

StartUP_EU: Using Game-Based Learning and Web 2.0 Technologies to Teach Entrepreneurship to Secondary Education Students

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Abstract: The present paper reports on the pre-piloting of the StartUP_EU Lifelong Learning European Project. StartUP_EU is a project for secondary schools that replicates the excitement and creative innovation of starting up a new company. The project developed a series of mini-games, an encompassing Web2.0 platform and a collaborative competition for secondary school students, between 14 and 18 years of age, to inspire high tech entrepreneurship. The platform was based on the open source ILIAS Learning Management Content (LCM) platform and the mini-games were developed in 3D Flash. Each mini-game focused on a specific challenge/task associated with business startup. Students participated in a competition completing a series of 8 tasks replicating the process of arriving at an idea for a business to a real product and creating an elevator pitch. Students had to fill in a pre-competition questionnaire at the beginning and a post-competition questionnaire at the end of the competition. The questionnaires were completed online and the pre-piloting lasted eight weeks, from the middle of January 2013 until the middle of March 2013. Forty seven (47) students took part in the pre-piloting with the vast majority of them never taken part in a competition about entrepreneurship and had limited or no experience with game-based learning. This paper presents the results of the pre and post questionnaires.

1. Introduction

Europe faces a number of challenges that can only be met if it has innovative, well-educated, and entrepreneurial citizens who, whatever their walk of life, have the spirit and inquisitiveness to think in new ways, and the courage to meet and adapt to the challenges facing them (EACEA, 2012). It is critical for Europe to maintain a knowledge-based economy and be at the forefront of technological, innovative entrepreneurship to maintain its competitiveness. To meet these targets young people should study and seek careers in the scientific and technological fields and understand entrepreneurship. In a discussion entitled: 'Educating the Next Wave of Entrepreneurs' at the World Economic Forum 2011, it was concluded that the earlier an entrepreneurial spirit is encouraged the better the results for society. This project field was chosen to directly address the motivation of entrepreneurship and innovation within European secondary school students.

StartUp_EU is designed to motivate secondary school students by replicating the excitement and creative innovation of a startup company. The project has created an educational game to develop entrepreneurial skills on a Web2.0 technology platform where secondary school students will learn about entrepreneurship through inspiring and thought-provoking videos, online workbooks covering business and marketing plans, and presentation skills. Students are then supported to develop their own business ideas collaboratively across Europe. The process mirrors the idea creation, barriers and problems in developing new technology and building a company. The goal is to enable students to understand the problems and rewards of working in the exciting high tech area and inspire students to seek out careers in this vital European sector. Through reflection activities students will have the opportunity to understand what factors influenced their success or failure.

According to the Key Competence Framework, the entrepreneurship key competence refers to an individual's ability to turn ideas into action. It includes creativity, innovation and risk taking, as well as the ability to plan and manage projects to achieve objectives (Brag & Henry, 2011). The Web2.0 platform will provide a mechanism for students to turn their ideas into action and includes: communications, facilities for partner finding, inspirational videos, online materials, competition submission, and online presentation tools. The reality of creating a new idea, analysing its potentials and the real need, will be set against the problems and costs of developing the idea into a virtual product for a market. The students will have the option and ability to play the mini-games autonomously.

Digital computer games have now been around for over three decades and the term games-based learning (GBL) has been attributed to the use of computer games that are thought to have educational value. Despite the fact that there has been much debate surrounding this theory (Pivec, 2009), GBL has been applied in a wide variety of different fields including medicine (Beale, Kato, Marin-Bowling, Guthrie, & Cole, 2007; Lennon, 2006; Roubidoux, 2005), knowledge management (Christoph, 2007; Chua, 2005), military training (Schneider, Carley, & Moon, 2005), science and mathematics (Habgood, 2007; Nelson, 2007; Squire, Barnett, Grant, & Higginbotham, 2004; Young & Upitis, 1999) promotion of language education (Johnson & Wu, 2008; Rankin, Gold, & Gooch, 2006), software engineering, computer science and information systems (Ford & Minsker, 2003; Jain & Boehm, 2006; Oh Navarro & Van der Hoek, 2005; Shaw & Dermoudy, 2005; Waraich, 2004; Zhu, Wang & Tan, 2007). Further research (de Freitas, 2006; de Freitas & Neumann, 2009; Egenfeldt-Nielsen, 2005; Prensky, 2006; Squire, 2004; Squire & Jenkins, 2003) has shown that serious games can be a very effective as an instructional tool and can assist learning by providing an alternative way of presenting instructions and content on a supplementary level. GBL and Serious Games can promote student motivation and interest in subject matter resulting in enhanced learning effectiveness.

Learning through games offers increased motivation and interest to learners through introducing fun into the learning process. Adding fun into the learning process makes learning not only more enjoyable and compelling, but more effective as well (Prensky, 2002, p. 4). One of the main characteristics of GBL is the fact that the instructional content is presented together with fun elements. A game that is motivating makes learners become personally involved with playing it in an emotional and cognitive way. By engaging in a dual level, learner attention and motivation is increased (Protopsaltis et al., 2011). Systematic literature reviews (Boyle et al., 2012; Connolly et al., 2012) have indicated that playing computer games confers a range of perceptual, cognitive, behavioural and affective, motivational impacts and outcomes where the most frequently occurring outcomes and impacts were affective and motivational followed by knowledge acquisition/content understanding.

Computer games have also had an effect of students learning styles. Beck and Wade (2004) examined a large number of young professionals and found that their approach to learning was deliberately overlooking the structure and format of formal education. Young professionals extensively used trial and error, welcoming contribution and instruction from peers, and emphasising 'just in time' learning to fulfil their needs and complete their tasks. All of these skills are considered essential in the modern world and GBL can assist towards developing and practicing them.

Furthermore, the next generation of jobs will be characterized by increased technology use, extensive problem solving, and complex communication (Levy & Murnane, 2004). These are skills that go beyond typical reading, writing, and arithmetic of years past. It is not only *what* students need to learn that is shifting, but also *how* and *when* they learn. Students of today are growing up with laptops, tablets, cell phones, and video calls, and they expect to use this technology in their daily interactions (NCREL & Metiri, 2003). Additionally, the skills required for success in games such as thinking, planning, learning, and technical skills are also sought by employers (Federation of American Scientists, 2006). Games are frequently cited as important mechanisms for teaching 21st century skills because they can accommodate a wide variety of learning styles within a complex decision-making context (Squire, 2006), foster collaboration, problem-solving, and procedural thinking (Johnson et al., 2011) which are important 21st century skills and important aspect of entrepreneurship.

2. Method

2.1 Participants

63 participants were registered to the StartUP platform to participate in the initial piloting, forming 13 groups from 4 schools. 49 participants filled out the pre-piloting questionnaire and after data cleansing, 47 questionnaires were used for the analysis. 14 participants (29.8%) were female and 33 participants (70.2%) were male.

2.2 Material

Different types of material were available to the students and teachers through the Web 2.0 platform. The materials were videos, mini-games, how to guides and examples. Videos are videos of 2 to 3 minutes that set the task within the narrative framework and declare the task's goals and expected outcome. Mini-games are self-contained games to be played for stimulating certain skills to be applied in the challenge at hand and save the scores within the game. How to guides are short practical guides that assist in solving the tasks. There are three how to guides, one explaining the StartUP_EU competition, the second explaining the challenges and the third explaining how to use the platform. Examples are useful to enhance the quality of student work by modelling the expected output. The examples were taken from real IT companies (Apple, Dell, Microsoft, etc.). The game rules were presented in written documents describing the rules, roles, deadlines and assets. All the materials were made available through the StartUP_EU platform.

2.3 Apparatus

Two types of apparatus were used in this study a Web 2.0 Learning Content Management System (LCMS) and five independent mini-games.

2.3.1 Web 2.0 LCMS

The StartUP_EU platform was based on the ILIAS 4.3.0 version. ILIAS is a SCORM compliant LCMS developed at the University of Cologne/Germany and is available as Open Source Software (OSS). The technical characteristics available to the users were the following:

- Integration/upload of text, images, audio, video in various file formats including: (jpg, png, gif, mp3, wav, mp4, avi, pdf, doc).
- File upload, material collection and creation of containers such as folders for topics. Uploads were restricted to a defined maximum size to prevent server overload.
- Group communication enabled by the following facilities: messages that could be forwarded to a personal email account, forum, chat, communication with tutor/mentor/discussion board for individuals or teams to ask questions that could be answered by mentors or peers, a star system allowing students to rate each other's responses and allowing mentors to provide qualitative feedback, group collaboration tools (wiki), links to Google Docs documents to allow collaboration, surveys to decide on questions within groups and a calendar to set deadlines for the submission of documents.
- Group brokerage function - groups can form online or offline, rights and roles are defined to support different users on the platform, groups are able to use a "notice board" to post "job offers" to recruit team members with particular skill sets and mentors/tutors can change the status of an individual's group membership.

2.3.2 Web 2.0 LCMS

A set of educational mini-games have been developed that allows students to practice and enhance their entrepreneurial skills as they develop their own business ideas collaboratively and autonomously across Europe. Mini-games have been created to support a number of challenges including:

- Sparking creativity
- Building your company team
- Understanding your clients

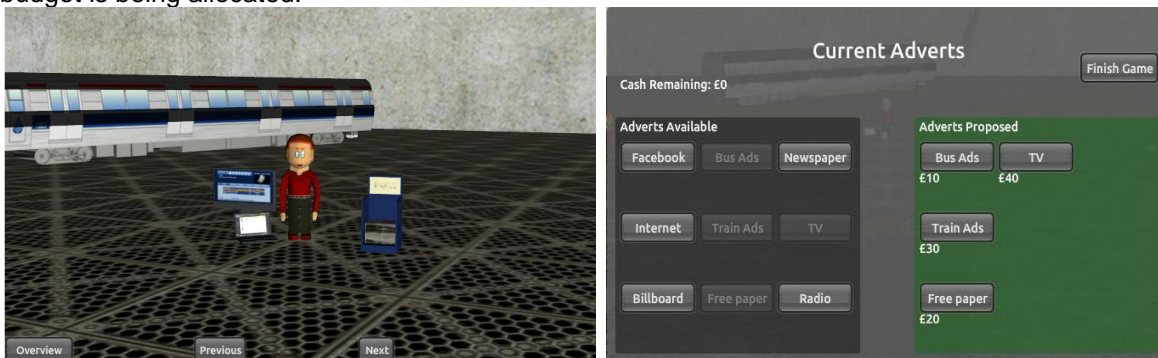
- Marketing your product
- How to develop your IT product.

Assessment in each mini-game is through the use of quests and how well an individual or team performs determines their final score. Mini-games can be played more than once to increase a player's score (that is, increase their learning). For example, in the mini-game 'Understanding your clients' the player plays the role of a salesman who sells a number of products. By driving a car through part of a city, the player has to find potential clients and match them to a suitable product. On finding a client, the player is allowed to ask a number of questions to help select the most appropriate product. Figure 1 provides an illustration of this mini-game.



Figure 1: StartUp mini-game "Understanding your clients"

As a second example, in the mini-game 'Marketing your product', the player is given a marketing budget and has to identify characteristics of his clients that may indicate how the budget should be spent. For example, one client may travel by train and watch TV, while another might travel by train and use the Internet frequently. Given that two clients travel by train, this might suggest that some of the marketing budget should be allocated to train advertising with a lower spend on TV adverts and Internet adverts. Figure 2 provides an illustration of two screens for this game, one where the player is identifying characteristics of a client and the second screen showing an example of how the marketing budget is being allocated.



(a)

(b)

Figure 2: StartUp mini-game 'Marketing your product': (a) finding out about the clients; (b) allocating the marketing budget

2.4 Procedure

The students were set a series of 8 challenges, a preparation stage and a final stage which replicated the process of arriving at an idea for a business. The process involved building a business plan for taking an idea or pitch to the reality of a real product. Each challenge was related to a real problem or information needed to build the business plan and was introduced by a thought-provoking video

accompanied by a mini-game and supportive material which explained in detailed how each challenge should be completed. All the material was uploaded onto the StartUP_EU platform and was accessible online. The pre-piloting assessed three of the mini-games and the StartUP_EU platform.

Students had to fill in a pre-competition questionnaire at the beginning and a post-competition questionnaire at the end of the competition. The pre-competition questionnaire assessed their own experiences, attitudes, knowledge and skills, and their expectations of the StartUP_EU tools, while the post-competition questionnaire focussed on assessing the usability of the tools, students' motivation, pedagogy and the skills developed by the students. The questionnaires were completed online and the pre-piloting lasted eight weeks, from the middle of January 2013 until the middle of March 2013.

3. Results

3.1 Pre-test Questionnaire

3.1.1 Experience with entrepreneurship education

Students were asked to state to what degree they had had previous experience with entrepreneurship education. The metric used included the adjectives “never”, “1-2 times per year”, “twice in a school term”, “once a month”, and “more than once a month”. There was also the option available not to declare anything as a separate option. The majority of participants (23, 48.94%) stated that they never had any experience of entrepreneurship education and 11 participants (23.40%) stated that they only had entrepreneurship education one or two times in a year. The results are as follows:

Table 2: Experience with entrepreneurship education

Past experience with entrepreneurship education	Number	Percentage
More than once a month	2	4.26%
Once a month	3	6.38%
Twice in a school term	3	6.38%
1-2 times per year	11	23.40%
Never	23	48.94%
Not Applicable	5	10.64%
Total	47	100%

Students were also asked to describe briefly their previous experiences with entrepreneurship education programs. Some interesting comments presented by the Belgian students included the following:

- “For economy, we had to create a little company and create our own product.”
- “For an assignment for the economy class, we had to create a self-made product. We also had to sum up all the costs and profits during the production.”
- “‘Kinderen van dewindt’ game, it was a fun game. You had to buy a building and start a business. Last year we played a game were we had to make our own company (buy a building hiring persons ...).”
- “We made a little virtual company and we made a business plan.”

Students were also asked whether they have participated in a competition on entrepreneurship in the past, and if yes, whether they would do that again. Unfortunately only the 8,5% (4) of them had done that in the past, and these four people did not provide additional valuable information concerning their future intentions.

3.1.2 Experience with game-based learning

Students were asked to state to what extent they previous experience with GBL. The metric used included the adjectives “never”, “1-2 times per year”, “twice in a school term”, “once a month”, and

“more than once a month”. There was also the option available not to declare anything as a separate option.

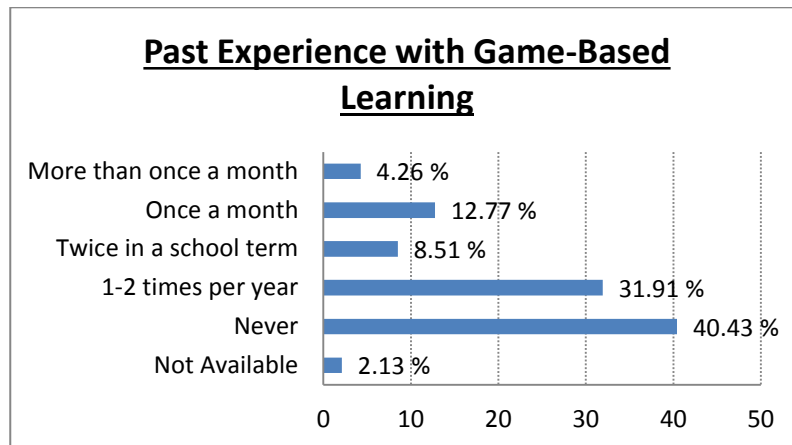


Figure 3: Students past experience with game-based learning

The results in Figure 3 indicate that the 40% of the students have no experience at all with GBL while another 31,91% only had experience once or twice per year.

3.1.3 Self-assessment of entrepreneurship own characteristics

Based on research from the EACEA (2012) students were asked to self-assess their own attitudes, knowledge and skills related to entrepreneurship. The skills included were: self-awareness, self-confidence, sense of initiative, risk-taking, creativity, problem-solving, knowledge on career opportunities and the world of work, knowledge of economic and financial literacy, knowledge on business organisation and processes, communication, presentation, planning, team work, exploring entrepreneurial opportunities, and design business projects. The cumulative results in percentages can be seen are shown in Table 3.

Table 3: Students self-assessment of their entrepreneurship related attitudes, knowledge, and skills.

	Very low	Low	Medium	High	Very high	NA ¹
Self-awareness	0.00	4.26	53.19	25.53	14.89	2.13
Self-confidence	0.00	2.13	46.81	31.91	14.89	4.26
Sense of initiative	0.00	4.26	34.04	46.81	12.77	2.13
Risk-taking	0.00	12.77	29.79	38.30	14.89	4.26
Creativity	0.00	10.64	36.17	31.91	19.15	2.13
Problem-solving	4.26	2.13	29.79	53.19	8.51	2.13
Knowledge - career opportunities and the world of work	0.00	17.02	48.94	19.15	12.77	2.13
Knowledge of economic and financial literacy	2.13	29.79	40.43	17.02	6.38	4.26
Knowledge on business organisation and processes	4.26	29.79	42.55	14.89	4.26	4.26
Communication	0.00	2.13	25.53	51.06	19.15	2.13

¹ NA: Not applicable OR I don't answer OR I don't want to answer

Presentation	0.00	6.38	29.79	46.81	14.89	2.13
Planning	0.00	8.51	40.43	36.17	12.77	2.13
Team work	0.00	0.00	27.66	31.91	38.30	2.13
Exploring entrepreneurial opportunities	6.38	10.64	38.30	21.28	10.64	12.77
Design business projects	2.13	12.77	46.81	23.40	12.77	2.13

The results revealed that students generally self-assessed their entrepreneurship related attitudes, knowledge and skills from medium to high, with the only two exceptions being: knowledge of economic and financial literacy and knowledge on business organisation and processes which were rated medium to low.

3.1.4 Expectations from StartUp_EU

Students were asked also to declare their expectations towards their participation in the StartUp_EU “exercise”. In particular, they were asked to declare which attitudes, knowledge and skills related to entrepreneurship they were expecting to develop through their participation in the StartUp_EU competition. The results are presented in Figure 3.

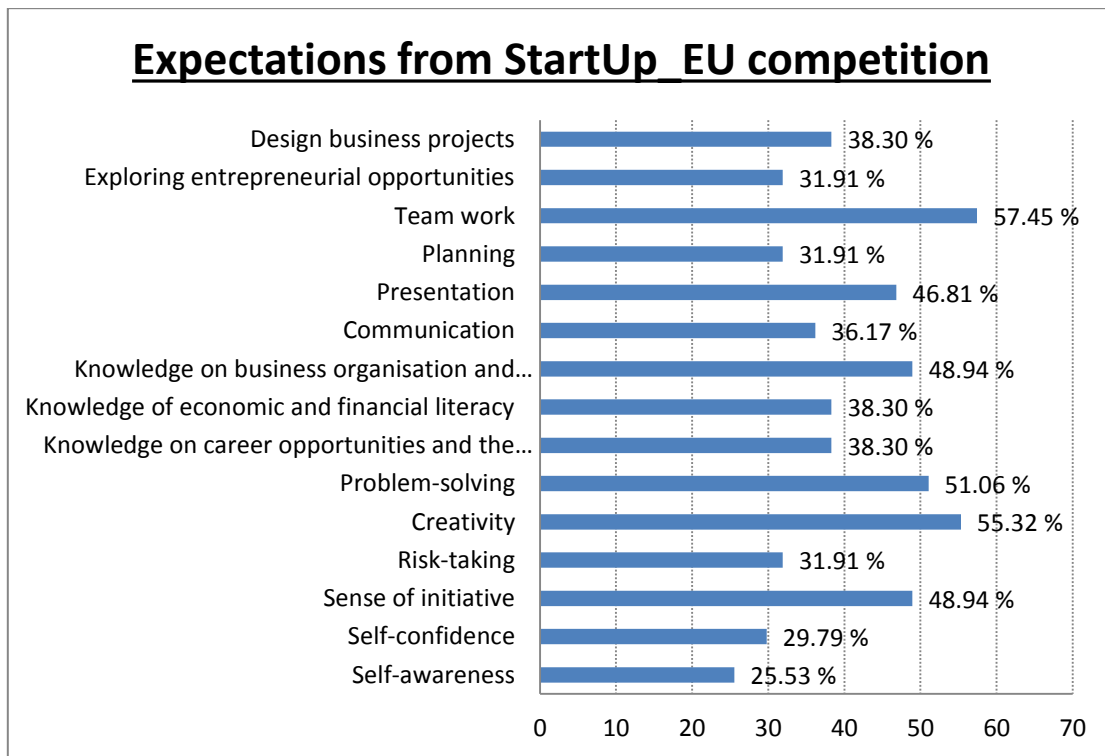


Figure 3: Students expectations in developing skills, knowledge and attitudes

Interestingly, the results showed that students expect – or would like – to develop mostly team working, creativity and problem solving skills through their participation in the StartUp_EU competition. Presentation skills, knowledge of business organization and processes, as well as their sense of initiative are close to the aforementioned first “group” of expectations with the rest of the skills, attitudes and knowledge.

3.2 Post-test Questionnaire

A total of 58 participants completed the post-test questionnaire, 27 participants completed the pre and post-tests. 4 additional participants had also filled in the post-test without completing the pre-test so 31 participants had completed the post-test in total. This means that the analysis can be analysed using the group who had filled in the pre and post-test (27 participants) and the group with the additional 4 participants who had only completed the post-test including that 27 giving 31 participants. It should be noted that an additional 22 participants had completed the pre-test questionnaire and 4 participants that have completed the post-test questionnaire without completing the pre-test. Participants were requested to self-evaluate their participation in the StartUp_EU competition, filling in a questionnaire that included Likert-type questions with the objectives of assessing the following:

1. Their intention to participate again in the StartUp_EU competition
2. Their usability assessment of the StartUp_EU platform
3. Their motivational usability to use StartUp_EU
4. The usefulness of StartUp_EU for learning entrepreneurship
5. The evaluation of the pedagogical model of StartUp_EU in its contribution of developing their entrepreneurial-related knowledge, skills and competences
6. The separate evaluation of learning objects included into the StartUp_EU (videos, mini-games)

The group of 31 participants consisted of 19 males (61.29%) and 11 females (38.71%) and the group of 27 participants consisted of 11 females and 16 males (59.26%).

3.2.1 Intention to use StartUp_EU

The students were asked whether they intended to use the StartUp_EU service to participate in the competition in the following year, given that they have access to the service for this period. The results were generally positive with the majority of the students from both groups specifying either strongly agree, agree or neutral. The results are shown in Table 4.

Table 4: Intention to use StartUp_EU to participate in the competition in the next 12 months

Answer	27 participant group %	31 participant group %
NA or Empty	0.00%	0.00%
Strongly Disagree	0.00%	0.00%
Not Agree	16.13%	14.81%
Neutral	48.39%	51.85%
Agree	32.26%	29.63%
Strongly Agree	3.23%	3.70%

3.2.2 Usability Assessment

The usability assessment of the service was conducted based on the *System Usability Scale (SUS)* of Brooke (1996). SUS is a ten-item attitudinal Likert scale that provides a global view of subjective assessments on usability. It is typically used after the respondent had had an opportunity to use the system being evaluated and yields to a single score representing a composite measure of the overall usability of the system being evaluated. SUS scores have a range of 0 to 100. In the case of StartUp_EU, the respective usability score was estimated to 63.87 for the 27 participant group and 63.15 for the 31 participant group out of 100 respectively, which is a generally positive result.

The constituents of the usability score were also looked at to identify potential areas of improvement for the platform. Some of the key findings were the following:

- 6.45% in the 27 participant group and 7.41% in the 31 participant group found the service to be complex and that the functions were not very well integrated.
- 12.90% in the 27 participant group and 14.81% in the 31 participant group did not find the platform easy to use, stated that they did not feel confident using the service and thought that they had to learn a lot of things before they could proceed. Approximately 10% in each group stated that it was difficult to use and that they would like a technical support person to use StartUp_EU.

- 16.13% in the 27 participant group and 18.51% in the 31 participant group believed that most people would not learn to use StartUp_EU platform very quickly.

The results have shown that overall, minor changes are required to make the platform more appealing, less complex and to improve overall usability.

3.2.3 Motivational Usability

The participants were asked to assess the motivational usability of the StartUp_EU service. The respondents were asked to assess whether StartUp_EU service incorporates novel characteristics, whether it stimulated further inquiry and whether it is enjoyable and interesting. The results are generally positive showing that the StartUp_EU platform is generally enjoyable and interesting. The results are shown in Table 5.

Table 5: Motivational usability of the StartUp_EU service

Group	27 participant group			31 participant group		
	SA	A	N	SA	A	N
Incorporates novel characteristics	7.41%	18.52%	59.26%	6.45%	16.13%	58.06%
Stimulates further inquiry	7.41%	37.04%	44.44%	6.45%	38.71%	45.16%
Is enjoyable and interesting	3.70%	55.56%	29.63%	3.23%	58.06%	29.03%

3.2.4 Usefulness of StartUp_EU

The results indicate that approximately 77% of the students from both groups believed that the service is useful for learning entrepreneurship. Overall, the 51.62% from the 27 participant group and 48.15% from the 31 participant group believe that StartUp is identical for entrepreneurship education.

3.2.5 Evaluation of Entrepreneurship-related characteristics

The students were also asked to assess particular characteristics of the pedagogical model used that are related to entrepreneurship. The reader may remember that these characteristics were also assessed in the pre-pilot phase (pre-test questionnaire). The researchers decided to use the same measures so as to identify potential tensions in increase of these self-assessment measures.

To create more coherent results and identify the potential tensions, only the data from students having completed both pre-test and post-test questionnaires are presented at this stage. At this point we remind the reader that the pre-test questionnaire was asking the respondent to assess its own (current) entrepreneurship-related attitudes, knowledge and skills, whereas the post-test questionnaire was asking him/her to declare whether its participation in the StartUp_EU competition contributed to the increase of the related characteristic. The results are shown in Table 6

Table 6: Ratings of self-assessed entrepreneurship characteristics in the pre and post-tests

Attribute	M before	M after	Difference
Self-awareness	3.59	3.19	-11.14%
Self-confidence	3.81	3.00	-21.26%
Sense of initiative	3.70	3.33	-10.00%
Risk-taking	3.63	2.85	-21.40%
Creativity	3.37	3.44	+2.07%
Problem-solving	3.81	3.56	-6.56%

Knowledge of career opportunities/world of work	3.30	3.19	-3.33%
Knowledge of economic and financial literacy	3.11	3.19	+2.57%
Knowledge on business organisation and processes	2.89	3.56	+23.18%
Communication	3.78	3.11	-17.72%
Presentation	3.74	3.15	-15.78%
Planning	3.70	3.04	- 17.83%
Team work	4.19	3.56	- 15.03%
Exploring entrepreneurial opportunities	3.19	3.33	+ 4.39%
Design business projects	3.30	3.44	+ 4.24%

The results suggest that participants became more hesitant towards entrepreneurship, however there is an increase in creativity, knowledgeable of economic and financial literacy, business organization and processes, inclination to explore entrepreneurial opportunities and design business projects. The decrease in scores of some of the characteristics was possibly due to lack of entrepreneurial experience of participants.

3.2.6 Evaluation of learning objects

The participants were asked to assess the learning objects on the StartUp_EU platform, particularly, to assess whether the videos introducing each challenge were highly motivational, whether the mini-games improved their learning of entrepreneurship, whether they were complicated, and whether they were useful in learning entrepreneurship.

In terms of the videos, results indicate that participants did not agree whether the videos accompanying StartUp_EU were highly motivational or not, however slightly more of the participants indicated that they strongly disagreed or disagreed that the videos were motivational. The results are shown in Table 7.

Table 7: Ratings of the introductory videos

<i>Rating</i>	Strongly disagree - disagree	Neutral	Agree - strongly agree
Videos are highly motivational (n = 27)	45.16 %	16.13 %	38.71 %
Videos are highly motivational (n = 31)	44.44 %	14.81 %	40.74 %

Overall, there is a positive attitude towards the contribution and usefulness of mini-games towards learning entrepreneurship and a quite clear opinion that the mini-games are not complicated. The results are shown in Table 8.

Table 8: Ratings of the attributes of the mini-games

<i>Group</i>	27 participant group			31 participant group		
	SA	A	N	SA	A	N
The mini-games improved my learning of entrepreneurship	25.92 %	37.04 %	37.03 %	32.35 %	32.26 %	35.49 %
The mini-games are useful for learning entrepreneurship	33.33 %	29.63 %	37.03 %	29.04 %	32.26 %	38.71 %
The mini-games are complicated	40.74 %	40.74 %	18.51 %	41.94 %	41.94 %	16.13 %

4. Discussion and Conclusion

Pre-test questionnaire

The majority of the participants in the pre-test (88.94%) stated that they had never had any experience of entrepreneurship education before or only experienced it once or twice a year. This education seemed to take place primarily in the context of an economy class, in a game to start a business or company and constructing a business plan. Only 8.5% of the participants had taken part in an entrepreneurship competition before suggesting that the StartUp_EU competition presents a novel learning opportunity for the participants. The majority of the participants (72.34%) also had never experienced or had only experienced GBL once or twice a year. This again indicates that the StartUp_EU platform presents a number of novel learning opportunities.

Student self-assessment of their entrepreneurship related attitudes indicated that they rated their skills from medium to high. Knowledge of economic and financial literacy and knowledge on business organisation and processes were the only exceptions to this and were rated medium to low. The results indicated that the students were relatively confident in terms of their knowledge and skills and had positive attitudes towards entrepreneurship. The participants expected to develop a number of skills from participating in the StartUp_EU competition including: team work, creativity, problem solving skills, presentation skills, knowledge of business organisation and processes and sense of initiative.

Post-test questionnaire

Students were generally positive about using the StartUp_EU service to participate in the competition in the following 12 months. The majority of the participants stated that they strongly agreed, agreed or were neutral indicating that the StartUp_EU service is appealing enough to get participants to use it in future competitions.

In terms of usability of the service, the System Usability Scale score for both groups was approximately 64%, which is a generally positive result. Approximately 7% of the participants found the service to be complex with functions that were not well integrated. Approximately 14% did not find the platform easy to use and stated that they did not feel confident using the service and thought that they had to learn a lot of things before they could proceed. Approximately 10% in each group stated that it was difficult to use and that they would like a technical support person to assist to use StartUp_EU. 17% of participants believed that people would not learn to use the StartUp_EU platform very quickly. Overall, minor changes are required to make the platform more appealing, less complex and to improve overall usability. Participants generally found the platform to be interesting and enjoyable with regards to motivational usability. 77% of the participants believed that the service was useful for entrepreneurship education and approximately 50% of the participants believed that it was identical for entrepreneurship education.

With regards to participant self-evaluation of entrepreneurship related characteristics, the results indicated that the participants became more hesitant however there was an increase in creativity, knowledge of economic and financial literacy, business organisation and processes, inclination to explore entrepreneurial opportunities and design business projects. The decrease in scores of some of the characteristics was possibly due to lack of entrepreneurial experience of participants or perhaps because participants realized that entrepreneurial education was more complex than originally anticipated.

In terms of the video learning objects, the results indicate that participants did not agree whether the videos accompanying StartUp_EU were highly motivational or not, however slightly more of the participants indicated that they strongly disagreed or disagreed that the videos were motivational. Overall, there was a positive attitude towards the contribution and usefulness of mini-games towards learning entrepreneurship and a quite clear opinion that the mini-games are not complicated and the

majority of participants believed that the mini-games improved learning of entrepreneurship and that they were useful for learning about entrepreneurship.

This paper has presented some of the results of a pilot study of a competition run on the StartUp_EU platform along with the learning objects presented on that platform in the form of accompanying material and mini-games. The results of the mini-pilot have been analysed and used to improve the platform and learning objects for the main-pilot which is currently in progress. Future research directions will involve completing the main pilot and analysing the results on a much larger scale to ascertain if the initial findings are consistent.

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References

- Beale, I. L., Kato, P. M., Marin-Bowling, V. M., Guthrie, N., and Cole, S.W. (2007). Improvement in cancer-related knowledge following use of a psychoeducational video game for adolescents and young adults with cancer. *Journal of Adolescent Health*, 41, 263–270.
- Beck, J. C., and Wade, M. (2004). *Got game: How the gamer generation is reshaping business forever: Harvard business school press*. Boston, MA: Harvard Business School Press.
- Bushnell, N. (2009). Presentation at Game Based Learning 2009 Conference, London, 19–20 March, 2009.
- Boyle, E., Connolly, T.M, Hainey, T., Hancock, F. and Boyle, J. (2012). "Engagement in digital entertainment games: a systematic review", *Computers and Human Behaviour*, Vol. 28, Issue 3, pp. 771-780.
- Bragg, S., & Henry, N. (2011). Order 121 - Study on Support to Indicators on Entrepreneurship Education: Final Report. Birmingham: GHK
- Brooke, J. (1996). "SUS: a "quick and dirty" usability scale". In P. W. Jordan, B. Thomas, B. A. Weerdmeester, & A. L. McClelland. *Usability Evaluation in Industry*. London: Taylor and Francis.
- Christoph, N. (2007). The role of metacognitive skills in learning to solve problems. PhD Thesis submitted to the University of Amsterdam. <http://dare.uva.nl/document/22568> (accessed 15/05/13)
- Chua, A. Y. K. (2005). The design and implementation of a simulation game for teaching knowledge management. *Journal of American Society for Information Science and Technology*, 56(11), 120–1216.
- Connolly, T.M., Boyle, E. A., MacArthur, E., Hainey, T. and Boyle, J.M. (2012). "A systematic literature review of the empirical evidence on computer games and serious games". *Computers and Education*, 59, 661 – 686.
- de Freitas, S. (2006). Using games and simulations for supporting learning. *Learning, Media and Technology Special Issue on Gaming*, 31(4), 343-358.
- de Freitas, S. and Neumann, T. (2009). The use of 'exploratory learning' for supporting immersive learning in virtual environments. *Computers and Education*, 52(2), 343-352.
- Education, Audiovisual and Culture Executive Agency. (2012). *Entrepreneurship Education at School in Europe: National Strategies, Curricula and Learning Outcomes*. Brussels: EACEA P9 Eurydice and Policy Support.
- Egenfeldt-Nielsen, S. (2005). *Beyond edutainment: Exploring the educational potential of computer games*. University of Copenhagen, Copenhagen.
- Federation of American Scientists. (2006). *Summit on educational games: Harnessing the power of video games for learning*. Retrieved from http://www.fas.org/programs/ltp/policy_and_publications/summit/Summit%20on%20Educational%20Games.pdf
- Ford, C. W. and Minsker, S. (2003). TREEZ – an educational data structures game. *Journal of Computing Sciences in Colleges*, 18(6), 180–185.
- Habgood, M. P. J. (2007). The effective integration of digital games and learning content. Thesis submitted to the University of Nottingham. <http://zombiedivision.co.uk/> (accessed 16/05/13).
- Jain, A. and Boehm, B. (2006). SimVBSE: Developing a game for value-based software engineering. In: *Proceedings of 19th Conference on Software Engineering Education and Training (CSEET)*. (pp. 103–114). Turtle Bay Resort, Oahu, Hawaii.

- Johnson, W. L. and Wu, S. (2008) Assessing aptitude for learning with a serious game for foreign language and culture. In: Proceedings of 9th international conference on intelligent tutoring systems. Montreal.
- Klingberg, T., Forssberg, H. and Westerberg, H. (2002). 'Training of working memory in children with ADHD', *Journal of Clinical & Experimental Neuropsychology*, 24, 781–791.
- Korczyn, A. D., Peretz, C., Aharonson, V. and Giladi, N. (2007). 'Computer based cognitive training with mindfit improved cognitive performances above the effect of classic video games; prospective, randomized, double-blind intervention study in the elderly'. Paper presented at the 8th International Conference AD/PD 2007, Salzburg, Austria.
- Lennon, J. L. (2006). Debriefings of web-based malaria games. *Simulation & Gaming*, 37(3), 350–356.
- Levy, F. and Murnane, R. J. (2004). *The new division of labor: How computers are creating the next job market*. Princeton, NJ: Princeton University Press.
- Nelson, B. C. (2007). Exploring the use of individualized reflective guidance in an educational multiuser virtual environment. *Journal of Science Education and Technology*, 16, 83–97.
- North Central Regional Education Laboratory [NCREL], & Metiri Group. (2003). *enGauge 21st century skills: Literacy in the digital age*. Retrieved from <http://pict.sdsu.edu/engauge21st.pdf>
- Oh Navarro, E. and Van der Hoek, A. (2005). Design and evaluation of an educational software process simulation environment and associated model. In: Proceedings of the eighteenth conference on software engineering education and training. Ottawa, Canada.
- Pivec, P. (2009). Game-based Learning or Game-based Teaching? Becta report.
- Prensky, M. (2002). The motivation of gameplay. *On the Horizon*, 10(1).
- Prensky, M. (2006). *Don't bother me mom, i'm learning*. St. Paul, MN: Paragon House.
- Protosaltis, A., Pannese, L., Pappa, D., and Hetzner, S. (2011). Serious Games and Formal and Informal Learning, *eLearning Papers*, elearningeuropa.info, n 25, (July 2011).
- Rankin, Y., Gold, R. and Gooch B. (2006). Gaming as a language learning tool. In: Proceedings of the ACM SIGGRAPH educators program.
- Roubidoux, M. A. (2005). Breast cancer detective: a computer game to teach breast cancer screening to native American patients. *Journal of Cancer Education*, 20(1), 87–91.
- Schneider, M., Carley, K. and Moon, I. (2005). Detailed comparison of America's army game and unit of action experiments. Carnegie Mellon University, School of Computer Science, Institute for Software Research International. (Technical Report CMU-ISRI-05-139).
- Shaw, K. and Dermoudy, J. (2005). Engendering an empathy for software engineering. In: Proceedings of the 7th Australasian computing education conference (ACE2005), Vol. 42. (pp. 135–144). Newcastle, Australia.
- Squire, K. (2004). *Replaying history: Learning world history through playing civilization iii*. Indiana University, Indiana, USA.
- Squire, K. and Jenkins, H. (2003). Harnessing the power of games in education. *Insight*, 3, 5-33.
- Squire, K. (2006). From content to context: Video games as designed experiences. *Educational Researcher*, 35(8), 19-29.
- Squire, K., Barnett, B., Grant, J. M. and Higginbotham, T. (2004). Electromagnetism Supercharged! Learning physics with digital simulation games. In: Proceedings of the international conference on learning sciences, Vol. 6, (pp. 513–520).
- Waraich, A. (2004). Using narrative as a motivating device to teach binary arithmetic and logic gates. In: Proceedings of the 9th annual SIGCSE conference on innovation and technology in computer science education. (pp. 97–101). Leeds, United Kingdom.
- Young, J. and Upitis, R. (1999). The microworld of Phoenix Quest: social and cognitive considerations. *Education and Information Technologies*, 4(4), 391–408.
- Zhu, Q., Wang, T. and Tan, S. (2007). Adapting game technology to support software engineering process teaching: from SimSE to Mo-SEProcess. In: Proceedings of third International Conference on Natural Computation (ICNC). (pp. 777–780).