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CHAPTER 6

Nomadic Learning: Is It Delivering on Its Promise? The Tale of Two Projects

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1. Introduction

Wireless technology provides its users the ability to access various on-line content or e-services from any location, any time, and from any device. In many educational institutions the mobility advantage has materialised the vision for “nomadic computing”, which started experimenting with creating a "nomadic learning environment” allowing students to learn at any out-of-the-class locations (Olsen, 2000).

This chapter will discuss the outcomes of two projects related to introducing mobile learning environments in the Polish-Japanese Institute of Information Technology PJWSTK in Warsaw, Poland.

Both projects were based on the concept of "nomadic learning", where a student is a "digital nomad", equipped with mobile device able to play educational content to be "consumed" in any place also out-of-the-class, from any place where internet access works, in many short episodes across the day. Each of two projects was aimed not only to expand the university infrastructure towards introducing nomadic as a new teaching mode, but also to invoke changes in teaching methodology and culture for both learners and teachers. Experiences from these two projects will be briefly discussed and supplemented with conclusions possibly interesting also for other academic institutions.

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This chapter is also raising questions about implementing the nomadic learning concept in practice, as well as it argues that more research is needed on mechanism of adoption of m-learning systems in local settings of a specific educational institution.

2. Related research

2.1 E-learning and m-learning

E-learning systems have been used in academic institutions for decades. Typical functionality of e-learning systems includes (Carliner and Shank, 2008):

- storage and transfer of teaching content (texts, slides, video),
- tasks and assignments for students,
- marking and assessment of student's progress,
- procedures for course administration and reporting.

Contemporary e-learning systems are expected to support teacher-learner communication using tow web-based communication modes:

- synchronous: chat room, messenger, web conferencing,
- asynchronous: bulletin board, e-mails, mailing lists and forum.

Up to recently used on desktop computers, e-learning systems have contributed a lot to creating an electronic learning environment, which now is an important part of contemporary university education.

Across the timespan of e-learning systems gaining popularity in academic setting, the characteristics of user-learner (but also user-teacher) have also changed a lot. Nowadays members of academic community (both students and teachers) undergo following trends:

- often live under pressure of numerous deadlines;
- are mobile, often commuting among many destinations where their activity takes place;
- often communicate with others on-line (e-mail, Facebook, voice) and are often "on-line" all the time, staying within the range of from local wifi or using internet access form their cell phone operator,
- the border between their work and private activities has blurred, because people often study and work at home, what is endangering personal work-life balance.

As a result, small-screen handheld devices have become an essential part of personal equipment, being able to serve also multimedia content for entertainment or leisure. Moreover, multimedia content is an attractive time-killer in specific settings, like waiting in traffic jams, travelling in a subway or on a train, so for young people the habit of reading texts is often perceived as laborious and tends to become marginal.

These recent changes make educator's work nowadays more challenging, because a contemporary student:

- usually has grown-up in image-based culture, overwhelmingly supported by TV, films, videoclips etc.;

- has problem in focusing his/her attention on a specific topic needing longer mental concentration, hence he/she expects frequent switches among the topics during the lecture as it happens in TV channels, otherwise gets bored easily;
- last but not least, with the growing trend to reduce class hours at many universities, learning duties often have to be performed out-of-class as homework, library studies or field projects; in student's life now the learning takes place not always at home but often on a journey, in a mensa, on a corridor, in a campus park - wherever access to internet allows for accessing on-line content or downloading and playing it later in a more convenient situation.

On the other hand, many students nowadays have ability to learn from the screen only, not using printed hardcopies or paper textbooks as it used to be up to recently. Many textbooks are now available as e-books, what supports the educational trend for creating a portable, paperless and private learning environment.

Mobile learning (m-learning, often called for short) is the extension of e-learning, aimed at providing access to educational content on personal pocket devices such as netbooks, smartphones or tablets connected to wireless internet. The learner has ability to participate in a course "live" of "played", using small screen and headphones, provided that quality of image and sound in acceptable, and – more importantly – the learner is increasingly motivated to participate in the course "on the move", out of the class.

M-learning can also be viewed as a natural evolution of e-learning, by adding previously missing component such as the wireless access to the courses. E-learning can be real-time or self-paced, also known as "synchronous" or "asynchronous" learning. Additionally, e-learning is considered to be rather modular and presented in more structured manner than m-learning. In contrary, mobile learning is often self-paced, almost non-modular and informal in its presentation.

As most universities already have their e-learning systems, in many cases introducing m-learning is erroneously viewed as a simple extension of e-learning. Oppositely, m-learning is much more able to change the way how students learn and interact with their teachers, only if appropriate organizational changes have been made beforehand, and that reformatting of existing courses to the mobile format has been also performed. Obviously, there is always a considerable risk of non-adoption of m-learning (as a method and as a system), because there are many factors that may affect its efficiency and outcomes in real settings.

2.2 M-learning: benefits and challenges

Mobile technologies trigger expectations for receiving following benefits from mobile learning (Mobi21, 2014a):

- encourage "anywhere, anytime" learning mode out-of-the-classroom;

- reach underprivileged children affected by digital inequity;
- create new social interactions, improve collaboration and communication on-line;
- enable a personalized learning experience, based on own pace of learning or selecting an individual learning path.

There are also some challenges too, like:

- the potential for unethical behaviour of some learners or data privacy issues;
- mobile devices can be seen as distractions not suitable to be used in school;
- theoretical gap: there is no theory of mobile learning;
- evaluation of mobile learning efficiency in many cases may show superiority of conventional learning methods.

Implementing a m-learning in an educational institution is a complex project, so both benefits and challenges must be carefully weighted before an organization undertakes an effort to introduce mobile learning to their educational practice.

2.3 M-learning adoption dilemmas

There is ongoing discussion in the literature which model is the best to implement m-learning teaching methodologies, and which strategies are the most appropriate (Gea *et al.*, 2011; Mobi21, 2014b). Mobile learning implies that course content and other learning resources would have to be structured in such a way that learners may return to the learning content at any convenient instance. Moreover, reduced size of the device should not restrict accessibility to the course, hence the content should be formatted in a way focused on achieving high usability, accessibility and positive user experience. There is no unified view which sequence of steps is most appropriate for stimulating adoption of mobile learning in educational institutions; however if successful, mobile learning may dramatically change interactions among learners, teachers and course content, bringing substantial cultural change within a specific educational organization (Bryan, 2004).

It may always happen that despite an m-learning system has been implemented, it is not accepted as a part of educational environment, hence not used as intended. The general mechanism of adopting new information technology (IT) solutions has been explored by a Technology Acceptance Model TAM (Davis et al. 1989). The TAM model identifies following acceptance contributing factors, shaping users' attitude when they encounter a new IT-based solution:

- external variables: environmental factors, context of use factors;
- perceived usefulness: the degree to which a person is convinced that the use of a specific system will improve obtained results;
- perceived ease of use: the degree to which person believes that using a particular system or solution will be easy and free from additional effort.

In contemporary networked settings also other factors – organizational, administrative, economical or cultural may strongly affect acceptance of new IT solutions or services. If m-learning could be considered as sort of on-line service available within

specific educational process, then familiarity of target users with other on-line services they may use in private life can be an asset. On the other hand, it may also raise users' expectations level as to quality of m-learning content and services, because users will tend to compare them with quality and usability of (probably much better) commercial solutions they use in other contexts.

Adobe (2010) has published a report on usage of mobile services and how they affect consumers' lifestyle and habits. However, educational services on-line were not identified in this study as a significant part of e-customers' interest, comparing to on-line entertainment, financial services, information search and social interactions on-line. Nevertheless, familiarity with other on-line services and frequent use of handheld devices with no doubt are advantageous factors when planning to introduce educational services to a mobile context of use.

Factors encouraging user's choice of a specific handheld device in a mobile context were in the focus of a recent study performed by Redlarski and Sikorski (2012). They identified four major situations (contexts of use) in which users declared to benefit from using on-line services:

- "home": indoors, when performing spontaneous, usually not work-related tasks,
- "journey": during the journey, in the means of transport, urban commuting, etc.
- "desk": sitting at the table, usually while performing a specific mental work,
- "field": all other situations outdoors - in the city, in a pedestrian traffic, on a trip, etc.

Most popular on-line services accessed by subjects in mobile context during this study were: e-mail, address book, travel services, commuting and travel info, maps, news, weather, finances, transfers, cell phone pop-ups, e-shops and entertainment on-line.

Participants in this observational study reported the following problems, discouraging them from using on-line services with mobile devices:

- unreliable data synchronization between different devices,
- difficulties in opening and saving attachments (PDF, MS Office),
- the need to print a document from a mobile device and other printing-related difficulties,
- the need to wait until the mobile device reboots after hanging up,
- poor usability of mobile applications or m-websites,
- slow data transfer on wifi or cell phone networks.

As a result, main factors determining users' willingness to use the device for accessing on-line services in mobile context can be considered as:

- sufficiently attractive relationship of the time in which the device is ready to use to the duration of the task to be performed,
- low tax complexity (low cognitive load),
- low demand as to precision of manual operations,
- expected format of task result as screen-only (no printing is needed).

Table 1 presents a summary of tasks characteristics guiding users to allocate to specific handheld device to the task, provided users had a choice all devices were available on hand, and connected to local wifi.

Table 1. Preferred handheld devices depending on characteristics of user's tasks

Task characteristics	***Preferred handheld device***
• long-term task, requiring long-term mental concentration (sustained reading and/or precise manipulation) • the need for protracted typing • seating position is preferred, usually at the table ("desk") • the use of printer is necessary	**laptop/netbook**
• frequent, short tasks, periodically repeated but not requiring sustained mental attention • the need for only a short typing on the touch keyboard • when it is not necessary to use the printer (or other peripheral devices, not including headphones) • tasks frequently performed "in motion", in standing posture or while performing other tasks at the same time	**smart phone**
• reading longer texts, without using the keyboard, and usually without the need to print the document • entertainment, multimedia • sitting posture is usually preferred, often in a relaxed mode	**tablet**

Source: based on Redlarski and Sikorski (2012)

The content of Tab. 1 indicates a pattern that describes the characteristics which determine the willingness of the user to access a specific on-line service with a specific handheld device, assuming availability of diverse handled devices and user's freedom to choose the most suitable one.

This research also suggests that in case of prospective use of handled devices for m-learning, learner's tasks should be appropriately structured, and primarily, the teaching method and content of the course must be tailored to mobile context of use. Especially the user's demand for comfort drives the m-learning value in comparison to value received from other alternative channels of access available in multiple contexts of use – a class, home, travel or any other environment. Therefore, due to specific time span of demand for user's cognitive attention, not all courses available in e-learning mode may be suitable for converting into m-learning. Poor usability of the m-learning platform or poor structuring the course content, both resulting from neglecting ergonomic factors relevant to mobile context of use, may result in poor usage of a m-learning system and in failing to deliver expected value to the user – a potential learner.

Following sections describe experiences gathered in two projects aimed at delivering m-learning services to the students; a first one "Nomadic 1"[1] was based on the concepts of "nomadic learning", while the second - "Nomadic 2"[2] attempted to combine the "nomadic" learning mode with puzzle-based learning approach.

3. Nomadic learning - two educational projects

3.1 Rationale and background

PJWSTK (Polish-Japanese Institute of Information Technology) is a high-profile private university, located in Warsaw (Poland), offering graduate programmes in areas such as computer science, social computing, digital media, design, architecture, management or Japanese language and culture.

For almost 15 recent years PJWSTK has developed a robust IT infrastructure supporting didactic processes, including also e-learning, broadcasting for media on the Internet as well as advanced multimedia authoring environment. These resources however were not integrated into one, consistent system, and were not managed in a systemic, coherent manner. Paradoxically enough, it did not affect the quality of teaching the university was known for. Despite of high position of PJWSTK on the Polish education market, so far the university has not developed an internal system for quality management of teaching processes; high quality of education results seem to be resulting rather from high competences and personal engagement of teaching staff than from specific quality-driven organizational efforts.

Multimedia materials aimed for teaching should conform visual accessibility standards developed by W3C (www.w3c.org), because in PJWSTK there are some students who are sight-impaired or handicapped (and some foreign students who are studying only in English language). Unfortunately, accessibility standards so far have not been met, mostly because the teachers were not given guidelines how to prepare slides and other visual materials for optimal accessibility and ergonomics.

Therefore the mail goal of both projects described below was to create internal quality assurance system addressed to teaching quality, accessibility and efficiency, and additionally using latest technological advances in IT for education. The second goal was to introduce the ”nomadic learning” approach to educational practice of PJWSTK, because the students seemed generally well-equipped with various handheld devices. This factor was one of key points in these projects, as long as students’ commitment to mobile devices and their usage can create new opportunities for advancing education opportunities.

[1] full project name was "Nomadic Learning – Improving Quality of Teaching", further we use the "Nomadic 1" name for short

[2] full project name was "Puzzles for the Nomad", further we use the "Nomadic 2" name for short

3.2 Project Nomadic 1 – description

3.2.1 The concept of nomadic learning

Recent progress in information technologies made possible accessing various resources via wireless networks. This progress has changed not only the way how people work and communicate, but also how they solve problems in teams and how they learn. Contemporary, computer-supported process of learning (studying), connected with distance learning, has been transferred in a big part to private time and space, out of the "school building". Because nowadays learning takes place in different forms and in different places it is often called "nomadic learning". According to Alexaner (2004) "nomadic learning", is based on the assumption that a learner in the networked world is a "nomad", who:

- nowadays often gains knowledge and skills "in motion", outside the formal framework set by the conventional educations institutions,
- participates in various projects, communicating with other learners nomads connected in the network.

Because PJWSTK students seemed to be ready for prospective participation in a "nomadic" educational process, the abovementioned definition was accepted as a basis for launching the first project aimed to introduce nomadic learning in PJWSTK. As the students were already prepared, the main challenge undertaken in the project was to prepare the IT infrastructure, the teachers and the organization of educational process for the change that was going to improve educational practices in PJWSTK.

3.2.2 Objectives and scope

The principal goal of the Nomadic 1 project was upgrading the quality, effectiveness and accessibility of the teaching process, basing on latest IT solutions and on introduction of the „nomadic learning" approach. Specific objectives of the project were defined as follows:

- establishing an internal unit responsible for teaching quality assurance and evaluation;
- performing a series of training courses for PJWSTK teachers, aimed at upgrading their teaching skills relevant to advanced use of e-learning in teamwork-based educational processes;
- integration of didactic resources already available by PJWSTK with new multimedia technologies and making them accessible on-line;
- preparing new teaching programs, taking advantage the use of mobile technologies, supplementary to current courses which have been run in a traditional manner.

In planning the objectives and scope of the project it was included that both students and teachers are "nomadic" to some extent:

- students' lifestyle has become mobile (nomadic), while learning process has moved a lot to a private time, out-of-class, including extensive portion of time spent on commuting;
- teachers' lifestyle has also become more mobile (nomadic), as he/she teaches in timeslots scattered across the day/week, in various places sometimes requiring frequent travels among campuses; as a result he/she now spends relatively less time in the office, but still wants to stay in a live contact with the students regardless of physical location at a given moment.

Subsequently, accessibility for the students was expanded from the sight-impaired accessibility to educational process as a whole, focusing on accessibility on-line of the teacher during contact hours also form out-of-office locations. If intended communication functions could be sufficiently supported within the m-learning platform, then the vision of nomadic learning could be also extended by ongoing learner-teacher communication taking place beyond physical distance.

3.2.3 Project stakeholders

The target users in PJWSTK to whom the project addresses its outcomes were specified as two groups:

- all students – primarily from computer science faculty, but also social informatics, information management, digital art and other faculties (including distant learners and weekend courses),
- all teachers and external instructors involved in teaching.

3.2.4 Project stages and workpackages

Following work packages have been defined for the Nomadic 1 project:

1. **Establishing an internal unit responsible for teaching quality assurance and evaluation:**

- cooperating with the steering committee of the project and university authorities during the project;
- performing evaluation and diagnosis of current state as to the quality of educational products and processes in PJWSTK, and identifying areas if needed improvements;
- preparing a set of teaching quality oriented organizational changes in educational and administrative processes in PJWSTK;
- identifying teachers' needs as to professional skills development.

2. **Organizational and IT-related changes:**

- organizational: planning organizational, process oriented and structural changes in PJWSTK, consulting them with PJWSTK authorities, as well as establishing support for the teachers in the areas of upgrading teaching methodology and introducing multimedia materials to courses available on-line;
- IT-related: integration of available teaching resources into new on-line courses and expanding exiting e-learning system with new functionalities, creating sin-

gle access point to all educational resources within PJWSTK (internal educational portal, coordinated by teaching quality assurance unit).

3. **Performing a series of training courses for teaching staff in PJWSTK:**
   - new teaching methodologies, including advanced e-learning functions;
   - authoring multimedia materials for on-line courses;
   - Web 2.0. collaboration technologies in teaching and communicating with students by social media;
   - educational psychology, assessment methods and interpersonal communication.
4. **Setting up a usability laboratory for educational technology evaluation:**
   - preparing guidelines, templates and patterns useful for teachers in preparing multimedia materials for on-line (and traditional) courses;
   - usability evaluation of multimedia content, courses and teaching programmes available on-line;
   - supporting the teachers with consulting and advice on developing high-quality teaching materials of any kind.
5. **Integration and implementation of prospective solutions:**
   - distributing to the teachers materials such as guidelines, templates and patterns for preparing multimedia materials for on-line (and traditional) courses;
   - authoring multimedia content for new courses, to be streamlined for students using handheld devices in nomadic learning mode;
   - upgrading existing IT infrastructure for expanding e-learning system with new functionality, towards creating an internal educational portal accessible with mobile handheld devices.
6. **Conducting courses based on new programs and new (nomadic) model of teaching:**
   - preparing sample courses and testing their effectiveness with expanded IT infrastructure;
   - converting other courses to a nomadic learning mode and running classes with new teaching programmes and new multimedia materials available on-line.

Ultimately, as an intended result of the project, not only teaching quality should be increased, but also attractiveness of the teaching process for the students and its availability - in technical and human dimensions. Nevertheless, the decision will be left to the teacher whether to convert a specific course to the nomadic learning mode. Obviously, not all the courses may be suitable for the m-learning mode, as for instance some courses may require intensive face-to-face contact with the teacher. Because part of the courses will be still run in a traditional way, twice a year a teaching quality evaluation will be performed – both from the viewpoint of the students and the teachers.

3.2.5 Identified risk factors

Following risk factors have been identified for the project:

- short duration time for the project (one year),
- problems with external suppliers of software and hardware,
- software development performed in a big part by internal forces,
- implementation problems relevant to organizational, human and technological issues,
- smaller than expected interest of students in using m-learning, eventually resulting in m-learning adoption smaller than planned.

3.2.6 Project duration

This project lasted one year, from July 2009 to July 2010 and was wholly financed by EEA Grants and Norway Grants via their Poland-based operating institution FSS.

Detailed presentation and discussion of outcomes of the Nomadic 1 project will be available in section 4.1.

3.3 Project Nomadic 2 – description

4.1 The concept of Puzzle-Based Learning

The second project, called Nomadic 2, was launched almost two years after the Nomadic 1 project was completed. Both projects were not only time-sequenced but also complementary, because:

- Nomadic 1 created an IT infrastructure and organizational solutions, as well as it allowed for training the teaching staff to use m-learning in their practice; it provided a fundament for using video and other dynamic content in e-learning systems, shifting towards nomadic mode as planned;
- Nomadic 2 was intended to deliver new value upon the results of Nomadic 1, but it was aimed at combining (already existing) nomadic learning with puzzle-based learning, which is a novel and promising educational methodology.

Puzzle Based Learning (PBL) is a new teaching and learning methodology that is focused on the development of problem-solving skills. As the PJWSTK-affiliated creators of PBL (Michalewicz and Michalewicz, 2008) argue, what is missing in most curricula – from elementary school all the way through to university education – is coursework focused on the development of problem-solving skills. Most students never learn how to think about solving problems. Throughout their education, they are constrained to apply the material from each chapter to solve a few problems given at the end of each chapter. With this type of approach to problem solving, it is not surprising that students are ill-prepared for addressing real-world problems. This traditional approach so far has dominated the educational arena – whether in history, physics, geography, or any other subject – almost ensuring that students never learn how to think about solving problems in general sense.

The main difference between PBL and a traditional way of teaching relates primarily to the methodology. Traditionally the classes are ready to learn the techniques of problem solving, given in the textbook: as they are put in front of us ready-to-use,

hence we do not take the effort to discover them. Then after a student graduates, goes to work and is confronted with a real new problem, he/she faces a question: how to solve it if the ready-to-use solution from the textbook does not work? Unless we have not learned the discovery techniques for problem solving, we are jammed in standardized hints, which hinder our abilities and performance in new situations. Puzzle based learning invokes independent thinking, transferable also to other areas of private or professional life (PuzzleBasedLearning, 2014).

The PBL leads to exploration of the problem space and to creative discovery of a suitable problem solving method. In PBL human error is a good thing, as it encourages to try harder and to induct conclusions on consequences of errors. If available on-line, PBL could be an attractive part of m-learning environment, offering nomadic students a challenge on-the-go, with advanced multimedia demanding bigger span of attention, not always possible in mobile settings.

For these reasons the PBL methodology was found in PJWSTK as an interesting add-on to already exiting m-learning infrastructure, potentially resulting in the development of new skills among target users – and not only among the PJWSTK students and staff.

4.2 Objectives and scope

The launch of this project was motivated by two basic factors:

- low popularity of long-life learning among young people in Poland, who tend to believe that university should still teach a profession good for years of someone's life;
- incompatibility of skills acquired during academic education to the needs of labour market, especially in the case of graduates from humanistic faculties.

The Nomadic 2 project (yet in progress) is aimed at developing solutions that allow young graduates from humanistic faculties (high schools and universities) to supplement new knowledge and skills, particularly sought after by employers. In addition, m-learning based solutions will offer a completely different quality and form of education, tailored to the expectations of young people as well as to the needs of the labour market. Because the learning content will be under continuous adaptation, the project will result in developing an innovative feedback-oriented learning model, combining puzzle-based learning (as a brain teaser) with nomadic learning mode. The training will take place in the form of multimedia courses in the areas of science, knowledge management, entrepreneurship, etc. Graduates of the humanities, after having selected specific courses, will be able to take the chance in competitions, quizzes, social games expanding their skills needed for contemporary professions such as a virtual teamwork leader, social marketer, information manager, health educator or media-based distant teacher.

Three basic deliverables have been defined in this project:

- PBL teaching methodology to be transferred to PJWSTK teachers;

- m-learning platform to be adapted for PBL-based courses and tasks;
- developing PBL-based content (tasks, games, quizzes, puzzles etc.), which will bring more interactivity into educational processes and will be more attractive for learners mainly from outside PJWSTK.

Ultimately, after completing the project, the PBL nomadic m-learning platform (owned by PJWSTK) will be available in open access to all parties, individuals and organizations, interested in reshaping their skills in response to latest demands in a labour market. As a result of this project, in the coming future many puzzle-based learning blocks will be available as game-like apps for smart phones, tablets or other handled devices.

4.3 Project stakeholders

Following project stakeholders have been identified for this project:

- young graduates of humanistic and social studies, who enrol PJWSTK for their further studies as well as any individuals interested in pursuing their skill development with PBL as a part of individual life-long learning education;
- teachers from PJWSTK, but also external instructors, interested in preparing new courses and converting existing teaching content into PBL-based courses; also institutions like vocational training centers or training companies will be able to share their own thematic courses, preferably PBL-based.

4.4 Project stages and workplaces

1. Problem domain – analysis and diagnosis:

- analyzing gaps in skills among science students and humanistic students;
- identification of courses aimed at minimizing skill gaps and their suitability to puzzle/nomadic learning;
- assessment of educational material and its adaptability to puzzle/nomadic learning;
- developing requirements for "puzzle editor" - a tool for converting conventional educational materials into puzzle/nomadic learning methodology;
- converting a sample course into puzzle/nomadic learning, usability testing and performance evaluation with mobile devices;
- pilot study – testing the course with sample of target users, user satisfaction survey;
- analysis of outcomes from pilot study.

2. Conceptual design, prototype solutions and implementation strategy:

- developing a conceptual design of a full-scale system;
- developing a guidelines handbook from converting courses into puzzle/nomadic learning;
- developing a puzzle editor – a tool for developing teaching methodology and converting the format of existing teaching modules;
- adopting e-learning platform for distribution of m-courses;

- developing an implementation strategy.

3. Testing of prototype solutions:

- testing course converting procedures in real settings;
- testing the prototype system in real settings for usability, accessibility and compatibility with standards;
- evaluating learning outcomes from target group and control group.

4. Evaluation of results from prototype solutions:

- evaluation of IT tools: e-learning system, puzzle editor and nomadic methodology editor;
- evaluation of matching course themes to the needs of target users;
- evaluation of efficiency for puzzle/nomadic teaching method and identifying necessary improvements.

5. Developing a full-scale system:

- a final set of courses;
- a puzzle editor and a version management system;
- a "nomadic" handbook with the puzzle-oriented "nomadic methodology" editor.

6. Promoting a full-scale system, its publicity and implementation:

- developing websites;
- promotion and visibility of the system for project stakeholders (social media, newsletter, leaflets, e-mailing, conference presentations);
- developing implementation guidelines for project stakeholders.

4.5 Identified risk factors

Having learnt from the Nomadic 1 project experiences, following risk factors have been identified:

- non-adaptability risk - content of some courses may be not suitable for converting to puzzle/nomadic learning methodology;
- non-systematic use of the system (by students or by teachers) may reduce learning efficiency;
- skeptical attitude of teaching staff to extramural, incidental and mobile forms of learning;
- lack or insufficient interest in new PBL-based method among teaching staff or among students.

4.6 Project duration

This project was assigned for two years, from 2013 to 2015 and has been financed by European Social Fund via their Poland-based operating institution.

Detailed presentation and discussion of outcomes of this project will be available in section 4.2.

4. Implementation and preliminary results

4.1 Nomadic 1 – selected outcomes

4.1.1 Implementation plan

Main components of the road map for the Nomadic 1 project are outlined in Fig.1, including the timeline of the project.

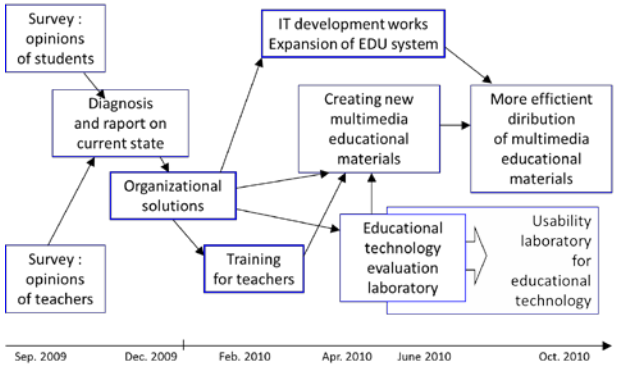

Fig. 1. The timeline and main activities in the Nomadic 1 project

Fig 1. presents only main activities related to nomadic e-learning, neglecting for instance software development works, IT infrastructure supplies and expansion of EDU - e-learning system used in PJWSTK.

4.1.2 Selected activities and their outcomes

Selected activities depicted in Fig. 1 resulted in interesting outcomes, shortly described below.

Diagnosis and report on current state

At this initial stage of the project two surveys were performed, which delivered following conclusions:

- the students in the survey criticized the scheduling the classes and inefficient informing on changes, and suggested more place for teamwork in university building; in turn, they appreciated quality of service offered by library and dean's office as well as the competence of teachers, quality of computer labs and composition of teaching programmes;
- the teachers in their survey were more critical, demanding improvements in following areas: administrative support for teaching, workflow of documents, regular updating documents and procedures, supporting in creation and publishing of electronic teaching materials, scheduling classes, and access to the "good practices" as to teaching quality.

These surveys were a starting point to initiating changes expected in areas related not only to nomadic learning.

Training for the teachers

As planned, a series of trainings for PJWSTK teachers was provided, including subjects such as:

- new educational methodologies, learners' activation techniques, project-oriented learning, evaluation of learning outcomes, interpersonal communication,
- developing educational content, advanced multimedia in teaching, methodology for m-learning, social collaboration on-line.

Expanding the EDU e-learning system

As planned, numerous software engineering works have been performed in order to adapt exiting e-learning system to handling and distributing multimedia materials intended for nomadic learning. These improvements included new functionalities for students and staff (like chat, forum, calendar, single logon, new user interface), but also many back-end works with databases and back-office systems used for administrative purposes.

Usability laboratory for educational technology

The usability laboratory was established with an intention of:

- developing methodology and patterns for improving quality and usability of educational materials,
- providing technical assistance for recording of high-quality teaching materials,
- providing guidance and advice to the authors of the materials.

Fig. 2 presents an example of a sample screen from a selected course using multimedia materials.

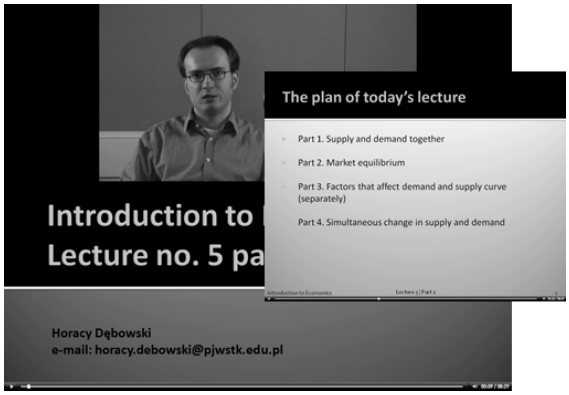

Fig. 2. A sample screen from multimedia course on economics

Organizational solutions

Last but not least, organizational solutions should be mentioned, but they will be not discussed in detail. They included activities not directly related to nomadic learning but equally important for the project:

- expanding internal quality management systems - organizational works, project planning and management;
- expanding IT infrastructure - IT project management.

4.1.3 Evaluation of outcomes

Majority of the project outcomes has been achieved as planned. However, as in many projects, some problems occurred in areas such as:

- coordination of work and timely execution of tasks;
- integration of emerging solutions;
- connecting new solutions with existing ones;
- implementation works made by PJWSTK full-time staff (additional workload);
- incomplete implementation of organizational solutions.

On the other hand, the Nomadic 1 project helped to outline new opportunities opening for PJWSTK as a contemporary educational institution. The project:

- completed the implementation of the new EDU e-learning system;
- facilitated access to materials for students by improved accessibility;
- facilitated easier creation of multimedia materials by the teachers;
- enabled further automation of administrative tasks;
- created support for teachers in the developing and distribution of educational multimedia materials;
- created possibility for high-quality recording of teaching materials self-made by teachers.

It should be noted that it was left to the teachers' decision whether to conduct their classes according to the new "nomadic" model. Nevertheless, the opportunity for studies in the "nomadic" style for everyone has been successfully created.

4.2 Nomadic 2 – selected outcomes

4.2.1 Implementation

For implementing PBL in practice two basic deliverables have been defined in the project:

1. The m-learning platform:

- a web portal aimed to distribute learning materials and courses;
- after the project, the system will be open for all interested parties, and all the content will be available in m-learning mode using smart phones, tablets or any other handheld devices.

2. PBL-based courses, prepared according to PBL methodology and guidelines

- 12 sample courses will be prepared during the project,
- user-friendly user interface and high system usability are considered as essential factors facilitating self-paced learning;
- the content of the courses and methodology of PBL teaching will be consulted by external experts from relevant domains.

Fig. 3 and Fig. 4 show sample screens of the administrative panel and of a sample course, respectively.

Fig. 3. A sample screen of the courses administrative panel

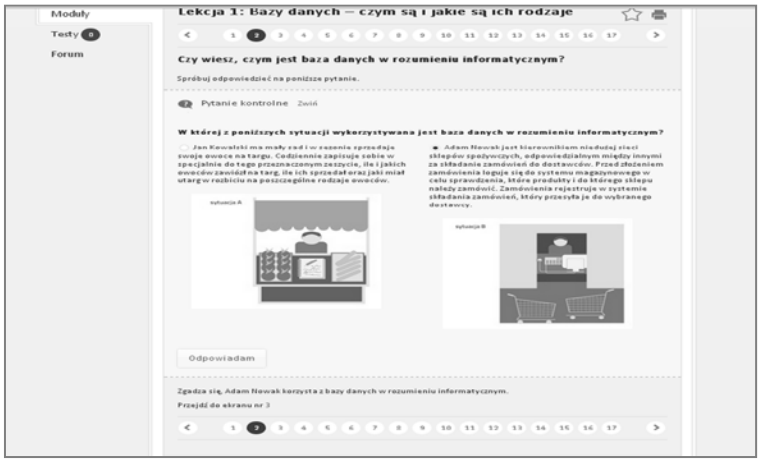

Fig. 4. A sample screen of a selected course

In both areas – developing the platform and developing the courses – iterative design and user-centred development methodology will be used, involving users and other projects stakeholders in order to assure high usability by extensive evaluation and testing of prototypes and conducting small-scale pilot studies.

4.2.2 Evaluation of outcomes

At the moment of writing, in addition to trainings and workshops for the staff, several modules of the m-platform have been already implemented. Fig. 5 shows the current welcome page of the PBL-based m-learning platform.

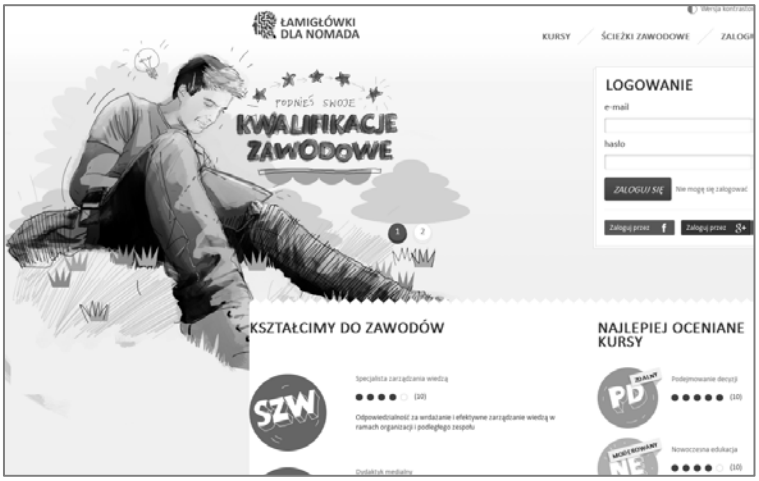

Fig. 5. The welcome page of PBL-based m-learning platform

Two types of evaluation approaches have been used in the project: internal and external evaluation.

Internal evaluation

Internal evaluation has been conducted by following evaluation groups:

- expert evaluations (Project Steering Committee supported by experts from PJWSTK), focusing on:
  - consistency of the whole education system learning;
  - adequacy of the system components to the needs of target groups;
  - degree of implementation of specific objectives, including the level of implementation of the system;
  - quality of project management and assessment of implementation outcomes;
- learner-based evaluations:
  - usability of the m-learning platform;
  - user experience from using the PBL modules;
  - willingness to use the m-platform and PBL courses in the future;
- teacher-based evaluations:
  - usability of the m-learning platform form the teacher's viewpoint;
  - evaluation of workload need to prepare the course with PBL editor;
  - teacher's user experience from using the PBL modules during the teaching and administering the course;
  - willingness to use the m-platform and prepare more PBL courses in the future.

In user-based evaluations questionnaire surveys were used, user workshops, user interviews and usability testing. Altogether about 140 learners participated in evaluation procedures (incl. 60 persons selected for measuring their skill increase), recruited mostly from the project's Facebook fanpage. Teacher-based evaluation was performed with a group of 15 teachers from PJWSTK. Evaluations were performed mostly as A/B testing, while one group used the new m-learning platform and the PBL-based courses, and the control group was developing their skills using traditional methods.

For expert evaluations mostly usability inspection methods and expert panels served as data gathering techniques. Altogether about 20 experts participated in different phases of evaluating the new teaching methodology and the m-learning platform itself.

As a part of internal evaluation also objective performance factors were collected, including for instance:

- quantitative metrics of system usage and learning outcomes;
- m-learning adoption data based on recorded behavior of users in a prototype system;
- time-related ratios related to learning curves and skill development among learners.

External evaluation

External evaluation by experts from outside of the project will cover:

- usability evaluation of a prototype m-platform and its individual modules
- teaching methodology evaluation assessed by an independent expert;
- evaluation of teaching modules selection in regard to matching the needs of the labour market;
- external audit of evaluation reports prepared from internal evaluations.

Because the project is yet in progress, this section presents only a sample of preliminary evaluation outcomes from the current state of Nomadic 2 project:

Preliminary evaluation of learning effects from a puzzle-based pilot course

A questionnaire survey addressed to learners delivered following results:

- average growth of knowledge: + 20% (as the difference between pre and post test);
- acceptance for structuring content: 87% of positive and very positive scores;
- evaluation of the use of interactive elements (in puzzles): 67% assessed positively
- courses completion rate: 80% of users who started.

Survey results among teachers

A questionnaire survey addressed to teachers also revealed their skepticism as to the PBL method:

- for some courses the use of puzzles may extremely difficult or impossible;
- puzzle based learning method is not a universal method, and hence does achieving specific learning outcomes may not be possible in some courses;

- puzzle-based learning implies a large number of interactions and feedback, including guidance from the teacher/group, which may be difficult to reproduce in distance learning conditions.

Guidelines for teachers and IT developers

Surveys and interviews with teachers revealed two groups of guidelines:

- the use of PBL and teaching methodology:

o using PBL should be not obligatory in the learning process;
o it should be determined far in advance which parts of existing course content may not be suitable for converting into PBL, and which ones can be more attractive for students as puzzles or quizzes;
o it is necessary to create a library of puzzles relevant to specific learning outcomes;
o developing easy-to-use puzzle editor is essential for the adoption of PBL;
o providing appropriate and immediate feedback for the user-learner;
o provide full accessibility of content from any device, any browser, by following the Responsive Design trend.

- the m-learning platform and its implementation:

o two overarching structures of the content should be created: one based on sequential diagram (the traditional process of teaching-learning), the other – scenario-based that takes into account programmed learning and will support individual selection of learning content;
o the m-learning platform should support asynchronous mode during the process of teaching and learning, which allows for flexible choice of learning time and diverse forms of work;
o the m-learning platform should support both individual effort for PBL as well as cooperation within the group; the m-learning platform should also support both moderated and non-moderated courses;
o the scope of content to be divided into short thematic pieces, ending with feedback data on learner's performance;
o the m-learning educational platform should allow for accessing the course content using mobile devices, with pay attention to user with low-end handheld equipment.

5. Further works and discussion

5.1. Nomadic 1

The Nomadic 1 project allowed for:

- developing organizational solutions supporting quality of teaching and skill development;
- expanding the IT infrastructure for nomadic learning mode, and m-learning in general;
- establishing usability laboratory and providing support of teachers;
- expanding existing e-learning system towards internal educational portal, suitable for streaming educational video multimedia material.

The Nomadic 1 project was completed on due time and its results were used a basis for starting the Nomadic 2 project.

5.2. Nomadic 2

The Nomadic 2 project allowed for:

- identifying the expectations of learners and teachers as to introducing PBL as a novel educational method;
- training teachers in PBL method and in converting traditional e-learning blocks into PBL based quizzes, puzzles and contests;
- developing ample courses, performing user-based evaluation and gathering feedback useful in developing full version of the m-learning system and full set of PBL-based course materials;

The project is yet in progress, so evaluation results are only partial at the moment of writing, however obtained results look promising.

Further works include integration of m-learning platform with newly developed PBL-based courses as well as further training of more teachers (also from outside PJWSTK) to encourage them to use the method even before the project is fully completed.

Both projects were equally aimed at strengthening educational potential of PJWSTK, but they differed in several distinctive aspects, shown in Tab. 2.

Table 2. Main differences between the Nomadic 1 and the Nomadic 2 projects

Evaluation aspect	***Nomadic 1***	***Nomadic 2***
project duration	- 2009-2011 (13 months)	- 2013-2015 (36 months)
project focus	- m-learning, nomadic learning	- Life Long Learning (LLL)
added value	- developing IT and organizational infrastructure for expanding e-learning to m-learning - developing multimedia content to be streamlined on-line for handheld devices - expanding administrative functions of existing e-learning system	- combining m-learning platform with the PBL methodology - developing PBL courses - developing new distribution channels upon existing e-learning system - promoting cultural change towards mobile learning and out-of-the class relationships with the teacher, group and institution
target groups	- PJWSTK students and staff	- users inside and outside PJWSTK
main deliverables of the project	- organizational solutions for teaching quality - IT infrastructure development - developing multimedia content and reformatting the courses for nomadic learning	- m-learning platform - PBL courses - tools for converting existing courses into PBL blocks
design and development methodology	- content-focused design	- user-centred design

milestones of the project	- analysis, incremental development, no pilot study	- analysis, pilot study, full-scale system
project management paradigm	- quality-driven process	- change management
teaching methodology	- multimedia courses for e-learning	- puzzle-based learning combined with nomadic learning (m-learning)
skill development	- training for teachers: teaching methodologies and e-learning	- training for teachers: puzzle-based learning, methodology for nomadic learning and converting courses to a new format

Both projects can be considered as two parts of the same meta-project – long-term revitalizing the teaching infrastructure expanding teaching methods and enhancing quality of teaching for all stakeholders of the educational process in PJWSTK.

6. Conclusions

Despite of successful progress of both projects, the problem remains unsolved how to secure wide adoption of a full-scale m-learning system without forcing administrative regulations. Sophisticated measures for success have been defined in the running Nomadic 2 project, but it may happen that even fascinating PBL-based courses may be found as interesting curiosity rather than a serious teaching method. Therefore the human factor - commitment of teachers, developing their skills and tracking the changes in lifestyles of end users – they all seem to be crucial factors for successful implementation of m-learning, extended with the PBL methodology and the nomadic learning approach.

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Summary

This chapter discusses the outcomes of two projects related to introducing mobile learning environments in the Polish-Japanese Institute of Information Technology PJWSTK in Warsaw, Poland. Both projects were based on the concept of "nomadic learning", where a student is a "digital nomad", equipped with mobile device able to play educational content to be "consumed" in any place also out-of-the-class, wherever internet access is, in many short episodes across the student's day. Both projects were aimed not only to expand the PJWSTK university infrastructure towards introducing nomadic learning as a new teaching mode, but also were aimed to invoke changes in teaching methodology for both learners and teachers. Experiences from these two projects have been briefly discussed and supplemented with conclusions and guidelines possibly interesting also for other academic institutions. This chapter is also raising questions about implementing nomadic learning concept in practice as well as about factors affecting its efficiency in real settings. This paper concludes that more research attention is needed on understanding the mechanism of adoption of m-learning systems in local settings of a specific educational institution.