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Gamification to develop entrepreneurial thinking and acting at Aarhus University and beyond

The case in a nutshell

Gamification plays a special role in entrepreneurship teaching at Aarhus University and in the EIT Food Master's programme in Food Systems. Digital & physical games are a speciality of an entrepreneurship professor from Aarhus University. In several courses he has been using both physical and digital games for targeted purposes. Three games played an important role in online teaching during the COVID-19 pandemic: LeapInTime is a patent game developed specifically during the pandemic to tackle online team learning about intellectual property. Savvygoat requires teams to fulfil tasks for climbing a mountain, training students in collaboration and internal team and project management. ESHIP:NavigatingUncertainty is a multiplayer cooperative board game that teaches student teams to decide cooperatively under uncertainty. Available evidence indicates a positive effect on students. Serious games tend to enhance their technical understanding related to entrepreneurial processes such as intellectual property protection and acting under market uncertainty. However, the effect of digital games on improving teamwork skills was found to be limited.

1. Background

Profile of the higher education institutions that apply games in entrepreneurship courses

Aarhus University was founded in 1928 and is located in the city of Aarhus at the Danish Baltic Sea coast. In October 2021, Aarhus University had more than 32,000 students enrolled. It has five faculties: Arts, Health, Natural Sciences, Technical Sciences as well as Business and Social Sciences. Entrepreneurship plays an important role in teaching and in extra-curricular support. The University has a dedicated directorate for "Enterprise and Innovation" that comprises three units: the Office for Business Collaboration, "The Kitchen" that supports students and researchers in start-ups other forms of entrepreneurship, and a Communication unit.

EIT Food is a European knowledge and innovation community in the European Institute of Technology (EIT). Since 2019, EIT Food has offered a two-year Master's programme in Food Systems. The programme takes 90 students per year. Each student chooses courses from three different European universities out of seven, including among others Aarhus University, Denmark. Entrepreneurship education is a key part. The programme offers three major entrepreneurship components: The study area "management of food system innovations", an entrepreneurship Summer School, and the Emerging Technology Business Case Study. The objective of the Master's programme is to develop leaders for the food sector who "drive a future transformation of the food system and increase the competitiveness of (..) future employing companies"[1].

Deterding et al. (2011) define gamification as "the use of design elements characteristic for games in non-game contexts" to engage users in solving problems.[2] Gamification plays a special role in the entrepreneurship teaching of Rajiv Vaid Basaiawmoit, an entrepreneurship educator from Aarhus

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[1] Brochure Master in Food Systems 2021, p. 3.

[2] See Deterding, Sebastian; Dixon, Dan; Khaled, Rilla; Nacke, Lennart (2011): From game design elements to gamefulness: Defining "gamification". Conference paper, https://www.researchgate.net/profile/Rilla-Khaled/publication/230854710_From_Game_Design_Elements_to_Gamefulness_Defining_Gamification/links/00b7d5315ab1be3c37000000/From-Game-Design-Elements-to-Gamefulness-Defining-Gamification.pdf.

University. He has specialised in embedded entrepreneurship education where he embeds gamified entrepreneurship education within science and technology curricula. This expertise attracted the Masters in Food Systems educational coordinator. He invited Rajiv to join the curriculum design team both to shape the curriculum as well as teach in it. Rajiv's unique approach to gamification was especially beneficial during the COVID-19 pandemic where he was able to use games to make online entrepreneurship education as interactive and engaging as possible within a virtual environment. He used both, games newly developed during the pandemic and games already available before the pandemic. While Rajiv has created and used quite a few educational games, this case study will highlight the following three games:

- LeapInTime (https://leapintime.grendelgames.com) is a patent game developed specifically during the COVID-19 pandemic to tackle online team learning about intellectual property.
- Savvygoat (www.savvygoat.com) is an online gamified process learning experience that requires teams to fulfil tasks - created either by the educator ("herder") or by the student teams ("goats") themselves - and then reflect on them while climbing a virtual mountain.
- ESHIP:NavigatingUncertainty (https://biosymfonix.com/Biosymfonix/Eship.html) is a multiplayer cooperative board game that simulates an entrepreneurship process under uncertainty. There is a real and a virtual version.

While Rajiv created and developed ESHIP:NavigatingUncertainty himself, he consulted on the development of LeapInTime and Savvygoat. The courses in which he applied these games include more than ten online EIT-Food summer schools and the special Entrepreneurship Summer School within a Master's programme in Food Systems by EIT Food,[3] the courses Nanoscience Entrepreneurship[4] and Bio Entrepreneurship[5] at Aarhus University, both at master's level, as well as the BioBusiness Winter School by the Hyphen Projects organisation[6]. Savvygoat and ESHIP are already available to the public; the University of Aarhus, that formally owns LeapInTime, plans to make it public by the end of 2022. Other higher education institutions can use the games after paying a licence fee.

This case study focuses on the objectives and contents of the games and on experiences with them.

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[3]   See https://www.eitfood.eu/education/programme/235/masters-in-food-systems.

[4]   See https://kursuskatalog.au.dk/en/course/118194/Trends-in-Nanoscience-Communication-and-Entrepreneurship and https://inano.au.dk/education/nanoscience-english for the curricula of the nanoscience programmes.

[5]   See   https://kursuskatalog.au.dk/en/course/94211/Bio-Entrepreneurship   and https://www.youtube.com/watch?v=89MIRaKKtjw.

[6]   See https://www.hyphenprojects.nl/bbws.

2. Challenges and objectives

Applying online games during the pandemic

Engaging students meaningfully online was one of the major challenges during the COVID-19 pandemic. Rajiv introduced games to the programmes and courses to involve students with their heads, hands, and hearts in innovative and entrepreneurial activity. Programmes in natural sciences and engineering like the Master's in Food Systems have two specific challenges related to entrepreneurial content and method. First, making entrepreneurship relevant for students whose major interest is in natural sciences. Second, the teachers were at risk of alienating students from the entrepreneurship content through online delivery mode.

An important objective of using gamification in entrepreneurship education is to reach as many students from science and engineering as possible. In Rajiv's experience, traditional entrepreneurship courses may only reach 10% of students from science and engineering – the others may not see the value for their studies and career. This applies to lectures about entrepreneurship concepts as well as to courses where students have to work on real-life business ideas. A further objective of gamification is to make students think more about the problem and not jump to solutions right away. Reflecting on the problem in-depth in the first instance and then considering various possible solutions may be an important learning. Gamification can support the development this kind of thinking. Moreover, Rajiv sees an important individual benefit: "Gamification can be an approach for exploring entrepreneurial selves."

The rationale behind using the three games considered here is specific for each game. EIT Food had LeapInTime developed to motivate students to engage with an important subject they normally do not like, namely patents. Savvygoat is useful to accompany students' learning process during a course. ESHIP seeks developing team cooperation skills in an uncertain environment, which is a key characteristic of entrepreneurship. What all three games have in common is that they foster collaboration in teams. This is important to make students realise how they behave in real teams, which may be different from what they had thought or planned. Moreover, all three games stick to reality, they do not take students to a fictional world. This was also important in their selection.

3. Input

Resource used for developing and running the games

The three games were developed with different funding sources. LeapInTime was funded by EIT Food. Savvygoat is a commercial start-up with various shareholders; Aarhus University and also another university provided some funding to customise the game for their students. ESHIP is a personal development by Rajiv. All three games are self-facilitating, i.e., teachers and students can play them without external support. For the time being, Savvygoat requires a little introductory training to teachers.

In addition to the digital devices for users, the games require various types of resources for using them in the virtual classroom. First of all, the teacher needs to involve researchers and domain experts for planning the use of the games and for evaluating their effect. In terms of preparation time, LeapInTime and ESHIP require rather little preparation, while Savvygoat relies on educators to set the tasks, upload resources or course content and maintain active feedback and communication channels with students. In terms of evaluation, the teacher has to define and validate learning outcomes and to assess the users' experience. For instance, Rajiv piloted and later refined Savvygoat with the support of entrepreneurship

lecturers from three universities in the EIT Food network. For all three games, Rajiv conducted review surveys with students.

### 4. Description of the games and experiences with them

LeapInTime

Background of the game

Due to an observed unfamiliarity of scientists and students with issues of intellectual property and patents, EIT Food charged the Grendel Games company with developing the multiplayer game LeapInTime. EIT Food sought to facilitate students' related understanding during the COVID-19 pandemic. LeapInTime was supposed to reduce reservations about entering the world of patents. Grendel Games released the game in early 2022. While EIT Food had to pay for the game, students from universities linked with EIT Food can now access the game for free. Other entities can licence the game too.

Description

Telling the story of Leonardo da Vinci who has travelled to a modern-day patent office, the goal of the serious game is to collaboratively design and file a valid patent within 45 minutes. Players enter a patent application process and progress through missions in three virtual rooms. They interact with items in the patent office and solve related puzzles. Gatekeepers provide entry to each room. In room 1, the team has to show an understanding of patents' purposes and commercialisation plans. In room 2, they have to assemble a patent for a specified invention in the right order. Finally, in room 3, the team must design and file an original patent. To solve these three missions, players engage with clues, original documents in patent databases and a patent design tool. The game has two versions: One basic and one advanced for students to challenge an existing patent. It uses real-world patents.

Figure 1: Homepage of the LeapInTime game

Source: https://leapintime.grendelgames.com/
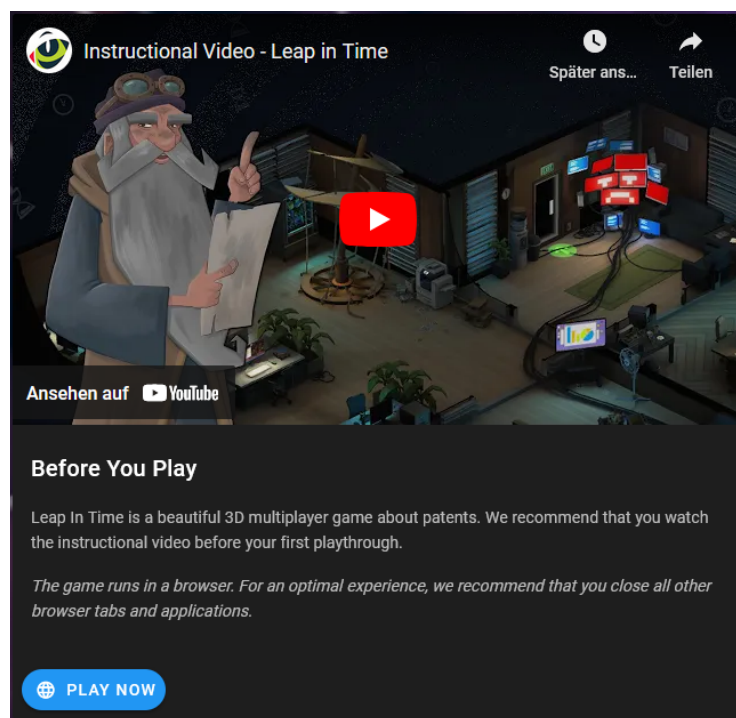
Experiences made

Initially, both teachers and students opposed the game. Other teachers said it is too simple; students said it is too difficult. However, results from surveys conducted among students who participated in the game were positive. They showed that after the game more students had a more positive perception of patent documents, their complexity and purpose in an entrepreneurial process than before. LeapInTime seemed to have positively influenced students' self-efficacy and interest regarding dealing with patents and intellectual property: After the game, almost half of respondents felt confident reading and more than one quarter felt confident decoding patent documents. Moreover, the vast majority agreed that they wanted to learn more about patents. Hence, apparently this type of gamification, using concrete tasks and requiring active collaboration in teams, is largely successful in lowering students' barriers to dealing with patents. Only a very small minority found that the game did not increase their understanding of and motivation to deal with patents and intellectual property. This might be because they do not like digital games or escape room settings or because they already have a good understanding of patents.

Savvygoat

Background of the game

The Master's programme in Food Systems and Aarhus University have deployed the platform Savvygoat during the COVID-19 pandemic and have used it since then. The institutions' objective to use the game is to enhance team processes in distance education and increase students' entrepreneurial skills concerning collaboration and leadership. Rajiv has acted as an advisor to the Savvygoat developers after they became acquainted at a conference. Currently, Savvygoat is available as a beta trial version, and slated to become available as a fully developed version in 2023.

Description

Savvygoat gamifies team-based learning by visualising a team's progress in reaching a virtual mountain summit through achieving different milestones. The mountain climb is a metaphor for solving a problem. Each milestone is subdivided into tasks with given deadlines and a reflection period after having reached the milestone. Teams can decide to complete optional and additional tasks as well as reflection exercises. The game promotes entrepreneurial thinking and acting. This may be drafting a business plan – but the game is not only applicable to preparing a business. Teachers can apply Savvygoat to any subject that suits experiential learning and teamwork processes for solving problems. Tasks can be, for example, preparing a reading list for a certain topic, presenting insights on a trade fair, or reflecting on their own learning journey. The game is unique as it is designed for accompanying learning processes over a certain period of time, for example a higher education course from the beginning to the end. Students use it continuously, but not all the time. Teachers can follow what the teams are doing and jump in when they make mistakes.

To support students in reaching the summit, the game integrates essential elements from project management systems (such as Trello or Canvas), learning management systems (such as Canvas and Moodle) as well as journalling tools. The game also streamlines feedback and communication channels among students and course leaders, and it provides special resources for completing specific tasks. Throughout the process, the game requires team members to lead the teamwork. It distributes points or penalties to motivate individual contributions. By making the progress of other teams visible, the platform aims to encourage a competitive environment. Currently, Savvygoat is available in a beta version. The

developers are looking for further higher education institutions to improve the game before it becomes available for a broader audience.

Figure 2: Homepage of the Savvygoat game
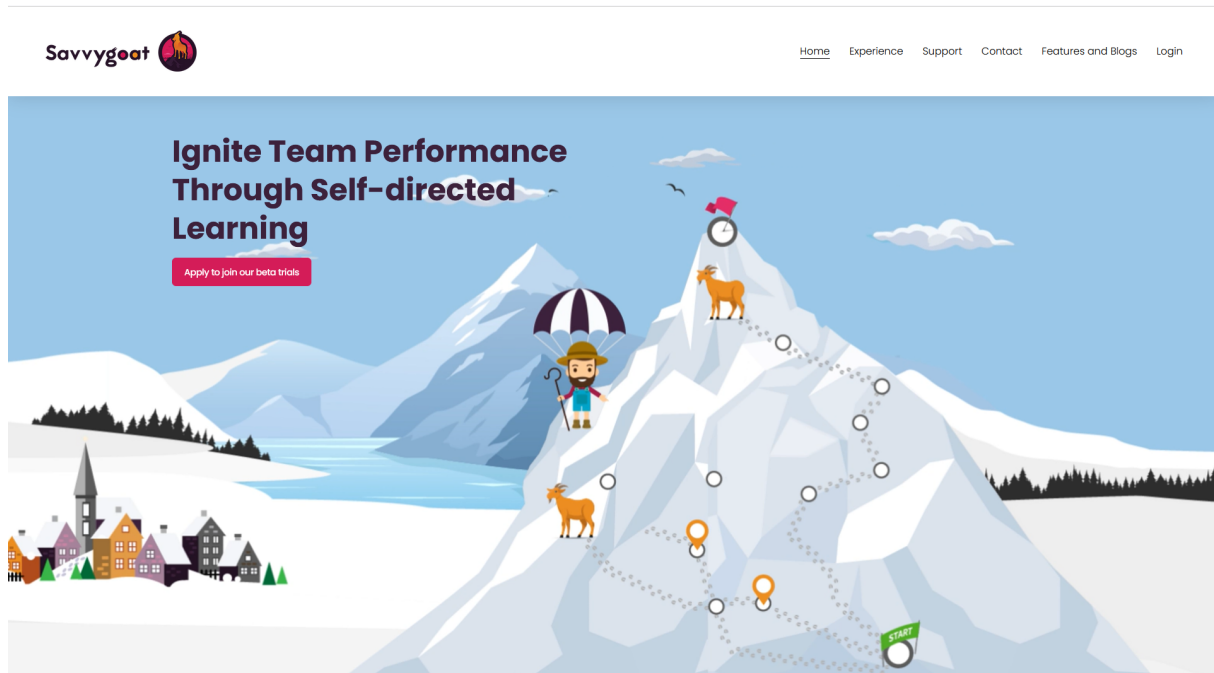
Source: www.savvygoat.com

Experiences made

Reviews conducted in courses at the University of Connecticut, USA, and Aarhus University demonstrate students' mixed experiences using Savvygoat in group projects. For technical reasons, when the students from Connecticut used Savvygoat for the first time, they had to work with a separate platform in parallel with the result that they had to duplicate everything. This frustrated them. They were much more positive in later rounds when they worked on only one platform. On the other hand, the Aarhus students had no such technical trouble. With only one platform, the educators saw far more positive responses across the board at both universities. Savvygoat was attributed by a majority of the participants as having improved their team accountability and helping their team gain an insight into its own performance. Also, all students rated very highly the ability to create their own tasks and thus determine their own journey. The same applies to the feedback and mentor contact as well as the reflection points of the platform.

However, more split verdicts – i.e. half liking and half not-liking their experiences – were found to happen in these areas: collaboration, competition (amongst peers), time management, and the ability to handle conflicts. Moreover, the educators found that stronger teams would have performed strongly anyway – with or without any intervention, just as good students perform well irrespective of teaching quality or environmental factors. However, it seems that weaker students benefited proportionally more from Savvygoat than stronger students. Thus, such interventions might be important to increase the average level of a classroom.

Finally, educators found that mixed responses (i.e. some extremely positive, some ambivalent and some extremely negative) may be due to contextual factors such as the presence of bugs or technical issues.

ESHIP:NavigatingUncertainty

Description of the game

ESHIP:NavigatingUncertainty is a multiplayer cooperative board game which Rajiv Vaid Basaiawmoit created himself in a digital and physical version.[7] It exposes entrepreneurship students to uncertainty, market competition and design-thinking to test their decision-making skills in teams. Rajiv developed the game with two assumptions: Firstly, students normally do not read the literature they are supposed to read for preparing a session. Hence, the game must be playable without specific knowledge. Secondly, students believe that everything is easy to plan or follows a plan. This is not the reality of entrepreneurial processes, so the game is supposed to destroy this expectation. Today, 75 institutions in 25 countries use this game.

Within a two-hour period, students collaborate and compete in teams of three to five players. They represent pre-determined characters. Each entrepreneurial team is tasked with solving a problem in a certain area of interest. Cards with instructions support students in the process, during which students create a project, navigate through market uncertainties, pitch their idea to other teams, and judge other teams' solutions. The team with the lowest uncertainty score wins. The game requires minimal explanation by educators, thus allowing them to focus on providing educational support during the game.

Figure 3: Homepage of the ESHIP:NavigatingUncertainty game

Source: https://biosymfonix.com/Biosymfonix/Eship.html

Experiences made

All in all, students so far have been positive about this game. As one student commented: "In the ESHIP game, our group was tasked with a simulation of a start up from idea to implementation. This led to a lot of constructive discussions where each member had to argue from the perspective of our given roles. The key point for me from the game was reflection."

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[7] He also distributes the ESHIP game through the Biosymfonix company.

Students who have used both the digital and the physical version of ESHIP:NavigatingUncertainty found progressing through the different stages of the entrepreneurial process easier in the physical version compared to the digital one. Students rated their overall experience with the digital version as average, indicating that the physical experience of simulating an entrepreneurial team is overall better and preferred. The reason is that ESHIP:NavigatingUncertainty is fairly complicated, and using it online adds a further layer of complexity.

5. Stakeholders

How stakeholders are involved and contribute to the outcome

Gamification means developing software, and software development requires loops of progression involving test users and advisors. Hence, the game developers and Rajiv, as an advisor, involved students and lecturers to continuously improve the games.

6. Lessons learnt about gamification in entrepreneurship education

Meaningful engagement of students in distance education during the COVID-19 pandemic posed a major challenge to higher education study programmes in general. The Master in Food Systems programme and Aarhus University had the additional challenge of successfully embedding entrepreneurship education and training in an online learning environment that predominantly involves students with a natural sciences and engineering background, thus exposing them to a new field. All in all, the use of gamification through serious games turned out to be a valuable approach to foster students' key entrepreneurial skills - during the pandemic and beyond. In particular, experience shows that the three games considered here can help develop team behaviour in a safe environment that is not real but feels real. With a view to combatting reservations against entrepreneurship education on the part of students from science and engineering, games may be an important icebreaker at the beginning of an entrepreneurship course.

However, applying games requires **thorough preparation** and should be accompanied with thorough **evaluation** to allow teachers to assess the effects on students. There is a risk of "overgamifying" and of game fatigue. Hence, teachers considering using games in their courses should carefully plan when to use games for which types of students and for what purposes. For LeapInTime and ESHIP, it has proven beneficial to use them twice in a certain course: Once in an explorative mode – i.e., students exploring the functions and content – and once in a reflective mode, i.e., students reflecting on the content, their behaviour, and the result. Thus, these games may fit well at the beginning and at the end of a course.

As regards Savvygoat, it became clear that the **game must be simple** to play to make students see value in it. There must not be anything that confuses or bores. Teachers should not assume that younger people – digital natives – are all prone to using games. In fact, many identify themselves as "non-gamers". These non-gamers may be afraid that others are better at gaming, which may cause them to have reservations about using games. Hence, the games should be fairly simple in order to involve all.

Moreover, experiences with applying Savvygoat showed that the **games must suit the type of students**. Students may report completely different assessments depending on their cultural background, their age and level of study as well as the learning management systems involved. This experience may also apply to other games.

Finally, one lesson learnt is that **not all games can or should be digitised**. The digital version of ESHIP turned out to be too complex for the intended audience, so Aarhus University uses only the physical version now and Rajiv has stopped all further development of the digital version.

Sources

This case study was prepared by Dr. Stefan Lilischkis and Maike Hentges from empirica Gesellschaft für Kommunikations- und Technologieforschung mbH, Bonn, Germany, through collection and analysis of documentation about related study programmes and courses as well as statements from Rajiv Vaid Basaiawmoit.

The status of information provided in this case study is December 2022.

Contact

Rajiv Vaid Basaiawmoit, Head of SciTech Innovation and Entrepreneurship, Aarhus University, e-mail rvb@au.dk.

Links

LeapInTime: https://leapintime.grendelgames.com

Savvygoat: www.savvygoat.com

ESHIP:NavigatingUncertainty: https://biosymfonix.com/Biosymfonix/Eship.html

Can Game-Based Entrepreneurship Education help its transition from Business schools to STEM schools? Panel discussion video, recorded for the 2022 Leiden edition of @ESOF - EuroScience Open Forum: https://www.youtube.com/watch?v=iBgIwLq5HG4&t=10s.