged in helping each other to develop, review and assess other’s course work. The UNITE system will be well suited for peer-assessment because in forums students can easily share and comment on other students work and contributions. They will read forum messages, receive direct feedback on their work and get another perspective to a problem or a topic since they are confronted with many different views and perspectives. Forum discussions are more ‘relaxed’ and can be used for low-stakes testing only. Exchange of ideas, evaluation and comments on the work of their peers makes peer-assessment part of learning process and valuable resource for mutual learning. In order to overcome and avoid comments like ‘I don’t like his/her work’, explicit instructions on what and how to assess, what aspects of the work should be taken into account and similar should be provided.

All things considered, benefits of self-assessment and peer-assessment in UNITE are vast: (i) as formative educational tools, self-/peer-assessments are more student oriented, reduce time spent by teacher and immediately provide feedback to a student, (ii) teachers can evaluate output of their courses more accurately, (iii) students become less dependent on their teachers, responsible and autonomic and furthermore (iv) self-/peer-assessment
helps in removing student/teacher barriers, enabling students to develop problem solving and thinking skills by taking more active roles and developing self awareness, cf. [17].

III. PEDAGOGICAL FRAMEWORK IMPLEMENTATION

Implementation of UNITE pedagogical framework, accomplished through incremental introduction coupled with continuous evaluation, is carried out through Teachers’ handbook, teachers’ training and e-Learning scenarios as well. Implementation phase comprises joint work of UNITE partners and school teachers related to the creation and delivery of new and/or customised scenarios. While working with UNITE platform, teachers make use of fundamental material delivered not only in English, but also on their mother tongue: (i) UNITE e-Learning scenario template along with three scenario examples [17], (ii) Content development handbook [19] and (iii) Teachers’ handbook [20].

The first implementation experience taking place in Elementary school Spinut, Croatia, is subsequently described in brief. Initially teachers were provided with Croatian translation of Teacher and Content development handbooks. Several meetings were held afterwards in order to introduce teachers and pedagogue to respective UNITE pedagogical principles and technological aspects, helping them to enjoy and enrich their e-/m- Learning experience. Comprehension of UNITE key concepts was followed with the development of a number of scenarios based on teachers’ understanding of the pedagogical and technological considerations. This development process was supported through step-by-step guidelines illustrated in Fig. 4.

Development along with the implementation of pilot scenario took place in May of 2007, addressing parts of physics and geography curriculum, particularly lessons related to European transport system. The most relevant material collected by teachers was subsequently employed in UNITE course preparation, hence being available for those who wanted to know more about related subject matter (module Course Editor and Course Viewer). Six groups of approximately equal number of students aged 13 and 14 were formed. Student assignments were placed within UNITE system (module Tasks) and appropriate instructions were provided. Students retrieved textbooks and internet sources as well as consulted their teacher in order to find material related to the problem defined in their assignment. Most relevant resources they found were placed in UNITE platform using mobiles, PDAs, laptops and PCs (modules InfoPool and mediaBoard). Additionally students appended related metadata (module Metadata Editor). While performing assigned duties, they frequently used advantage of forum and chat discussions (modules Forum and Chat). Undertaken activities enabled students to express their own competence and knowledge about the various aspects of transport in Europe and eventually about aspects UNITE system usage. The platform enabled them to create and to edit presentations encompassing answers to all the questions provided in allocated assignments.

Furthermore, various aspects of students’ work were assessed. First, each group filled-in the questionnaires available within the presented course. Second, each presentation was followed with oral examination and discussion among students and their teacher, who provided her/his qualitative evaluation according to the acquired answers. Third, coordination among the group members and their contributions was assessed based on the up-growth of the presentation. Moreover, every student group provided additional feedback about own group work employing peer-assessment and/or self-assessment against their own criteria.

Several snapshots of the UNITE user interface and abovementioned platform components or modules are illustrated in Fig. 5.

IV. CONCLUSION

Schools often fail to recognise potential applications of the new technologies and have difficulties to develop, publish and maintain their own e-Learning policies and strategies. When designing e-Learning system it is very important to have a clear understanding of the planned pedagogical objectives as well as to decide which pedagogical approach will be employed. UNITE’s pedagogical framework, covering theories and practices for the enhancement of a learning experience with the use of information and communication technology (ICT), is a good example of e-Learning pedagogical basis design.

This five-component pedagogical framework (PF), by means of its constituents, produces the set of parameters that drive and guide the creation of e-Learning scenarios. UNITE’s pedagogical framework components are:

- **pedagogical framework context**: defines areas that influence the framework itself and forms the basis for further development of UNITE’s theories,
- **pedagogical approaches**: promote particularly principles of constructivist theory, along with blended, collaborative and active learning in particular,
• assessment techniques; define and support diverse types of assessments as computer-based one, tutor-assessment and self-/peer-assessment,
• teacher training; supports teachers’ work and endorse them during the content production as well as throughout the delivery strategies decision and finally
• current pedagogical practices and national specifics; reflects current pedagogical practices implemented in national curricula and national specifics.

Apparently the UNITE system will not be used to replicate the traditional teaching and learning practices, but rather to constitute the added value in everyday teaching and learning environment as well as for the promotion of autonomous and active learning in both individual and collaborative settings in addition to diverse forms of formative assessments.

ACKNOWLEDGMENTS

This work has been carried out within the project UNITE 026964: Unified e-Learning environment for the school, partially supported by the European Community under the Information Society Technologies (IST) priority of the 6th Framework Programme for R&D. The research has also been supported within the project 177-0361994-1998 Usability and Adaptivity of Interfaces for Intelligent Authoring Shells funded by the Ministry of Science, Education and Sports Technology of the Republic of Croatia.

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