Teaching Design Thinking through Gamified Learning

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Abstract: Entrepreneurial capacity has long been considered as a key transversal competency applicable in all subjects and educational levels. It empowers individuals to explore their talents, to introduce creative ideas, and to take action towards turning ideas into viable solutions that contribute to business growth and social well-being. Design thinking is a human-centered, solution-oriented approach to entrepreneurial innovation that aims at introducing solutions to business as well as social issues by better understanding how a user experiences a proposed service or product. This paper introduces the design and implementation of active learning digital services supported by gamification principles in learning contexts that facilitate the introduction of design thinking to higher education engineering students. The proposed learning intervention engages students in the design thinking processes of empathizing, ideating, designing, and validating through an on-line learning platform that promotes collaboration in and across teams, brainstorming, and peer reviews of designs allowing students to learn from experience through cases inspired by real world challenges.

1 INTRODUCTION

Innovation is a key driver of economic growth. If facilitates the implementation of ideas into services, the delivery of those services to market, and the support of business operations after launching, creating jobs throughout this process. By driving economic growth innovation facilitates higher living standards and promotes social cohesion. In today's business environment, where unemployment reaches high levels at 6.7% in the general population and 14.9% % among youth in EU28. (Eurostat, 2018), innovation and entrepreneurial thinking can be a catalyst for growth helping curb unemployment by facilitating the pursuit of emerging business opportunities, contributing to the raise of GDP, making good use of human capital, and promoting the wellbeing of society.

In order to put ideas into life it is important to understand the needs and desires of the target group that will benefit from a product or service and the design of a product the perspective of consumers in order to best address those needs. On the other hand, social entrepreneurship, namely using entrepreneurial thinking for introducing solutions to social challenges, is of key importance for today's youth that will be faced with significant challenges as a result of global population growth and its consequences, including shortage of resources, poverty, need for access to education by all, and more. Social entrepreneurship often involves finding solutions where none seems to exist to address complex issues. Using basic field knowledge in combination with entrepreneurial capacity and innovative thinking can lead to social interventions that powerfully address these challenges.

Building the skills that can shape ideas into viable solutions is as important in higher education as developing core knowledge on a specific field. Without those skills ideas will remain ideas and never reach the targeted sector. For this reason, entrepreneurship education is important in higher education curricula. It typically involves basic principles such as performing a feasibility analysis and building a business plan. However, entrepreneurship higher education often lacks the

equally significant social dimension. As a result of this significant omission, society as a whole misses the opportunity to put the fresh, open young minds of students to work towards addressing social challenges, to build social entrepreneurship mindsets, and to build related practical skills that will empower students to be active in the future in civic matters.

2 DESIGN THINKING

Design thinking is a user centred approach in design that aims to introduce fitting solutions to business or social challenges by best understanding how a user experiences a proposed product or service. In business, it aims at enhancing customer experiences helping a company grow. In social entrepreneurship it aims at introducing economically viable solutions to challenging social issues.

While user centred design has been applied in diverse principles for some time, design thinking innovates by introducing a methodology for more accurately addressing user needs. Design thinking differs from traditional analytic user centred design methods by focusing on "going broad" at the initial stages of design (Baeck and Gremett, 2011) without evaluating at that stage potential solutions. The key idea of design thinking is that by fully understanding users, accurately defining a problem statement, collaborating, and thinking out of the box designers may be able to introduce solutions to "wicked" problems to which none appears to exist at first glance.

Varying approaches to design thinking have been introduced; most have as common activities empathizing with users, getting inspiration, ideating for generating a broad range of potential solutions, creating prototypes that a user can interact with, and validating solutions with the engagement of users.

3 A GAMIFIED LEARNING PLATFORM FOR DESIGN THINKING

This work aims at facilitating design thinking in higher education by introducing an active, experiential learning approach that engages students with design thinking principles towards building their capacity to act as innovators in business and civic contents (DesignIT project, 2018). This is facilitated through a the design and implementation of a digital platform that allows students to experiment with design thinking practices by working on problems inspired by the real world (DesignIT project, 2017).

3.1 A Problem-based, Active Learning Methodology for Teaching Design Thinking

Problem-based learning promotes the development of knowledge through active approaches that expose students to problems, often inspired by real life. Problem based learning is part of wider active learning models that support the notion that learners learn better by doing as opposed by being the passive recipients of information. This links problem based learning to constructivist learning design that advocates that knowledge is synthesized rather than transferred. Various approaches to problem based learning are used in practice; however the core principles of identifying a problem, breaking it down to components, solving those, and synthesizing a final solution from parts are often part of a problem learning environment. In additional to core knowledge, problem based learning supports the development of transversal learning skills such as analytical thinking, creativity, ability to collaborate, and others.

This work deploys active and problem-based learning design by exposing students to real-world problems that they are asked to solve by applying design thinking principles (Tsalapatas et. al, 2018). Students are exposed to a challenge that is based on the principle of study and has learning objectives related to curricula work. The challenge is introduced by the instructor; in some cases, the challenge may be introduced by an external company that seeks the innovative mindsets of young engineers to introduce a potential solution to actual business challenges within design thinking practices. Examples of challenges include:

- The design of an e-commerce platform that allows the marketing of goods and services in remote areas while at the same time it helps create sustainable jobs for young individuals.
- The design of a digital learning application that enriches interactivity and engagement in high school STEM education.
- The design of a social game for carers.
- The design of a game for raising awareness on forest fires.
- The design of a user friendly application for local touristic guides.

- The design of a digital service that supports pervasive learning, i.e. learning that can take place interactively anytime, anywhere by exploiting smart devices, geolocation, and increasing network bandwidths.
- The enhancement of digital communication in business.
- The development of innovative search mechanisms for huge image databases.
- The support of communication among construction workers speaking multiple languages.
- The design of smart and sustainable learning ecosystems in schools.
- The design of digital learning ecosystems that promote wellbeing and health.

3.2 Gamification in Learning

Serious games are games, in digital application or other form, which are designed for a purpose other than entertainment. The broader term of gamification refers to the deployment of gaming elements in non-learning contexts, ranging from business to education and training (Huotari & Hamari, 2012, Robson et al, 2015). According to Gartner, gamification elements are deployed in business process management for engaging workers, promoting creativity, understanding customer needs, and meeting objectives (Olding, 2012). In professional training, serious games, often used as simulations of the real world, may be deployed for building skills when training is expensive or involves training in risky procedures. Examples include building personnel skills in a simulated environment for avoiding downtime of production facilities for training purposes, building piloting skills in the safe environment of simulators, or building the skills of medical personnel in emerging medical processes.

In education, gamification is deployed in broader blended learning activities as a tool contributing to the achievement of learning objectives. Gamification mechanisms may include rewards, a sense of affiliation, a sense of purpose, access to additional content upon completion of tasks, assuming roles, group collaboration, competition, social recognition, social sharing of achievement, and others.

In order to be successful, gamification design needs to be linked to educational goals. The exact blend of mechanisms to be deployed depends on the learning scenario and the target group. To ensure that gamification is effective as a learning tool, it must be embedded into wider learning design that includes debriefing and feedback processes for assessing behavioural changes related to learning outcomes (Garris, 2002). The potential that well-designed games offer for instilling positive behaviour has led to the emergence of persuasive games, which aim to provide positive influence in social issues, e.g. promoting healthy lifestyles, training educators to act towards suicide prevention, raising awareness on poverty and homelessness, and more.

3.3 Platform Design and Implementation

Design thinking is a process that requires effort and experience. This work presents a digital platform that facilitates design thinking in learning contexts.

3.3.1 Learning Objectives

The implemented digital platform targets higher education engineering students and has the following high level learning objectives:

- To digitally support broad learning processes that introduce design thinking in engineering and wider contexts.
- To allow flexibility to educators on integrating diverse design thinking practices in the classroom.
- To promote long-term learner engagement with educational activities related to design thinking.
- To enhance collaboration and communication in an active, digitally enabled classroom by providing easy to use facilities that foster ideation, brainstorming, and peer reviews.
- To provide educators with information in individual and team achievement within design teams.

3.3.2 Main Functionality

The platform is designed for deployment in blended learning classroom activities on design (DesignIT project, 2017).

Each class is assigned a “lobby” accessible by its members only. Students work in teams, each of which focuses on a specific challenge. The platform offers flexibility in terms of the organization of the

challenges. Each team may work on a separate challenge, all teams may work on the same, or groups of teams may share a challenge. This flexibility is allowed to support classes in which diverse challenges may be introduced by the instructor or other stakeholders, or teams may wish to define their own challenges.

Figure 1 below demonstrates the entry page of the service.

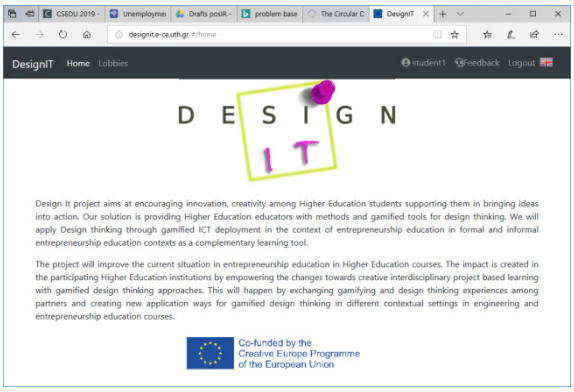

Figure 1: The DesignIT platform entry page.

Figure 2 below demonstrates an example of a lobby corresponding to the "Technology of Education" course of the Department of Electrical and Computer Engineering of the University of Thessaly. In this example, identical challenges are allocate to all participating teams. Students may join the challenges that interest them to collaboratively work with others on designing a solution.

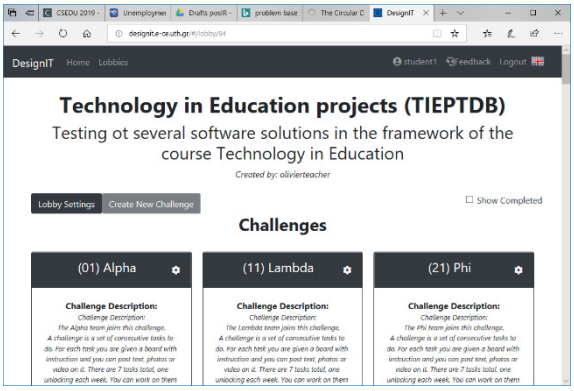

Figure 2: The lobby of the "Technology in Education" class at the University of Thessaly, Greece.

By joining a challenge, a student sees in the form of an arrow at the centre of the screen the list of design thinking activities defined by the challenge creator, who often is the instructor.

Notably, design thinking steps are only presented by numbers as opposed to descriptions. This is a design choice that allows instructors to apply different design thinking paradigms without being restricted to a specific format. The instructor may define the objectives of each numbered step that the students are expected to follow in the design thinking process. For example, step 1 may correspond to ideation, step 2 to reviewing, step 3 to brainstorming, step 4 to refining a solution, step 5 to validating. This is demonstrated below in Figure 3. Design thinking steps demonstrated as numbers for flexibility.

On the main working screen, students work on a canvas on which they introduce "notes", as demonstrated on, which corresponds to the main working page for a student where she may add notes on ideas towards a potential solution to the challenge. The main working screen is shared by all challenge members, who see in real-time additions and modifications made by team members and further have the option of processing each other's additions.

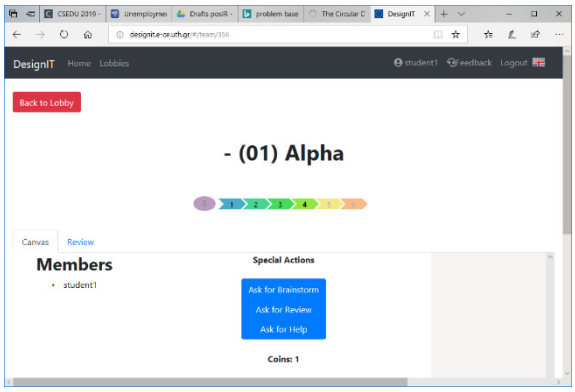

Figure 3: Design thinking steps demonstrated as numbers for flexibility.

On the main working screen, students work on a canvas on which they introduce "notes", as demonstrated on Figure 4.

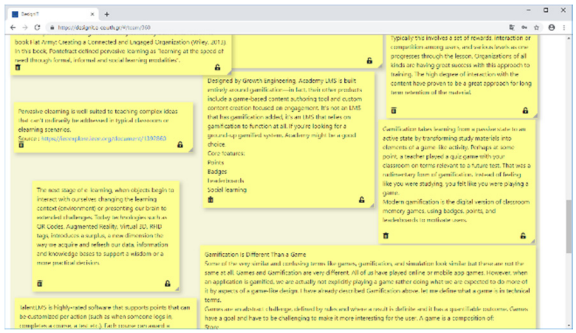

Figure 4: A canvas that supports ideation as a group activity.

Each note may include plain text, an image, or a video highlighting concepts related to the challenge or desired characteristics of a proposed solution. The canvas represents a board of ideas that support ideation created by all challenge members. Notes may be coloured for demonstrating grouping of functions, implementation priorities, or other desired characteristics that team wishes to convey. Team members may also delete notes.

A team may request feedback on a canvas that is work in progress by other students or by the instructor. This can be done in one of two ways:

The team may "Ask for Brainstorm", a function that opens the canvas to students external to the team to edit the challenge canvas by adding notes with ideas. In addition, a team may "Ask for Review" which calls the instructor and external to the team students to provide feedback on the canvas. Feedback may be either in the form of text or "upvoting" or "downvoting" of ideas, a function similar to "liking" in social media contexts.

The brainstorming and review processes are important in design thinking as they promote idea validation. The facilitate collaboration not only within a team but also across teams in a class introducing valuable information towards the design of a solution that best addresses user needs.

3.3.3 Integrated Gamification Elements

Student engagement is promoted through gamification elements integrated into the platform. The elements offer a sense of competition through rewards and recognition of achievement.

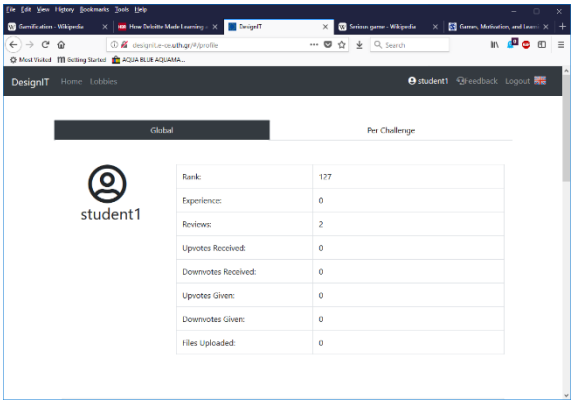

Figure 5: Student rewards: rank, experience, reviews performed, content uploaded.

One form of rewards is coins, which students for participation at the global level, which refers to overall engagement, and at the challenge level, which refers to engagement in a specific educational activity. A student receives coins for uploading content into the platform, reviewing the work of peers, and receiving reviews.

Students furthermore build experience for participating in learning, for example for joining a challenge, reviewing, asking for help, participating in a brainstorm, and other activities. Students are ranked by experience, which adds a further element of competition.

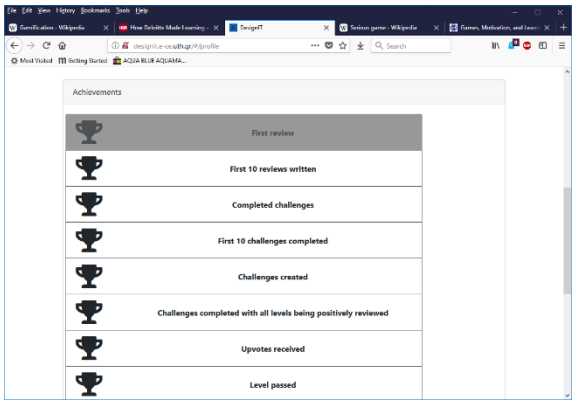

Figure 6: Student achievements for reaching milestones.

Another form of reward is achievement trophies that student receive upon reaching a milestone such as creating a challenge, completing a challenge, completing 10 challenges, completing a challenge with only positive reviews, reaching the highest levels of the rank, and more.

4 CONCLUSION

This article presented the design and implementation of digital services that support learning processes on design thinking. A flexible tool has been implemented, aiming to promote student creativity and collaboration towards innovative and entrepreneurial thinking. The tool has been designed for deployment in broad design thinking activities that empower students to see opportunities and turn ideas into action. The tool further promotes the capacity of educators to introduce innovative learning interventions into the classroom through emerging technology supported active learning frameworks. The tool is currently being evaluated in learning experiments taking place in higher education institutions in Greece, Estonia, Portugal, and Finland. Early feedback is very positive, with students and educators highlighting the added value of enriched, real-time collaboration that is facilitated through digital

services making design thinking activities more active, engaging, and participatory.

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