Project LEAP: Lean and Agile Practices linking Engineering Higher Education to Industry

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O5. Evaluation of LEAP serious game and instructional support content in Greece, Estonia, Portugal, Spain and UK

Evaluation strategy, mid-project report

FUNDING DISCLAIMER

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1. INTRODUCTION

The LEAP project aims at facilitating the smooth transition of engineering higher education students from the academic environment to the world of work. The project aims to address this goal by exposing higher education students to emerging industrial practices with the objective of preparing them to effectively become integrated into professional environments upon graduation. The project focuses on lean and agile industrial design processes. Lean processes help contain production costs by maintaining simplicity and order throughout the production process. Agile processes help better address customer needs through a work framework in which design and implementation are interleaved in "sprint" work cycles that are executed collaboratively by the implementation team and the customer. This approach ensures that the final product addresses real customer needs and takes into account customer perspective.

The LEAP project develops a serious learning game and supporting educational content that apply in practice problem-based and active learning approaches that help build knowledge through experience. The LEAP problem-based learning framework, learning game, and instructional support content will be validated in real-world contexts in European higher education classrooms. Specifically, project outcomes will be validated in Greece, Estonia, the UK, Spain, and Portugal.

This report introduces the LEAP evaluation strategy, namely a framework for establishing the added-value of the LEAP outcomes through the perspective of the LEAP target users, namely higher education students and educators. The LEAP evaluation strategy will be deployed during the actual evaluation process, which will start in the fall of 2017 and will be completed in August 2018 in-line with the project proposal timeline. The evaluation strategy presented below introduces qualitative models that help establish the perceived relevance, acceptance, and effectiveness of project

results as complementary learning tools to be deployed in wider blended learning contexts.

This document, which details the LEAP evaluation methodology, constitutes a mid-project progress report on O5, i.e. the LEAP evaluation activities. The final version of the report will include descriptions of evaluation activities in higher education classrooms in the foreseen evaluation sites in 5 countries, evaluation results, and recommendations on how to introduce the LEAP outcomes into wider higher education activities based on the experience built through piloting. The final version of the report will be publicly available on month 24, in-line with the project proposal implementation timeline.

2. EVALUATION METHODOLOGY

Participatory user-centred design strategy combined with formative evaluation is applied throughout the LEAP games design that offers the chance and the right tools to researchers and game designers to develop and improve the games iteratively. Participatory design offers a set of practices and studies related to end-users as full participants in activities leading to software and hardware computer products and computer-based activities (Muller and Kuhn, 1993). In Participatory design researchers and practitioners are brought together – but are not necessarily brought into unity – by a pervasive concern for the knowledges, voices, and/or rights of end-users, often within the context of software design and development, or of other institutional settings (Muller, 2002). In LEAP project we engage with different stakeholders in the Stage 1 for developing the LEAP games.

LEAP evaluation strategy is established through formative, quantitative and qualitative evaluation methodologies using the focus-group discussions, observation sheets, and questionnaires in data collection. The qualitative data will be analyzed using the approach to get feedback for LEAP games' functionalities and quality, relevance, acceptance and effective-

ness of games in the higher education learning courses. The quantitative evaluation will focus on the following evaluation aspects described below:

2.1   Evaluation aspects

LEAP evaluation strategy will provide a comprehensive guide on the **quality, relevance, acceptance and effectiveness** of the LEAP serious games (Techincal Debt, 5S Simulator, SCRUM Simulator) and instructional support content. The evaluation process will provide insight to external interested parties, including teachers and policy makers, on how to evaluate the proposed learning frameworks and software tools in relation to desired and expected learning outcomes on employability. The evaluation results will be compiled into a publicly accessible report through which interested parties will be able to get practical feedback on how to best integrate the LEAP proposed methodologies and tools into their own instructional practices.

The following aspects will be the focus of the evaluation process:

- **Overall quality and usability** of the LEAP games - a) feedback and reactions of the game testers and b) game design, functionality, and interactivity aspects.

- **Relevance** of the game to **a) active teaching situations and different subject contexts**; the purpose is to assess the educational added value introduced by the proposed serious games methodology for simulating industry practices in blended learning activities within which games can be used effectively and how teachers use the games in the teaching process in terms of promoting active learning, hands-on experiences and knowledge transferability and abstraction **b) industry processes**; existing industry practices will be considered in order to assess the extent to which the game exposes higher education students to emerging industrial trends **c) teachers' current knowledge and competences**; existing skills of educators will be taken into account for making plans on how these

skills can be updated towards facilitating the more effective integration of ICT into instructional processes d) **students' current knowledge and competences**; this is necessary for ensuring that the LEAP tools address specific learning objectives

- **Acceptance** of the LEAP games by students and teachers, namely the willingness of teachers and students to use the tools in the long-term

- **Effectiveness** the LEAP games to the learning process considering learning outcomes.

The evaluation results will be compiled into a publicly accessible report through which interested parties will be able to get practical feedback on how to best integrate the LEAP proposed methodologies and tools into their own instructional practices.

2.2   Evaluation outcomes

Generating objective feedback from the deployment of the LEAP games and methodologies in real-life educational contexts in Greece, Spain, Portugal, Estonia in diverse educational, cultural, and economic environments.

2.3   Target audience of evaluation

The strategy will provide insight to external interested parties, including teachers and policy makers, on how to evaluate the proposed learning frameworks and software tools in relation to desired and expected learning outcomes on employability.

3. EVALUATION PROCESS OVERVIEW

2.1 Process overview

Evaluation will take place in an on-going manner throughout the implementation period. Outcomes will be widely disseminated to the lifelong learning community and will be used towards the development of a post project adoption strategy.

Phase 1: Participatory Design and formative evaluation (alpha testing) of LEAP games prototypes (during fall 2017)

- The experts and teachers are engaged to participatory design sessions to develop the games. This phase is conducted at the face-to-face and online meetings of the project and documented at the meeting minutes and with design descriptions.

- The testing of the LEAP serious games in its alpha stage by LEAP partners (researchers-educators, small student samples); Instruments: design session evaluation sheet to validate the functionalities of the games.

During the participatory design and testing of the alpha versions of the serious game, users/testers (teachers, students, experts) will have opportunity to put their hands on early but completed scenarios of the game in a design sessions and evaluation acts. During the participatory design stage validation through an external expert will be also pursued in the area of learning design aiming to further improve project outputs and ensure that they meet the needs of students and educators. The expert will be asked to provide their professional input based on their background and experience.

Phase 2: Beta testing - Summative evaluation of LEAP games prototypes, which will take place in the fall of 2017 and spring of 2018.

Beta-testing of LEAP games beta-versions in real-life educational contexts in Greece, Spain, Portugal, Estonia, and the UK with final sample sizes described below.

Instruments: The qualitative evaluation observation sheet of LEAP games for teachers (in each country teaching context at the courses and the LEAP game application process will be described by teachers). The quantitative LEAP games evaluation questionnaire for students.

Sample:

- In Greece (1 site): 70 higher education students

- In Estonia (1 site): 50 higher education students

- In Portugal (1 site): 50 higher education students

- In Spain (1 site): 50 higher education students

- In the UK (1 site): 50 higher education students

At different applicable courses and subject context in the partnering countries the LEAP games and methodologies are introduced. Validation will take place in classrooms through the organization of "learning experiments".

During the validation sessions students will:

- Use the serious games scenarios/exercises off-line at the design stage and before their digital integration into the game for evaluating the game content itself

- Use the virtual game for building experience on agile and lean industrial production design

- Participate in collaboration through end-to-end learning activities build around the serious game

- Be encouraged to discuss their experiences with peers

- Fill in the evaluation questionnaire

During evaluation sessions trainers / instructors will:

- Use observational assessment methods and document the reaction of students and their progress in building experience on agile and lean industrial production design

- Document their findings in short reports to be communicated to consortium partners

2.2. The evaluation categories in instruments

3.1 Quality of LEAP games

a) Evaluating usability of games

Example questions:

Relevance: "Please evaluate the feasibility of the scenarios of the game and by how they respond to teaching and learning situations and subject contexts and workplace conditions of real labour market, e.g. are the scenarios convincing and realistic or they look rather non-original and unrealistic."

"Please provide information and feedback about the effectivity of the features that, according to your opinion, reflect the agile and lean methods of LEAP games. Are there are any other interventions that could help the game become even more suitable for teaching lean and agile methods?"

Quality and usability:

Example questions:

 "Please evaluate the way in which the player-user interacts with the characters and the remaining objects and environment of the game?"

 "Please suggest ways in which the game could be further enhanced in order to become even more interactive and attractive to young people."

3.2 Relevance of LEAP games

a) Relevance to teaching situations and subject contexts

Assessing the educational added value introduced by the proposed serious games methodology for simulating industry practices in blended learning activities (such as evaluating contexts and learning scenarios) where games can be used effectively and how teachers use the games in the teaching process: promotes active learning by doing; promotes knowledge transferability to other subjects

b) Relevance to industry processes

Inspired by real world work practices, have user-centred entrepreneurial mindsets

c) Relevance to teachers - evaluating teachers' knowledge and competences needed for using the games (take into account existing skills of educators and will document how these skills can be upgraded to facilitate integration of innovative technology into their instructional practices.)

d) Relevance to developing students' knowledge and competences according to the learning outcomes

3.3 Acceptance of LEAP games

- Acceptance by teachers – willingness to use
- Acceptance by students – long-term engagement, attraction and interest with LEAP games

3.4 Effectiveness of LEAP games

Evaluating the achievement of expected learning outcomes:

- The development of experience among higher education students on emerging industrial processes, including agile and lean product design
- The capacity of higher education students to understand agile product design that is highly user-centred
- The capacity of students to understand lean product design which promotes the responsible use of resources thus being friendly to the environment and more

a) Effectiveness of educational outcomes - Student exposed to agile and

lean industrial practices

- Can explain how LEAP games simulate lean and agile processes thereby demonstrating that they fully understand what agile is about and why it is applied and how it is applied
- Can learn from lean and agile approaches how to learn new knowledge on their own to be responsive to challenges

b) Educational activities are aligned to industry requirements

- Can apply critical thinking in deciding-thinking cycles
- Can deconstruct a problem into smaller components and solving each of them separately
- Can estimate the duration and feasibility of tasks, considering the needed changes in timeline and efficiency can make dynamic time-management plans for the agile design process
- Can prioritize tasks and allocate competences, have readiness to respect and take various roles in the development process and having holistic understanding of the importance of every role in the agile design process
- Can dynamically needs based way make decisions and propose future steps of actions based on the assessment of the feedback from former stages
- Can plan and analyse trials and handle errors without giving up
- Can adjust initial designs to current requirements reusing the previous work and upgrading it by using the feedback and the previous prototype
- Can flexibly adapt to changes in occasions when requirements come up unexpectedly, including strategic prioritization of the requirements

c) Effectively transfer experience LEAP serious game into the real-world in related educational and future professional activities - students' entrepreneurial mindsets, critical thinking, and collaborative capacity

- Can cooperate with others within the team, be open-minded and receptive to others' ideas to coexist with others so as to complete a specific goal
- Can build relationships with their customers in order to keep up with their needs
- Can develop ability to be flexible and adaptable
- Can develop self-confidence and self-control to stay calm in case of changing challenges
- Can develop openness and receptivity to new ideas or tools
- Can weight every decision when it comes to business and engineering to think and act as professionals in solving everyday life problems

d) <u>Effectiveness of learning outcomes on employability - effective preparedness for transitioning into the world of work</u>

Can apply agile to cope with difficult new situations:

- the capacity of students to apply agile and lean product design in the context of new projects
- the capacity to think out-of-the-box in an entrepreneurial manner for introducing viable solutions that are environmentally friendly and respectful of users / consumers
- The capacity to adopt user-centred approaches in the design of solutions that address real-world needs of consumers

3. DESCRIPTION OF EVALUATION SITES

Greece: In the University of Thessaly, the LEAP project will be applied to a specific number of scholars, approximately one hundred of them, since it will be incorporated, due to the requirements of this project, in the course named "HY420 Software Design and Development", which is taught by H. Tsalapatas. This course is conducted during the 7th semester, in fall, of the studies of the Department of Electrical and Computer Engineering in the

University of Thessaly. This is a graduate program course, available to undergraduate students with instructor's permission; furthermore, it's a course offered to Erasmus students, as well. The scholars will be expected to express what they actually believe about the LEAP project as new engineers that have the qualification of understanding the value of the project. The implementation of the LEAP project is not yet complete. This is one of the basic reasons why their contribution will be crucial for the development and the optimization of LEAP project, because the aforementioned are newly arrived to this field, and have brand-new ideas about the implementation, the design and they can contribute to this project by expressing what exactly their needs are, what makes them learn new knowledge and apply it without being tired, bored or even unwilling.

Apart from the course: "HY420 Software Design and Development", that was mentioned before, there is planning at the University of Thessaly and more specifically at the Department of Electrical and Computer Engineering of a brand-new course which may be conducted through the academic year of 2017-18 and if that happens, H. Tsalapatas will be in charge. It is called: "HY516 Game Design and Implementation", it could be held in the 9th semester, in fall, as an elective course and if it is confirmed, it may create an opportunity of applying the LEAP project to its future students during this course. This could be a great opportunity of this employment, since more students would have the chance to use this serious game and of course they could evaluate it. Nevertheless, there is no further official information about the presence of this course, yet.

Spain: The validation of the LEAP project in Spain will be based on the School of Telecommunication Engineering at the University of Vigo. The project will be applied to a number of scholars around one hundred in the subject "Projects Lab" that is included in the fourth year, second semester of the Degree in Telecommunications Technologies Engineering. This is a graduate program course, available to undergraduate students with instructor's permission and also available for Erasmus students [1]. This

subject involves the development of interdisciplinary projects that must be addressed by a team of students who must represent at least two of the four technologies of the Telecommunication Technologies Engineering Degree. The teams are supervised by two faculty members from different Departments to enrich and facilitate the cross-fertilization between different areas of work.

One of the main issues involved in this subject is the team work performed by students and the development of an engineering project of product. In this context, the application of Lean and Agile methodologies seems very appropriate in order to support team communication, coordination and management as well as the different stages involved in the development of new innovative products towards the provision of value to final users.

Portugal: The evaluation site will take place at the Instituto Superior de Engenharia do Porto (ISEP), the Engineering School of the Porto Polytechnic. With more than 6000 students in total, ISEP offers a wide range of programmes in different fields of Engineering at the Bachelors and MSc levels. It is planned that the evaluation will be done with students from the Bachelor and MSC programmes in Computer Engineering (courses on Software Engineering and Multimedia Applications Architecture), Electrical Engineering (courses on Programming and Management) and Mechanical Engineering (courses on Programming and Management). Approximately 20 students per course will be involved.

UK: 120 students in Preston. The students will use the tools in the contexts of agile learning practices in engineering principles. This work will be implemented under the coordination of UCLan, which has a long tradition of applying agile practices in educational contexts.

Estonia: The evaluation of LEAP games in Estonia will take place in Tallinn University (TLU). TLU is relatively new university with a special focus on interdisciplinarity. We have a lot of projects and subjects that emphasise interdisciplinarity. Project-based approach where LEAP games are

applicable in Tallinn University are: Design courses in study programmes of Educational technology and Informatics.

Also Interdisciplinary cross curricula ELU project will be targeted. ELU is a new type of subject at Tallinn University where students from different study fields carry out a collaborative project on a topic of their interest. The team consists of 6-8 students from at least three different study fields.

It is a subject which is not organised in the form of a lecture and where the teacher does not dictate the students what to do and how to do it. The initiative and management of the activities lies with the students.

Project-based learning is important because in today's world the work arrangement of different areas of life is more often than not project-based: concrete goals have to be achieved by given deadlines and on limited resources, and solutions have to be sought to non-standard tasks. All of it is often carried out in the form of teamwork. It also develops the skills needed for entrepreneurship.

CONCLUSIONS

This report provided an overview of the LEAP evaluation strategy, which is designed in the context of intellectual output 5. The strategy aims to introduce guidelines that the LEAP partners will deploy in the context of evaluation activities with groups of higher education students and instructors in the context of engineering principles with the objective of producing ongoing feedback on how the LEAP outcomes enhance learning experiences related to agile and lean industrial practices. The strategy will be applied in practice in the fall of 2017 and spring of 2018, at which time LEAP partners will implement learning experiments during which students and educators will deploy the LEAP tools in classroom and wider blended learning activities. The outcomes from the evaluation process will be documented in O5, which corresponds to the LEAP evaluation report and guidelines on how to best use the tools based on the input received during the piloting

process. The report will be made publicly available at the end of the project implementation period.

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