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# SUSTAINABLE DEVELOPMENT IN SERIOUS GAMES: RETHINKING GAME-BASED LEARNING STRATEGIES FOR MASTER'S DEGREE ENGINEERS

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**ABSTRACT:** *Sustainable development and sustainability assessment is one of the most important challenges of our time. On the other hand, game-based learning (GBL) is proven to increase soft skills, such as critical thinking, creative problem solving and teamwork, as well as to improve cognitive development, learning retention and social learning, which are of vital meaning for future sustainable aware researchers and professionals. Additionally, the literature review indicates that there is a complete lack of studies in integrating social and environmental sustainability into serious games. The purpose of the study is to integrate sustainability issues into educational project management using an existing serious game as educational tool and thus to create a new sustainable informed basis for serious games in master's degree engineering courses. The proposed scenario indicates that the focus is on both the deliverable/product of the project, such as the project specifications, requirements, deliverable, quality criteria and materials used as well as the delivery/process of the project, such as management planning and project sequencing. Through a case study all the game characteristics that can evolve in order to include sustainability concepts are presented.*

**KEYWORDS:** *Sustainability, Serious Games, Project Management, Game-Based Learning.*

## 1 INTRODUCTION

Experimenting and learning are increasingly considered as means to innovate governance approaches for pursuing a more sustainable society. This paper puts forward the case for the use of serious games to help support sustainable growth through the use of games for conventional skills and knowledge development related to project management. It presents all the elements of sustainability that can be applied to a serious game (SG) oriented course for master degree engineering (MEng) students, as well as a SG framework for industrial engineering and project management, which implements an extensible framework for different organizations to develop sustainability-oriented games. Moreover, it analyzes a content based on sustainability issues under the scope of game mechanics. This paper provides an overview of game-based learning and the state of SGs for sustainable management, offering insight into their potential as effective tools in facilitating project management education. Serious games have been shown to possess numerous qualities that have been connected with improved learning experiences and cognitive development (Madani et al., 2017).

The aim of the paper is to propose a SG environment that will enable students to become aware of sustainability topics. Our proposal can be thought as an application that introduces sustainable development (SD) principles

in an engaging way, as a precursor to designing with professional parametric design and environmental simulation processes. This new concept bears the name “Aeiforia<sup>1</sup> Serious Game” or “AmuSInG” and it introduces values concerning planning, management and SD.

The objectives of the study reported in this paper are to: (a) Identify all the elements of a SG that can sustainably evolved, (b) design and propose a SG prototype that aims to improve students' skills as engineers and leads them towards a sustainable project management philosophy.

The paper is organized as follows. Section 2 describes the sustainable way of thinking and SD. In Section 3, some selected definitions of SGs and game-based learning (GBL) are given. In Section 4, the design, the basic features and the class activities of the SG case study used are presented. The implementation of the sustainability feature into the case study SG and the “AmuSInG” concept is reported in Section 5. Finally, the paper ends with conclusions and future work.

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<sup>1</sup> derives from the Greek word for sustainability

## 2 SUSTAINABILITY AND SUSTAINABLE DEVELOPMENT

According to Cairns and Martinet (2014), the term "sustainability" is inherently ambiguous. Sustainability can be understood either as the conservation and protection of ecosystems or as an improvement in living standards, under the aegis of economists. These different perspectives also refer to different interpretations, making it more difficult to understand the term sustainability. As proposed by Silvius and Schipper (2015) and later by Huemann and Silvius (2017), the most commonly accepted definition is that of the Brundtland Report: "*Sustainable development is a development that meets the needs of the present without jeopardizing the ability of future generations to meet their own needs*" (World Environment and Development Committee, 1987). Sustainability, according to this report, deals with three dimensions: economy (cost), society (people) and environment (planet).

### 2.1 Economic Dimension

Maximizing profits, reducing costs and increasing revenue are considered as some of the traditional business techniques (de Lange, 2017). The primary goal of an organization is to generate wealth for shareholders. Silvius (2017) recognize the importance of the economic dimension as it protects the shareholders' capital. Profits are reinvested in the organization to ensure that the organization achieves growth.

The strategic value of a project can be considered in terms of various economic dimensions that are featured in sustainability. Benefits, value, and value creation may imply different things to the project contractor and the customer and appear differently during the different phases of the project's and the product's life cycle thus making the specification of project goals very challenging (Kivilä et al., 2017).

### 2.2 Social Dimension

The social dimension refers to the communities in which organizations operate, as well as to employees of an organization. Employees are the ones who produce the results of the organization and should be rewarded by the organization itself. The results of the organization's work also depend on how the community supports the organization. Utilizing communities and workers for organizational success without exploiting them is the balance adopted by the notion of social dimension. Dempsey et al. (2012) proposed that organizations must "take care" of the individual communities in which they are active, making later Silvius (2017) totally agree with their point of view. Anything that adversely affects the society in which the organization is active may create problems for its own reputation (for example the BP Deepwater Horizon (1988) oil spill or Marikana) and is very likely to

reduce the available clientele, which customers will turn to more reputable organizations.

Organizations that recognize the importance of human factor often participate in corporate social responsibility initiatives. These initiatives are organizational actions that take place to improve the quality of life of workers as well as society in general, while ensuring economic growth (Bebbington et al., 2017). Social sustainability is about identifying and managing impacts, both positive and negative, on people.

### 2.3 Environmental Dimension

As Ludwig (1993) said, this dimension deals with the natural environment in which people live. The literature shows that the planet has been adversely affected by the activities of the human race Sha et al. (2017). It has already been reported since 1995 that the pursuit of economic goals has led and would continue to lead to the deterioration of the environment that supports humanity (Pretty, 1995). The environment is an important source of resources that must be maintained to ensure the continuity of natural processes (Hopwood et al., 2005).

Sustainability has been largely linked to environmental protection and mankind's failure to maintain natural wealth (Ferguson, 2016). Support provided by the natural environment is essential for the functioning of most organizations. Organizations are based on natural resources around the world. As these resources are reduced, organizations have difficulty in continuing their activities (Nawaz and Koç, 2018). Environmental non-sustainability has a negative impact on organizations and affects earnings, as operating costs are rising as supplies become costlier.

### 2.4 Combining Sustainability Dimensions

A balance is needed between the three dimensions of sustainability. It has been widely accepted that economic development, social prosperity and the prudent use of natural resources cannot be achieved without taking into account all dimensions and interactions between them (Elkington, 2006). The dimensions and their relationship can be seen in Fig. 1, which points out that only when there is a balance between the three dimensions, sustainability is achieved. If not, issues within the three spheres of sustainability emerge, depending on which dimension we are more focused on. Some examples of these issues can also be seen in Fig.1. Being more focused in social-environmental aspects provides good environmental management ethics towards society but lacks economic growth consideration. On the other hand, environmental-economic focus will assure energy efficiency by reducing costs and at the same time achieve resource efficiency however; the social dimension (concern for the values, norms, rules, and roles) would be absent. Finally, economic-social development neglects environmental

ethics and focuses on business ethics and worker's rights.

### The Three Spheres of Sustainability

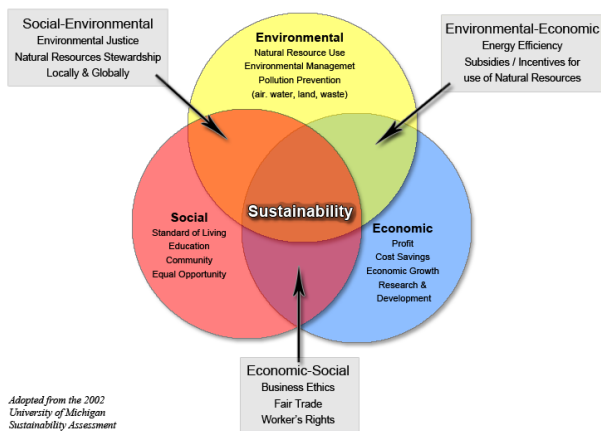


Figure 1: The three dimensions of sustainability, the relationship between them and the issues within (Sandra I. Rodriguez, 2012).

In addition to adopting policies and undertaking actions to improve their sustainability, corporations are also developing tools for monitoring, assessing, and reporting their environmental and sustainability performance. In his 1997 book "Cannibals with Forks", John Elkington proposed a triple bottom line against which corporations should measure the value they create and destroy. The triple bottom line (TBL) framework consists of three equally-weighted categories of impact: economic, social and environmental. Like definitions of sustainability, the TBL framework is built on the recognition that business sustainability depends upon positive stocks of economic, social and environmental resources (Sandra I. Rodriguez, 2012).

To promote dialogue between students and understanding of concepts related to sustainability and resource management, changes need to be made in the learning process and the use of the currently available tools. The use of a fun SG context to introduce SD principles, through the integration of sustainable issues in an existing SG, is what the main idea of this paper is.

### 3 SERIOUS GAMES AND GBL BACKGROUND

SGs are defined as games that educate, train, and inform. These games are designed for a primary purpose other than entertainment, enjoyment or fun. The initial intention of SGs is to combine the serious aspects (learning, instruction, etc.) with the playing aspect of digital games (game) (Khenissi et al., 2015).

There are numerous definitions for SGs, often varying depending on the different perspectives and purposes that they were developed to explain (Giessen, 2015). Some of the most used terms in this field are: "serious

games", "digital serious games", "edutainment", "Game Based Learning (GBL)", "Digital Game Based Learning" (Digital GBL) and "applied games" (Caballero-Hernández et al., 2017).

GBL is a pedagogical method of learning that utilizes role-plays, board games, card games or video games to promote retention of learned material and cognitive development. The game-based simulation is starting to be employed in several areas (Ricciardi and Paolis, 2014).

SGs that incorporate digital GBL are deemed by many to create the greatest potential for student learning over other media (Pereira et al., 2012). The creation of immersive and engaging environments in which players can explore and learn is more feasible than ever, especially with today's technology (Deshpande and Huang, 2011).

GBL has the potential to help engage students and enhance learning. Master's degree engineering students are receptive to the use of GBL in their courses, and educators have the opportunity to implement commercially available educational serious gaming tools like the SuPeRB<sup>2</sup> game, which is fully described in paragraph 4. Students will have to implement sustainable logic changes into the game itself in order to add extra value to the learning process. Through this process they will engage themselves into the SD philosophy and thus become aware of the sustainable way of thinking. Principles very close to the GBL and SGs philosophy.

### 4 CASE STUDY: THE SUPERB GAME

SuPeRB game is a typical serious game that incorporates GBL by giving students the opportunity to use a physical problem-solving tool by engaging themselves into programming activities.

Professors in the University of IMT Mines Albi in France were looking for ways to empower their master's degree engineering students' skills, turning their natural curiosity into creative exploration. They came up with the use LEGO® Mindstorms as an instant engagement tool and built upon it a whole instructional method. The instructional method of the specific course was inspired by the RobAFIS™ student competition. From systems engineering to the engineering of one system. The main objective of RobAFIS™ is to highlight the benefits of basing systems engineering education on a project life cycle realization: a full life cycle including the implementation of an operational system, deployed by a client, in a real environment.

So, in that way, students are reviewing the basic principles encountered in the planning and designing processes and at the same time they explore the latest ideas and

<sup>2</sup> deSign Programming Robot Brick

thinking around key project management topics. They end up finding key solutions in upcoming designing issues.

#### 4.1 Context of the game

The SuPeRB game that has been developed in IMT Mines Albi and inspired by the RobAFIS™ program is a useful tool for the master's degree engineer students in order for them to achieve greater learning gains from playing SGs. It is taking place at the last semester of the fifth year of the graduate school of engineering where students have the opportunity to deal with design processes, create and operate their own system/device and program it using a Product Lifecycle Management (PLM) software, for the first time during their studies. Through this, they discover the difference between theory and reality and understand the importance of a system that works perfectly according to the initial design. The main idea is for the students to learn by themselves basic principles of system engineering, design and project management. The whole concept might have been inspired by the RobAFIS™ program but the use of a PLM software support gives the SuPeRB game a whole new dimension creating a big difference between the two programs.

In previous class activities, students used an ad-hoc robotic simulation package in order to improve their knowledge of the course subject (learning basic principles of system engineering, designing and project management); it clearly follows the importance of developing an innovative teaching method to improve the involvement of the students. As consequence, the class activities based on LEGO® Mindstorms were included in the curriculum activities of the students.

The activities have been attended every year by an average of 30 to 40, usually divided in teams of 7 to 9 in order to design, build and control a mobile robot able to compete in the execution of a predefined task. Each team clarifies predefined tasks among their members in order to complete their task more efficiently. Theoretically the goal is to have a team of 6 people, roughly with some specialization divided in two members responsible for the LEGO® bricks, two members to program the device and two members that organize the PLM activities. It is important while appointing the responsibilities to avoid having one skill mastered by only one student.

The LEGO® bricks give to the students the power to create and command their own robotic creatures, vehicles and machines built by the LEGO® bricks. By combining LEGO® elements with a programmable brick, motors and sensors, they can make their creations walk, talk, grab, think, shoot and do almost anything they can imagine. Each robot comes complete with its own unique features and a program that controls the robot's behavior. Once the task to be accomplished is assigned, each team works autonomously. Every year the task is

different. As typically few constraints are specified regarding the robot design (e.g. maximum size and number of motors and sensors), given the same resources each team usually develops solutions that differ a lot one from the others.

Every project has to produce something. "If you don't have any deliverables, you don't have a project" (Hamilton, 2002). That's why students in graduate school of engineering of IMT Mines Albi submit four main deliverables each year:

- Deliverable 1: In this deliverable the specifications and the planning process of the project given are specified. Identifying the risks in the systems engineering project is an important part too. Thus, students determine where to apply management resources and what to leave alone, as management resources are not unlimited. They can simplify many calculations and, more importantly, provide information with insight into the effects of uncertainty on project outcomes. The professors' feedback gives students the chance to improve their work and build more accurate self-assessment skills.
- Deliverable 2: This part is all about brainstorming, project drawings and evaluation of possible solutions. Students dig into design thinking. Design thinking is a methodology that has been used in product design, branding design, service design and other areas such as information systems design (Chou, 2018). It can be used to generate new and innovative products and systems. Students list all their basic ideas concerning possible solutions towards the requirements given and they create drawings to visualize their robot construction. They carry forward to a brief evaluation of the project and conclude to the final methodology.
- Deliverable 3: This part incorporates the bill of materials (BOM) and the assembly process. Students explain what, how, and where to find the required materials to build their robot and include all the necessary instructions on how to assemble their product/system from the various parts ordered.
- Deliverable 4: Examination day; where everything needs to be as planned. A personal bet for the students and their work.

#### 4.2 Materials and software

The series of LEGO® Mindstorms Kits, with the programmable brick, a set of modular sensors and motors and standard LEGO® parts coming from the LEGO® Technics line, allow to design and implement small, customizable and programmable robots both from hardware and software point of view. The basic hardware/software element of Mindstorms Robotics Invention System kit is a programmable brick that derives from the one created at the MIT Media Lab. Normally the brick may be programmed by uploading a

program written using the bundled graphical software or one of the several available languages.

Different versions of LEGO® Mindstorms Kit have been released over the time, each of which is characterized by an increasing level of complexity, thus allowing the development of more sophisticated and complex robots both from the mechanical and the control software point of view.

A bill of materials (BOM) describes the different components that together create a product/system. Students have the chance to understand the importance of the right selection between big lists of LEGO® bricks in order to give solutions to upcoming design problems. A BOM for a bicycle, for example, consists of all the parts that make up the bicycle, including the number needed (quantities): one frame, one saddle, two wheels, and so on. In our case students are called to clarify the BOM for the LEGO® robot in order to achieve the goals that it is made for.

Students have the chance to use a PLM software, an information management system that can integrate data and processes. In the class activities, students utilize the Windchill PLM software that allows them to manage the information needed throughout the entire lifecycle of a product, efficiently and cost-effectively, from ideation, design and manufacture, through service and disposal. Students realize the importance of documentation through this process. After everything is done, students hand over the three deliverables mentioned in paragraph 4.1.

As for the delivery process, students dig deeper into appearing problems after the delivery of their robot where they understand the importance of accuracy during the designing process. They have to carefully inspect all the contents of their product/system. A delivery process is a special process describing a complete and integrated approach for performing a specific project type. It provides a complete end-to-end lifecycle and can be used as a reference for running projects with similar characteristics (Peñaloza, 2018). From the software point of view, in the class activities the students utilize the LEGO® Mindstorms EV3 software which is easy to use and free to download. Nevertheless, programming the brick is possible through another programming language (big list of some of the most popular third-party alternatives). In fact, by installing the proper plug-in, the developing environment allows not only to fully exploit all the potentials of the libraries, but also to directly download the compiled code on the brick by using USB or Bluetooth connection.

#### 4.3 Course schedule

The lesson plan and the class activities of the game which takes place in IMT Mines Albi are as follows:

- Requirements and specifications are given regarding the robot design and the tasks it is called to fulfil.
- One lecture (3 hours) on how to build the already defined robot.
- One lecture (3 hours) dedicated to the pre-design process (BOM) and project management skills.
- Two lectures (3+3 hours) where the students try the LEGO® robot construction and programing.
- Exams session: 45 minutes outside the examination class to build and program the robot – 20 minutes to present their completed task inside the class and to explain the logic behind – 20 minutes dedicated to questions and feedback analysis.
- Final grades for the students are given as follows: 1/3 professors' evaluation – 1/3 other teams' evaluation (students) – 1/3 proper robot delivery (product design).
- The following link provides a wider scope of understanding towards the SuPeRB game: <https://www.youtube.com/watch?v=3Koxe6Nk mOE&feature=youtu.be>

#### 4.4 The need for sustainability inclusion

The objective of this class, so far, was for engineering students to discover the complicity of product design, to understand the difficulty of scheduling a project (project management), to dig into the programming philosophy through a software, to comply with the user's requirements and cultivate their innovation skills.

Analyzing the current set-up of the game and at the same time recognizing the needs of modern societies, a big change towards the modernization of the game itself and its possibilities is required. The integration of sustainability into GBL is picking up momentum. Integrating sustainability stretches the game's boundaries and adds extra value.

After careful consideration and after analyzing the process of the conduction of the classes, the authors of this paper came up with conclusions on opportunities for inclusion of sustainability concepts. Table 1 outlines all the current elements of the game that can evolve in order to entail sustainable concepts and categorizes them according to the TBL; Economy, Society and Environment.

Integrating sustainability issues in the SuPeRB game/product will give the chance to students to expand their horizons towards a more sustainable way of thinking. The supplementary knowledge in terms of SD will create a new sustainable SG with great significance ("AmuSInG").

Dimension of Sustainability	SuPeRB Game
Economic	<ul style="list-style-type: none"> <li>▪ Location of construction of the parts of the game</li> </ul>
Social	<ul style="list-style-type: none"> <li>▪ Working in teams</li> <li>▪ Working during business hours</li> <li>▪ Students learn basic principles of project management</li> </ul>
Environmental	<ul style="list-style-type: none"> <li>▪ Rechargeable batteries</li> <li>▪ Plastic bricks</li> <li>▪ Working hours in relation to energy consumption</li> </ul>

Table 1: SuPeRB game characteristics that can evolve in order to include sustainability concepts

## 5 INTEGRATING SUSTAINABILITY ISSUES INTO GBL

The continuing depletion of natural resources has become a major focus for the society at large. There is an increasing recognition of the need to sustain an ecologically-balanced environment, while, at the same time, exploring and exploiting the natural resources to satisfy the ever-increasing demands of the human race. A profound solution to this is the adoption of SD practices. Increasing the awareness towards a more sustainable future is thus critical (Moloney et al., 2017). To achieve this in the education sector, changes in the use of decision games called “serious games” need to be done. Serious games are gaining in popularity as tools that add entertainment to teaching and training.

### 5.1 Context

This paper explores how sustainable philosophy can be integrated in SGs with a view to facilitate the understanding of the issues around sustainability, to identify opportunities towards improving the feature-set of these games, and to enhance knowledge around SD strategies. To achieve this goal, the SuPeRB game was taken into account, and improvements that will foster the notion of sustainability are proposed that will add significant value to the game and thus create a new sustainable oriented version under the name of “AmuSInG”.

### 5.2 Material

Taking into account the basic elements of the SuPeRB game that can be changed towards a more sustainable philosophy (refer to Table 1), Table 2 provides solutions on how something like that is possible, introducing the “AmuSInG” approach. The dimensions of sustainability

summarized in Table 2 provide input for integrating sustainability requirements into the content related aspects of the game, such as the specifications and design of the deliverable, materials used, benefits to be achieved, quality and success criteria.

Starting with the economic dimension of the TBL, the proposed scenario suggests that a way to maximize profits and reduce costs is the construction of some parts of the game to be made on-site. Some of these parts can be made upon request in IMT Mines Albi, (bricks) using an existing 3D printer. As simple as this may sounds, a business plan has to be conducted in order to clarify the sustainable contribution behind this proposal. The sustainability value of this implementation has to be clarified, which constitutes a great suggestion for future research.

Continuing with the social dimension, an upgrade towards the current status of the game can be made by introducing basic GBL principles. Working in teams is not enough. The new proposal includes budgets, helpful pictures, virtual reality (VR) environments and a mobile app. Following the students’ progress, reward budgets will be given by the professors resulting to extra rewards like helpful designing related images that will guide them through the construction phase easier and faster. A VR app will immerse students in incredible 360-degree visuals of the game. In addition to all these, a mobile app will provide real-time insights of all the actions that take place during the class. Students have to complete more than one quest on the same topic; they earn more virtual points, a higher leader board standing and hopefully, better understanding of the material. By this way retention of learned material and cognitive development is promoted making the game more interesting to the students. Applying SD principles into the game, students get the chance to become aware of sustainability issues, increasing the social impact.

Finally, the environmental contribution to the TBL suggests the use of electricity instead of batteries (photovoltaics) for the movements of the robot and low-cost environmental materials for the bricks. The energy goes straight from the photovoltaic panel to the electrical circuits without the need of a battery. Working outside the class or during daylight to reduce electricity consumption to a minimum and the creation of environmental aware engineers are significant contribution towards ecological issues as well. During this process, the social dimension gains significant value as well.

The main question that this paper discusses is whether all the elements that can be upgraded in the game to include sustainability concepts (Table 1) have a positive or a negative impact to the additional value of the deliverable/product and the delivery/process of the project. The discussion of the seven defining characteristics presented on Table 2 represents the qualitative outcome of this study. Next to this analysis, the study also indicates how

these characteristics improve the TBL criteria of sustainability and thus create additional value to the game itself and the stakeholders.

Dimension of Sustainability	“AmuSInG”
Economic	<ul style="list-style-type: none"> <li>▪ Parts built on site upon request</li> </ul>
Social	<ul style="list-style-type: none"> <li>▪ Working in teams with rewards (budies, best student of the week, etc.), integrating VR and mobile apps</li> </ul>
Environmental	<ul style="list-style-type: none"> <li>▪ Electricity based game</li> <li>▪ Low cost environmental materials</li> <li>▪ Working outside during daylight</li> </ul>

Table 2: Implementing sustainability issues into the SuPeRB game

### 5.3 Course schedule

The lesson plan and the class activities for the “AmuS-InG” approach game, along with the highlighted new features, could be as follows:

- Requirements are specified regarding the **sustainable design** and the tasks it is called to fulfil.
- One lecture (1hour) about **SD and environmental awareness (renewable energy sources – RES)**.
- One lecture (2 hours) on how to build the robot **following the TBL principles**.
- One lecture (2 hours) dedicated to the pre-design process (BOM) and **sustainable project management skills**.
- One lecture (1 hour) on how to **utilize a 3D printer and design 3D bricks on a computer**.
- One lecture (3 hours) in **informing students about GBL, VR, mobile app and rewards given (budies, helpful pictures, etc.) to teams that achieve high performance**.
- One lecture (3 hours) organized in teams, outside class (**field**), where the students try the robot construction, the programing part, **VR and the mobile app application**.
- Exams session: 40 minutes to build and program the robot – 20 minutes to explain the **sustainable logic** behind – 20 minutes dedicated to questions and feedback analysis.
- Final grades for the students are given as follows: 1/3 professors’ evaluation – 1/3 other teams’ evaluation (students) – 1/3 proper robot delivery (product design).

## 6 CONCLUSION & FUTURE RESEARCH

This work has been focused on the design and development of the first prototype of a SG that follows sustainable logic, following the TBL criteria for educating master’s degree engineers. To the best of authors’ knowledge, no previous research has been conducted towards the SD of a SG that incorporates awareness into sustainability topic for educational purposes. As far as the specific case study is concerned, the SG is intended to be integrated into the course "éléments de conception de produits et procédés" and to be used as a supplementary learning tool for students in industrial engineering. The game will be played in practical work sessions and it is expected to include more levels and more challenges that the students should gradually resolve. Some configurations of the game are too easy and others are more complex. Overall, the idea of a sustainable oriented game (“AmuSInG”) was well received and the students manifested an increased willingness to want to play it. Stimulate this kind of intrinsic motivation is what the game is aimed at and thus which has been achieved successfully.

This study opens an interesting prospect for research. Firstly, it is interesting to improve and extend the original game. Once the game is enriched with a long storyline and additional challenges following the sustainable path, it will be interesting to reassess. Another way which is also promising is to provide the system with an algorithm for collecting and storing the results of training sessions to assess learner’s skills.

Paragraph 5.2 provides a list of supplementary ideas that can be integrated into the sustainable logic of the game, following the Tables 1 and 2. As mentioned in previous paragraph the main question is whether all the elements that can be upgraded to include sustainability concepts in the game (Table 1) have a positive or a negative impact to the additional value of the deliverable/product and the delivery/process of the game. In paragraph 5.2 we can observe all the previously mentioned updates that “AmuSInG” approach has to offer and their gaining value according to the TBL philosophy.

One direction for future research should therefore be the specification of the gaining value for each implementation mentioned in Table 2. Positive and negative impact on TBL and sustainable philosophy can be mentioned. The project can be expanded even further, going one step ahead and taking into account not only the narrow borders of the game/product itself but also the sustainable impact of the delivery/process of the project. To incorporate sustainability into GBL projects and raise the level of capability, organizations and professors must reconsider the way that sustainability is incorporated.



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