



Encouraging training skills in the furniture and woodworking industries through an innovative simulation-based approach

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ABSTRACT

The article presents the results of the project aimed at applying gamification in education. ENCOURAGING SUnRISE ERASMUS+ project builds on the emerging needs of companies in the Wood and Furniture Industry to give employment to young graduated generations (in HE and VET) including: students prepared technically and students motivated to work in this specific sector. To achieve this challenge, the project explored the use of gamification and the Simulation Learning Environment. In particular, ENCOURAGING SUnRISE introduced gamification to the Wood and Furniture Sector training program. The project is a step to trigger modernisation in initial and continuous VET in the sector through gamification and simulation tools. Therefore, the objective of this research was to prepare and investigate the influence of gamification and the Simulation Learning Environment in improving competencies in the furniture and wood sector, as an innovative educational solution. After identifying the needs and challenges, a selection of skills (soft and hard) was made to perform various tasks in the scenario-based simulation game. The quality assessment of the course has been highly rated by students, teachers, and workers As well as the rate of improvement of technical and non-technical knowledge at the end of the course. This creates a chance to respond to needs and opportunities of traditional industries by offering innovative didactic approaches. ENCOURAGING SUnRISE may in a modern and attractive way reinforce the top skills that the most outstanding workers of the sector usually display.

Keyword: Gamification, Furniture, Simulation Learning Environment, Simulation Tool



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1. Introduction

Digitization today affects virtually every area of life - the economic environment, business, livelihood issues, taxation, health, etc. It is no different in the case of education. The dynamic progress of digital technologies influences the constant evolution of tools supporting teaching. Indeed, wide access to the Internet, including in schools, creates great opportunities to use a number of sites, applications and platforms that attractively support the learning process for people at different levels of education (kahoot.it, moodle.org, quizlet.com, web.seesaw.me, acadly.com and more). These tools became particularly important during the COVID-19 pandemic, during which the difficulties of months of remote education piled up in front of both teachers and students. Reports on the impact aspect of remote teaching reveal that it was a difficult task with many negative consequences. The literature indicates, for example, that schools have been forced to deal with severe staff shortages, high absenteeism rates, quarantines, and rolling school closures in addition to an increase in COVID-19 cases at the end of 2021. Additionally, there are still mental health issues among students and teachers, higher rates of violence and misbehavior, and worries about lost instructional time [1]. A term that comes up very often in discussions of courses taught remotely is gamification. It is a concept coined in the 1990s, the authorship of which is attributed to programmer Nick Pelling. In the 1990s, Nick Pelling - a programmer, integrated game aspects with non-gaming elements. Although his initial goal was to inject some pleasure into routine activities like using an ATM to withdraw cash or upgrading the in-flight entertainment system, both of which he perceived as being uninteresting and lacking in excitement, this proposal was not well received by tech users. Everything changed in the course of years along with the development of WWW,

applications for mobile systems like android or ios. Basically, gamification is the transfer of mechanisms known from games to the real world to change human behavior. It is based on the use of game elements (e.g. points, levels, quests, badges) in a different environment than the game itself. It was shown that after the points were eliminated, there was a very noticeable negative effect on user activity [2]. Integration of the game mechanics aspects in gamification has an influence on participant behavior toward autonomy, competence, and purpose. These impressions result in greater engagement, greater competence development, and greater performance [3]. As a result, gamification goes far beyond just a completion of points and badges and acquisition of a higher reputation. It is strictly connected to motivation, which in the literature was distinguished into four categories:

- Relatedness - users desire a social connection and a sense of community.
- Autonomy - users desire to have freedom in their decision-making and want to be in charge.
- Mastery - users who favor personal improvement, thus fulfill the concept of "information gap" i.e. when a user is aware that he doesn't know something, he becomes more engaged in searching for information, solving a puzzle, etc.
- Altruism - is the users' desire to understand the purpose behind their actions; encourages cooperation, learning together with others [4].

In the literature there are lots of examples about the positive impact of using gamification in education, particularly for deeper understanding of the concepts, subjects, and methods related to resolving scientific and sociological issues in performance evaluation. [5]-[7]. It is also worth mentioning that in gamification, in contrast to traditional, not to say old fashioned, learning methodology, participants - "players" have freedom to fail. It is considered as an internal part of the whole concept [8]. Allowing participants for mistakes is one of the most engaging mechanisms. Moreover, gamification rewards effort without punishing failure. To ensure that gamification is successfully injected into the learning system, the procedure must be carried out methodically and sequentially. It cannot be taken for granted that gamification would produce immediate results [3]. It must be also emphasized that gamification is not the same as using or designing games (Game-Based Learning) in lessons. It incorporates game mechanics and game thinking into non-game activities and there are numerous definitions towards gaming aspects [9]. In the case of GBL, an educational game is a stand-alone element of a lesson, and most often applies to single lessons. Gamified learning entails a sustained change in the format of the classroom (a year, a semester, the time it takes to complete specific material). Classes are changed into a system that resembles a game and is integrated into the subject. The win condition, or the moment we know the game must be described by:

- Clear goal, or what the player is obliged to do to succeed (although not always once).
- The action, or the course of action we anticipate the player doing.
- Obstacles - are the challenges the player will face while attempting to accomplish the objective.
- Rules - are the guidelines that must be followed while playing the game.

Increased interest in the gamified learning concept and games (also Virtual Reality - VR) are also contemporary topics exploited in various Erasmus+ projects. Table 1 shows some of them when also the following keywords are specified: research and innovation; new innovative curricula/educational methods/development of training courses; ICT - new technologies - digital competences; pedagogy and didactics; enterprise/industry and SMEs (incl. entrepreneurship); new learning and teaching methods and approaches; digital skills and competences; open and distance learning.

Table 1. Erasmus + projects examples using modern teaching methods (gamification, games, Virtual Reality)

Project number	Project title
2020-2-LV02-KA105-003194	Games – a bridge to youngsters' Well-being & Values
2020-1-TR01-KA101-083004	Our business education power
2020-2-SK02-KA205-002589	Games against hoaxes - game based approach to critical thinking education of youth
2020-3-MT01-KA105-092351	Exploring How to Use Escape Rooms&Board Games as Educational Tools for 21st Century Human Rights Problems
2019-1-PL01-KA229-065660	Game for the health - game for the future
2019-1-NL02-KA205-002463	She Got Game!
2019-1-RO01-KA201-063778	Using Mobile Augmented Reality Games to develop key competences through learning about sustainable development

Project number	Project title
2019-1-ES01-KA203-065815	Promoting Open Education through Gamification
2019-1-DE02-KA202-006559	GATE:VET – using GAMification in TEaching at VET schools
2019-1-ES01-KA101-062470	Cooperative Learning, based on reality through gamification and technology.
2018-3-FR02-KA205-015240	Escape Your Stereotypes
2018-1-RO01-KA201-049411	Future schools using the power of Virtual and Augmented Reality for education and training in the classroom
2018-1-MT01-KA105-038444	Game Zone : Developing an inclusive society through games
2018-1-BG01-KA204-047923	Enhance Adult Learners Digital Skills for Furniture Industry
2018-1-DK01-KA204-047087	Games for basic skills teaching
2018-1-CY01-KA202-046856	INternationalization serious Game for Start-ups and entrepreneurs
2018-1-DE02-KA202-005088	Experiencing augmented reality on cultural heritage applications in iVET
2018-1-ES01-KA101-048813	21st Century Skills, Learning through games, robotic, coding, VR and environment activities
2018-1-UK01-KA201-047880	Serious Games for Initial Foreign Language Learning
2017-1-FR01-KA219-037109	Open your minds through games
2017-1-MT01-KA201-026955	Create Digital Games for Education
2017-1-AT01-KA219-035048	GAme-based education or how to Make LEarning eaSier

Few projects deal with teaching digital skills among workers from the furniture industry [10]. In this matter one may be shown: Digifind - 2018-1-BG01-KA204-047923 (www 1). It is the programme for the professional development of adults' educators created as a comprehensive education plan aimed at helping trainers teach Digital skills and Industry 4.0 to low-skilled adults employed in the furniture industry [11]-[12]. Hence, there is clearly an interesting gap to fill with implementation of the gamification concept into the wood and furniture sector. To achieve both challenges, technical and attitudinal, the presented SUNRISE project explores and introduces the use of gamification and the Simulation Learning Environment to the Wood and Furniture Sector. Project's aim is to trigger modernisation in initial and continuous VET in the sector through gamified learning paths and also virtual reality simulation tools. This creates a chance for alignment of the needs and opportunities offered by traditional industries through innovative didactic approaches. ENCOURAGING SUNRISE reinforces the top skills that the most outstanding workers of the sector usually display and it shows it in an attractive way. Moreover, it is a free content available in different languages, allowing its wide use across Europe. ENCOURAGING SUNRISE project builds on the emerging needs of companies in the Wood and Furniture Industry to give employment to young graduated generations (in HE and VET). It is a way to gain knowledge and motivate action through fun and competition. In this modern training approach, students are pulled into the furniture company related scenario, score points and compete with others by carrying out specific activities planned by the trainer.

2. Method

SUNRISE partners analyzed what new knowledge, skills and competences are needed to integrate furniture VET programs on the one hand and simulation tools on the other hand [13]-[16]. The needs of the target group have been identified through 3 main reports, such as (1) Report of the need of the furniture industry regarding KETs [17]. (2) Impacts of the digital transformation on the wood furniture industry: Report on the Sector Status [18]. (3) Boosting the potential of KETs, Addressing Skills Needs in Europe [19]. The strategy was as follows:

- Gathering the needs and challenges identified in the three reports of knowledge, skills and competences.
- Identification by the consortium and associated partners and taking into account the opinions of 50 experts (verification surveys) regarding the new needs of the furniture and wood industry, gamification and ICT solutions for an innovative didactic approach.
- Selection of 10 skills (soft and hard skills) to perform various tasks in a simulation game to test and allow the furniture learner to improve the level of these skills in a simulated work environment.

The consortium and the associated partners identified and addressed the opinion of 51 experts (verification survey) in terms of furniture and wood new needs, gamification and ICT solutions for an innovative didactic approach.

The interviewed companies were able to collaborate with ENCOURAGING SUNRISE by sharing their know-how and enabling us to record videos of the different manufacturing processes and take different pictures that would be of great help for the learners. Furthermore, most of the companies were agreed by the different flowcharts that we presented to them as it collected most of the different processes, materials, machinery, tools, and durations of those processes. Then, concerning the staff allocated to each of the tasks, there were no coincidences among the different interviewed companies, which shows the high degree of differentiation and personalization among the furniture sectors. Due to the size of the sample, the Partnership, after the data harmonization, decided to develop scenarios just for two of the type of factories, according to the received answers: panels and board manufacturing and transformation (case furniture), and wooden finished furniture and upholstery (skeletal furniture).

The concept of gamification is based on a main scenario, which is an imaginative furniture factory, where different types of furniture are manufactured: cabinet, skeletal (including upholstered furniture). The real environment in factories is also presented in films from individual departments. The films are shot in real factories. They illustrate the individual stages of the production process. The preparation of the films required the development of a concept to reflect the factory environment as accurately as possible, show the operation of machines and tools, as well as the way of processing the material up to the assembly of the finished furniture. Engagement in gamification might be empowered by setting up clear goals (specific ones and more difficult, but not exceeding player's abilities) aligned with challenges around furniture production. In gamification we can distinguish the following goals:

- Outcome goals - Related to completing specific tasks challenges, quests, exploratory tasks.
- Performance goals - Goals require the user to reach certain performance level badges, points, achievements.
- Process goals - Topic open for future investigation learning.
- Stretch goals - Topic open for future investigation achievements.
- Smart goals - specific, measurable, attainable realistic, and time bounded goals need further studies.

Players through performing different tasks will gain points - the more points, the better position in the company. Main goal is to become a boss. Number of points for tasks varies and depends on the correctness of the tasks. Players not only earn points needed for status promotion included in the main path, but also have a chance to get some "aside" achievements for completing specified challenges/tasks. On the way to the boss stage players will have a chance to complete tasks where technical knowledge will be required, as well as soft skills competences will be incorporated into them.

Gamification is differentiated for trainee and regular worker depending on the choice of factory type (case/skeletal furniture). However, for the production manager and the manager, it is identical in both cases. This means that six different modules have been prepared that reflect the problems in furniture companies at every career level. Points are awarded for solved tasks, e.g. true and false, drag and drop. Assignments can be corrected while learning. In addition, you can earn badges for logging in and earning points. After each module you can earn badges, gamification allows you to monitor your progress in the form of percentage points earned. An additional motivation is the sunrise ranking, which can be observed by every player. The developed gamification was verified during pilot studies. Each module was checked and then the respondents answered questions about gamification. All comments have been analyzed and forwarded for corrections.

3. Results and Discussion

The course consists of 6 modules (Figure 1), comprehensively describing the issues of the furniture industry. Four modules deal with issues of construction and technology of cabinet and skeletal furniture, and two deal with management competencies. The recommended order is: trainee, regular worker, manager, board member, while each module can also be done independently. Moreover, There is a special module including a virtual tour of the production halls of the furniture industry.

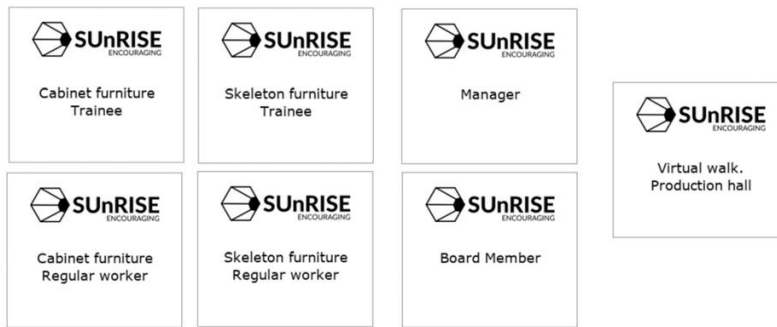


Figure 1. Course structure

Figures 2-6 present examples of the tasks available in each module.

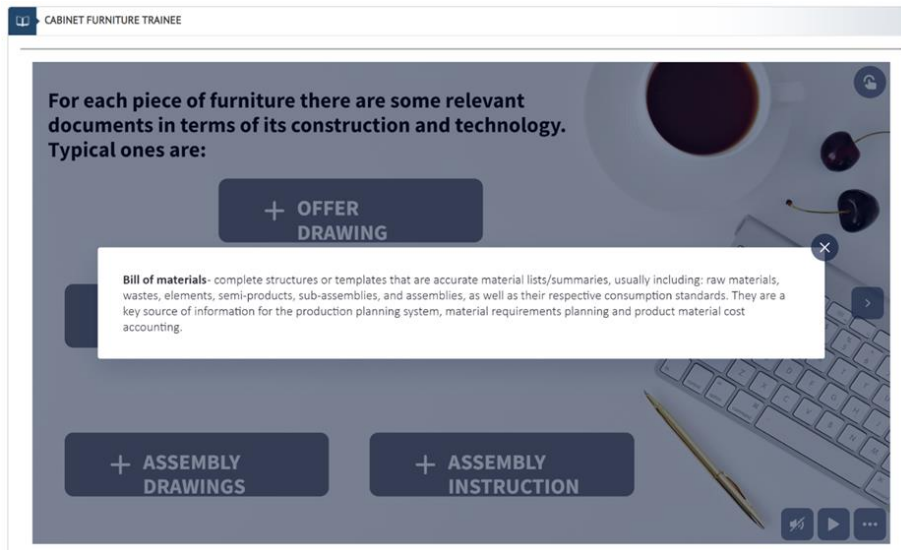


Figure 2. An example of the content part in the Cabinet Furniture Trainee module

The screenshot shows a task titled 'TASK 1' with the instruction 'Let's recap this. Please choose the proper definitions.' Below the instruction are five buttons: 'Offer drawing', 'Working drawings', 'Assembly drawings', 'Assembly instruction', and 'Bill of materials'. Below these buttons are five text boxes containing definitions for each term. At the bottom, there are 'SUBMIT' and 'SAVE' buttons.

Offer drawing	Working drawings	Assembly drawings	Assembly instruction	Bill of materials
complete structures or templates that are accurate material lists/summaries, usually including: raw materials, wastes, elements, semi-products, sub-assemblies, and assemblies, as well as their respective consumption standards.	document containing detailed step-by-step instructions for assembly of furniture. It usually includes: recommendations for preparing the space for installation, guidelines for safe use of the furniture, a presentation of the furniture body with the indica	technical drawing that accurately shows the construction of an furniture element or an independent part of furniture. It contains all dimensions important in the context of manufacturing and a description of the shape features.	graphic presentation of the general, final form of a piece of furniture using scales 1:1, 1:2, 1:5, 1:10, 1:20. In the case of furniture with variable spatial orientation of elements or subassemblies, resulting from the adopted functionality.	technical drawing depicting the detailed structure of the furniture prepared separately for each of the characteristic levels: finished product, assemblies, subassemblies.

Figure 3. Example of a task in the Cabinet Furniture Trainee module

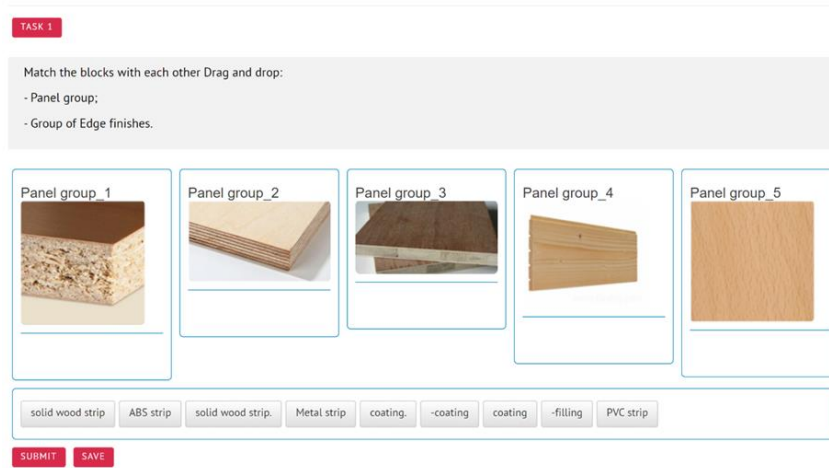


Figure 4. Example of a task in the Cabinet Furniture Regular Worker module

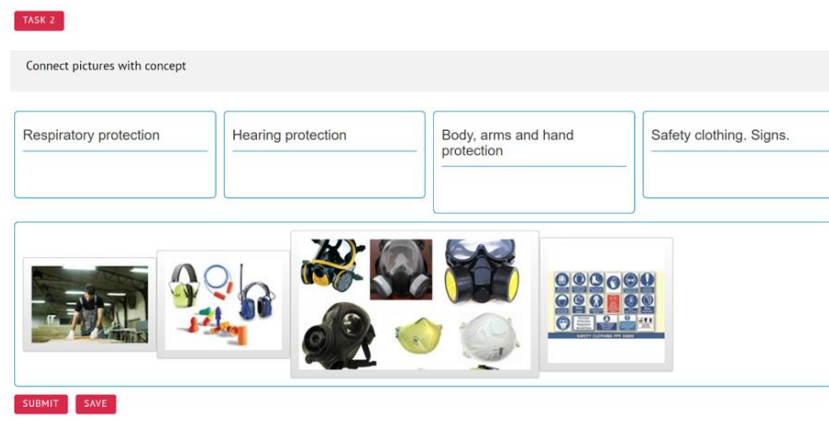


Figure 5. Example of a task in the Manager module

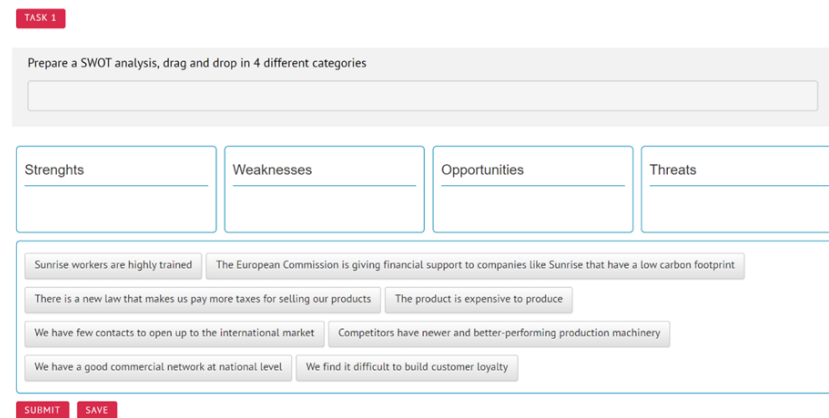


Figure 6. Example of a task in the Board Member module

After completing the module, the user can view the individual statistics of correct answers (Figure 7) and the ranking of all users (Figure 8).

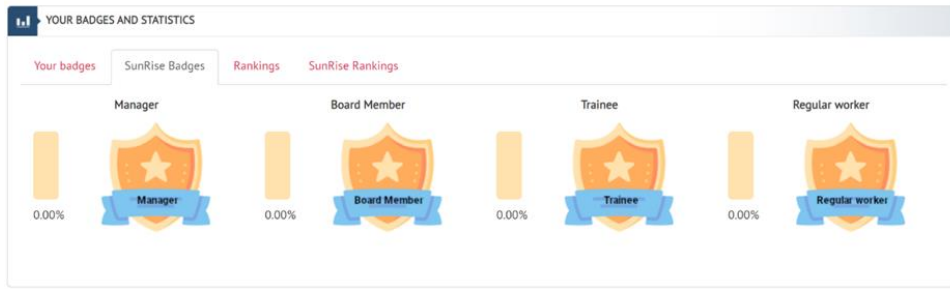


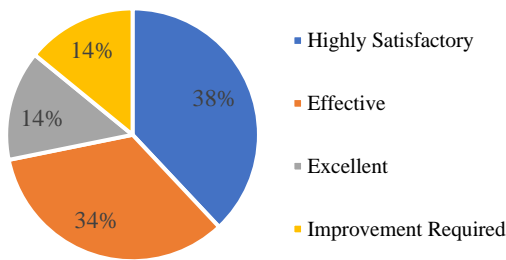
Figure 7. Individual user statistics and badges

MANAGER				BOARD MEMBER			
No.	Nick	Avatar	Points	No.	Nick	Avatar	Points
1	Adam S.		4445	1	Mikołaj S.		988
2	Julia L.		2785	2	Patryk J.		974
3	orest		1656	3	Adrian A.		971
TRAINEE				REGULAR WORKER			
No.	Nick	Avatar	Points	No.	Nick	Avatar	Points
1	Szymon N.		2700	1	Franciszka G.		3050
2	Marek J.		2700	2	Zuzanna S.		3014
3	Patryk J.		2691	3	Marek J.		3010

Figure 8. Ranking of users within each module.

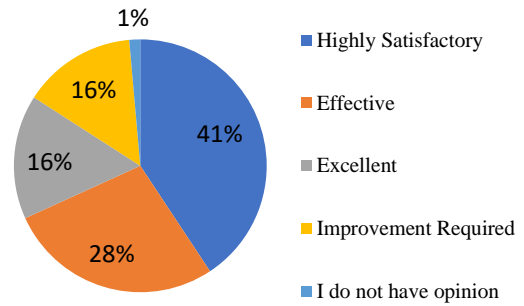
The pilot study involved 69 people, representing a group of students, teachers, and workers. In response to the question the following answers were given (Figure 9, Figure 10):

In response to the question of how users rate the duration and planning of the course, the following answers were given:



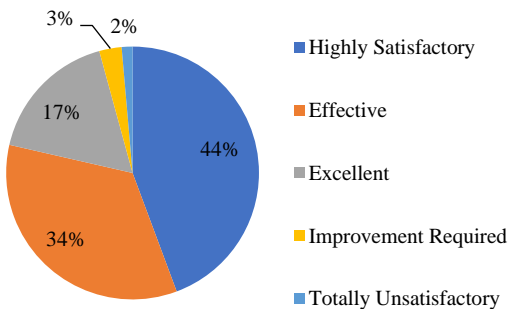
(a)

What do you think about the evaluation method?



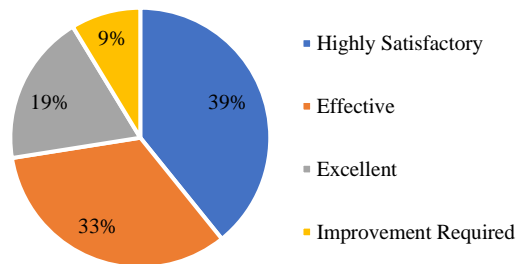
(b)

The virtual learning environment (design, structure)



(c)

Content of the course (amount of content) was evaluated by respondents:



(d)

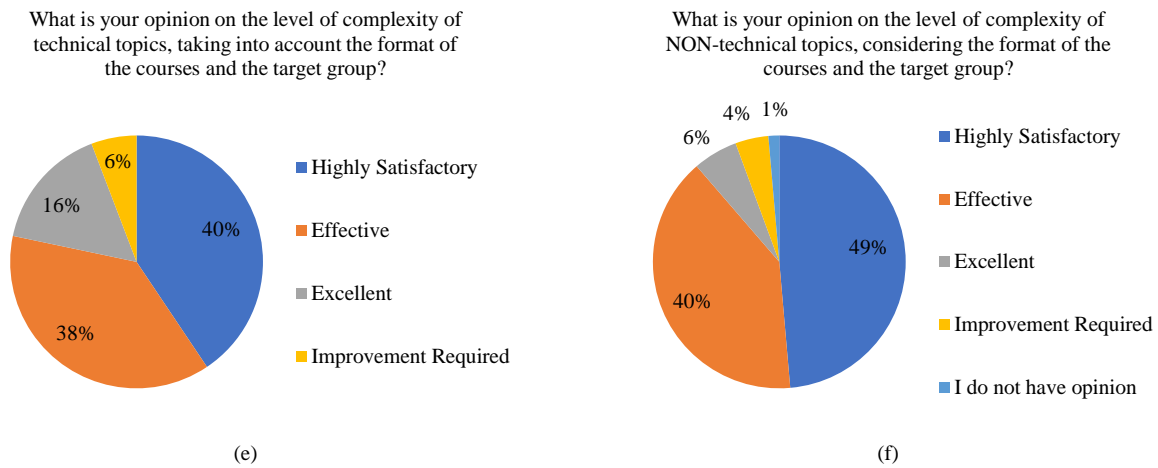


Figure 9. Course Quality Assessment, (a) How users rate the duration and planning of the course?, (b) What do you think about the evaluation method?, (c) The virtual learning environment (design, structure), (d) Content of the course (amount of content) was evaluated by respondents, (e) What is your opinion on the level of complexity of technical topics, taking into account the format of the courses and the target group?, (f) What is your opinion on the level of complexity of NON-technical topics, considering the format of the courses and the target group?

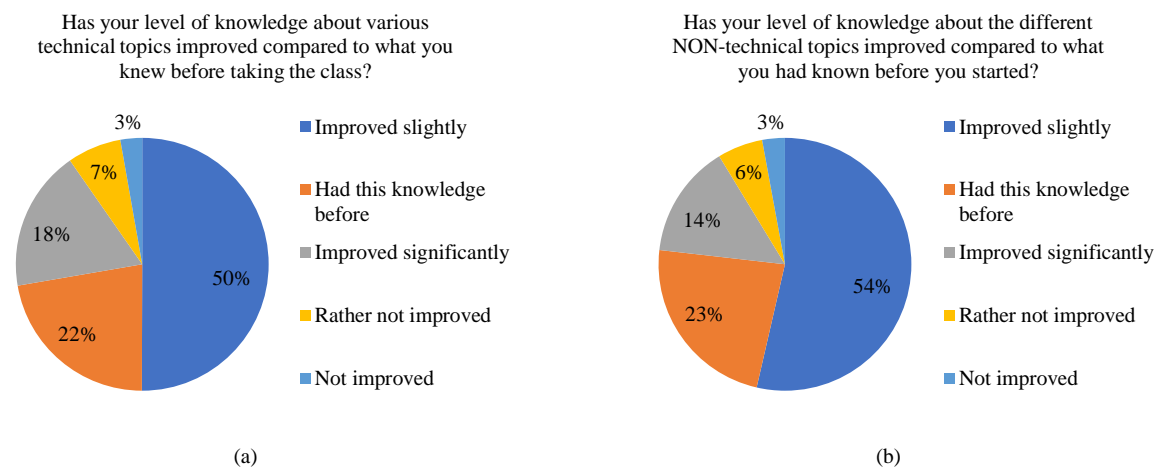


Figure 10. Rate of improvement of technical and non-technical knowledge at the end of the course, (a) Has your level of knowledge about various technical topics improved compared to what you knew before taking the class?, (b) Has your level of knowledge about the different NON-technical topics improved compared to what you had known before you started?

In response to the question of how users rate the duration and planning of the course, more than 85% were highly satisfactory, effective or excellent. The content of the course (amount of content) and the virtual learning environment (design, structure) were evaluated by respondents in more than 90% as highly satisfactory, effective or excellent. The question "What do you think about the evaluation method" was answered in more than 80% as highly satisfactory, effective or excellent. The questions "What is your opinion on the level of complexity of technical topics, taking into account the format of the courses and the target group?" and "What is your opinion on the level of complexity of NON-technical topics, considering the format of the courses and the target group?" received responses of more than 90% as highly satisfactory, effective or excellent.

The last questions were about the rate of improvement in technical and non-technical knowledge at the end of the course. In response to the questions "Has your level of knowledge about various technical topics improved compared to what you knew before taking the class?" and "Has your level of knowledge about the different NON-technical topics improved compared to what you had known before you started?" users answered in more than 90% as improved slightly, had this knowledge before and improved significantly.

More information about the project and access to the gamification available in the QR codes below (Figure 11 a,b).

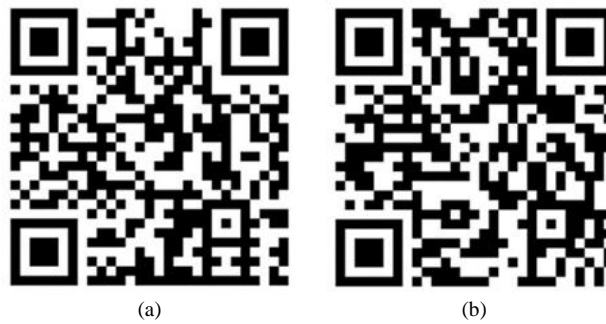


Figure 11. (a) Link to the ENCOURAGING SUNRISE project website (www 2); (b) Link to the developed course based on gamification

4. Conclusion

So far, 275 people have used the <https://www.logglobos.eu> platform. The high interest in the platform indicates the need for developing this type of training, which enhances employees' competencies. Additionally, creating training in the form of gamification is an interesting alternative to the traditional way of acquiring knowledge. The platform has been subjected to the pilot study before being made available to users. The pilot study involved 69 people, representing a group of students, teachers, and workers. Then, the people involved in the testing were asked questions to verify the correctness and usefulness of the developed gamification. In response to the questions, users highly rated the quality and content of the course. They also admitted that gamification as an innovative educational solution has improved their competences. As shown by the conducted pilot studies, confirmed by the growing number of people taking part in the course, the developed gamification fills the visible gap and demand for the course in the furniture industry. Therefore, it seems advisable to undertake further research aimed at developing materials that enhance competencies in the wood and furniture sector.

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