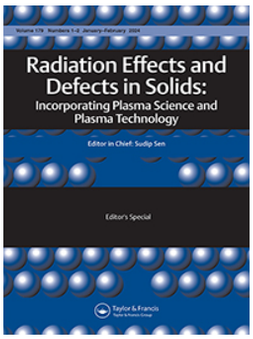

Taylor & Francis
Taylor & Francis Group

Radiation Effects and Defects in Solids
Incorporating Plasma Science and Plasma Technology

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/grad20

Developing competencies through flow, gamification and cultural integration: an analysis of the potential of games in teaching/learning

L. Lopes, S. Schreurs, C. Licour & S. Soares

To cite this article: L. Lopes, S. Schreurs, C. Licour & S. Soares (2024) Developing competencies through flow, gamification and cultural integration: an analysis of the potential of games in teaching/learning, Radiation Effects and Defects in Solids, 179:1-2, 3-13, DOI: 10.1080/10420150.2024.2318700

To link to this article: https://doi.org/10.1080/10420150.2024.2318700

Published online: 24 Apr 2024.

RADIATION EFFECTS & DEFECTS IN SOLIDS
2024, VOL. 179, NOS. 1–2, 3–13
https://doi.org/10.1080/10420150.2024.2318700

Taylor & Francis
Taylor & Francis Group

Developing competencies through flow, gamification and cultural integration: an analysis of the potential of games in teaching/learning

L. Lopes [a,c], S. Schreurs [d], C. Licour [e] and S. Soares [a,b,c]

[a]Departamento de Física, Universidade da Beira Interior, Covilhã, Portugal; [b]Centro de Matemática e Aplicações, Universidade da Beira Interior, Covilhã, Portugal; [c]Laboratório de Instrumentação e Física Experimental de Partículas (LIP), Lisboa, Portugal; [d]Research Group NuTeC, CMK, Hasselt University, Diepenbeek, Belgium; [e]Department of Nuclear and Medical Physics, HE2B / ISIB – Brussels Engineering School, Brussels, Belgium

ABSTRACT

Much has been done to recover from the effects of the COVID-19 pandemic on school and university education, both in filling gaps in learning and in social integration and motivation of students post-pandemic. The need to transition from conventional teaching to remote learning has led students and teachers in a spiral of evolution in the development of digital skills due to the urgent adaptability required by the situation. The search for new technologies and didactics that seemed difficult at the time because many were not yet expecting such a sudden change, now takes advantage of that experience to create projects and courses that allow for accelerated recovery and thus transform what was once a complicated task into a new perspective on teaching and learning. One of these ways is the use of epistemic games and gamification to maintain 'flow'. Flow is a combination of skill development through challenges and the pleasure of completing tasks. In this work, we will discuss a project that, with the union of remote and face-to-face teaching & learning, allowed university students to use the knowledge received during an intensive course on environmental radiation to design an escape room-style game with the aim of teaching students at other levels of education. CERAMUG, a Blended Intensive Programme (BIP) in partnership with ERASMUS+, aimed at two-way learning, to learn to use specific instruments for measuring natural environmental radiation and to teach, through a game, the existence of this natural radiation in order to inform and raise awareness of high school students on the subject. The aim of this course was to promote the development of competencies that allow students to succeed in their future professional challenges. The impact of the project is not only the innovative experience for students to learn specialized nuclear measurement techniques, but also to encourage other employability competencies

ARTICLE HISTORY
Received 14 November 2023
Accepted 24 January 2024

KEYWORDS
Gamification; teaching; learning; environmental radioactivity

CONTACT S. Soares shsoares@ubi.pt

and digital skills necessary for their careers, as well as promoting integration among students from different cultures and countries.

1. Introduction

Whenever the COVID-19 pandemic is mentioned, one of the main concerns lies in the educational context. Teachers and students had their learning routines disrupted with the challenge of transitioning from in-person classes to remote teaching, and interactions with teachers and peers became limited. Despite the practice of distance learning already being used in some countries (*1*), the abrupt manner in which this transition occurred during the pandemic demanded a rapid adaptation, with the development of digital skills such as the use of collaborative platforms and video conferencing, as well as the utilization of digital tools for content creation (*2*). Although it was a temporary experience, it is important to reflect on what was learned, especially in terms of acquiring technological competencies, personalizing education, and accessing content. After the pandemic, it is crucial that these competencies continue to be valued (*3*), as the use of technology enriches the learning experience, serving as a powerful ally in the educational and professional process, offering access to diverse materials and expanding possibilities for interaction and collaboration. Additionally, it promotes the training of teachers and students to ensure that a graduate from vocational or higher education is prepared for an increasingly digital world.

However, remote teaching has its limitations. The lack of in-person interactions can impact student motivation and engagement, as well as hinder the development of essential social skills. In this regard, the modality that blends remote and in-person teaching emerges as a promising approach, as it combines the best of both worlds: the convenience and flexibility of distance learning, along with the advantages of integration that are acquired in-person (*4*). Students can receive personalized content and concepts and autonomously engage in activities, and then apply this knowledge in person and within the group after adequate preparation. Teachers also benefit from this model as they can design more robust content, requiring students to utilize concepts previously acquired and internalized during online teaching in in-person classes and training sessions.

This work aims to present a successful example of learning through a course based on a Blended Intensive Programme (BIP), in partnership with the Erasmus + Programme in accordance with the project rules (*5*). The course, named Course on Environmental Radiation Measurements Using Gamification (CERAMUG), with the University of Beira Interior as the coordinating Higher Education Institution (HEI). The in-person location of the course took place at UBIMedical and the Laboratory of Studies on Radon Exposure Effects (LabExpoRad), both located in the city of Covilhã, in the district of Castelo Branco, Portugal. The choice of the location is due to the presence of natural radiation from uranium and, consequently, radon emanating from the granitic rock distributed throughout the Covilhã region (*6*).

The main objective of this course was to deliver a game, in the style of an escape room, where groups of participating students should base their missions, questions and challenges on the knowledge acquired throughout the course. They were also required to submit a report that summarized all their learning. The course allowed us to understand

Table 1. Number of students per HEI.

HEI	Number of students	Country
Univesidade da Beira Interior (UBI) – coordinator	*3*	*Portugal*
Haute École Bruxelles-Brabant (HE2B) – Institut Supérieur Industriel de Bruxelles (ISIB)	3	Belgium
Universiteit Hasselt (UHasselt)	4	Belgium
Universitat Politècnica de València (UPV)	2	Spain
Czech Technical University in Prague (CTU)	4	Czech Republic
Università Degli Studi di Milano (Umilano)	5	Italy
Università di Bologna (Unibo)	7	Italy

that this mode of intensive training assists students not only in recovering from the social and scientific learning gaps left by the pandemic but also in acquiring cultural and teaching knowledge through the exchange of experiences with their interaction among themselves.

2. The CERAMUG BIP ERASMUS+ course

The CERAMUG course was divided into two parts, a virtual component, and an in-person activities component. The virtual component lasted for 20 days, starting on 6th February 2023, and the in-person activities took place between 27th February and 3rd March 2023. The entire course program was previously discussed among the teachers from participating institutions to encompass the diverse backgrounds of the students so that everyone could comprehend the topics taught and successfully complete the course with meaningful learning. The course counted with 28 participants, including both bachelor and master students, from 6 different European universities, in addition to the coordinating institution, as shown in Table 1.

2.1. Virtual component

As the course's objective was to deliver a game based on the knowledge acquired during the in-person activities, the students received training on how to use a platform for creating the escape room. The chosen platform was *genial.ly*, also known as Genially, available at https://genial.ly. On 6th of February 2023, during a 1.5-hour class, the students received both basic and advanced instructions on how to use Genially, particularly focusing on accessing and creating escape room-style games. They were shown examples of other games with similar objectives to the course, *i.e.* teaching through gamification, to familiarize themselves with the platform's features. At the end of this class, they were divided into 6 working groups, and a communication community was created on the WhatsApp application to facilitate the integration process among participants.

Later that day, for approximately 1 h, the students attended a class on the Sustainable Development Goals (SDGs) (*7*). They were introduced to the concept of sustainable development, the function of the Agenda 2030, and the 17 SDGs, as well as how the involved countries aim to achieve them. This session included a practical part in which the students were asked to reflect, followed by a discussion on two topics: 'Situate the e-commerce industry according to the impact on the 5 most relevant SDGs (individually, explain why). Compare and discuss in groups' and 'How would you score them today on a scale of 1–5

Table 2. Tasks delivered to each group as a theme for presentation during F2F activities.

Group	Task
Group 1,3	Energy mix: nuclear or not
Group 2,4	Radiation exposure of travel and leisure
Group 5,6	Reuse of Naturally Occurring Radioactive Material (NORM)

(SDG wheel)'. This was done to maintain the dynamism of the class and provide an opportunity for everyone to participate and better internalize the SDGs, an approach aimed at expanding knowledge on the subject, allowing higher education students to develop critical thinking regarding the importance of sustainability and apply it to their future decisions, both in their professional careers and in the community at large, becoming conscientious citizens (*8*). After the discussions, each group received a task, as explained in Table 2. These tasks involved selecting 5 SDGs related to each topic, rating the SDGs for each topic, explaining the reasons behind those ratings, and proposing a solution to improve the score of one of the SDGs. The topics were presented during the face-to-face (F2F) activities, with a maximum duration of 15 min, based on the following rules: ensure it is a group task and that all members support the presented ideas; explain the point of view for your topic; describe how you will interact with the other groups during the presentation; and explore the use of videos, quizzes, or other elements that could be incorporated into an escape room game. This task was part of the student evaluation, composing 30% of the final grade.

During the 20-day period that comprised the virtual and in-person components, the students had the opportunity to interact with each other and with the professors from their own and other institutions, as they were all part of the same communication group. They were also provided with a Microsoft Teams community where they could access and download files used in virtual classes, review and download examples of the games presented as class examples, as well as the slides and reports of the SDGs. Additionally, they could review recorded video classes and hold virtual meetings.

One of the objectives of this virtual component was to develop digital skills, which are essential for academic and professional performance. These skills are not only useful for the subsequent stages of the course but also contribute to increasing the employability of each student, an important requirement for their future careers, regardless of their area of expertise.

2.2. In-person activities component

The program of in-person (F2F) activities included both theoretical and practical classes, visits to laboratories studying environmental radiation, and a cyclotron visit to gain insights into the application of nuclear physics in medicine, among others. Further details of the activities will be described in Table 3 and Table 4. It is worth mentioning that, in the first F2F activity, there was a general presentation about the course and a brief individual and oral introduction of each student to allow the entire group to get to know each other better. This dynamic facilitated 'breaking the ice' and fostering a positive atmosphere for collaboration among all participants.

Figure 1. The photograph was captured during the water sampling process in one of the locations specified in Table 4.

All the results and knowledge acquired from theoretical classes, visits (Figure 1), and practical sessions were presented through an escape-room-style game, targeting secondary school students to raise awareness about environmental radiations and SDGs. The game constituted 35% of the final grade and was delivered on the last day of the in-person activities (F2F). Additionally, a report was required, with a deadline set for two weeks after the conclusion of the in-person program and constituted the remaining 35% of the final grade. After the report´s evaluation, the students received a certificate for 3 ECTS (European Credit Transfer and Accumulation System).

2.3. The letter G of CERAMUG

Gamification is not a novelty as a pedagogical strategy (*9*, *10*) in classrooms with the aim of increasing motivation and learning (*11*). Although the use of personalized serious games for teaching and how to best harness this technology is still controversial, as many studies are yet to be conducted to understand whether there is indeed an improvement in learning and motivation (*12*). However, with CERAMUG, it was found that the virtual game designed by the students contained significant theoretical information about environmental radiation and could easily be used in a classroom setting for secondary school students to enhance their knowledge of radiation during their schooling phase. Moreover, during the preparation of the game, the CERAMUG students had the opportunity to gain a better understanding of all the topics discussed from the virtual component to the presentation

Table 3. Lectures delivered F2F to students.

Lectures' theme	Subject
GIS – Geographic Information Systems	Mapping data adds spatial dimension and often allows to uncover underlying correlations between what seems uncorrelated measurements. Most natural data need to be located under a geographic context to have significance, GIS allows to gather information under powerful geodatabases, process, filter and query the data. It is also possible to apply spatial analysis algorithms to model data and predict behavior either in space as in time, 2D, 3D or 4D, to model fluxes, and to support decision making. A short introduction to QGIS (https://qgis.org/en/site/) and a simple modelling exercise was presented.
Examples of another projects and courses in environmental remediation	- The Role of e-learning Methodologies and Tools for Competence Building in Decommissioning and Environmental Remediation - IAEA Network of Environmental Management and Remediation – ENVIRONET - MINDER–Erasmus + Joint Master in Nuclear Decommissioning and Environmental Remediation
History of the region	Short talk – Introduction to Covilhã, the region of Serra da Estrela, Portugal, and Iberia
Finding ^{137}Cs	^{137}Cs is a fission product and has been released in the environment following nuclear weapons atmospheric tests and different accidents in nuclear power plants. Moreover, it's half-life of 30 years, its ability to be airborne transported, and its large solubility make ^{137}Cs a good tracer to study the distribution of pollutants and its mechanisms. Lithogenic isotopes as ^{226}Ra, ^{228}Ra and ^{40}K are also relevant because of their ubiquity and their dependance on the geolocation. Those radioisotopes can be measured with great interest in various media such as plants, soils, water … HE2B/ISIB and UBI have a research project in this field.
Radon: from the basics to the uncertainty calculation	Introduction to radon and health effects, different measurements techniques, radon in buildings and legislation.
Radon measurements in water using RAD7 Radon Detector	Step by step explanation how radon measurements in water are done from sampling to measurement and results with the RAD7 detector and software.

Table 4. Practical activities during F2F.

Activities' theme	Subject
Visit to ICNAS – Institute for Nuclear Sciences Applied to Health (Coimbra)	The students could learn about production and development of positron-emitting radiopharmaceuticals and visit the cyclotron unit. Currently, ICNAS supplies radiopharmaceuticals for PET imaging at a national and international level.
Visit to LRN – Laboratory of Natural Radioactivity (Coimbra)	The students could learn about calibrations' equipment or detectors for the measurement of radon and thoron, risk assessment related of the exposure to radon, sampling and measurements techniques for radioactive isotopes (including radon), among other things.
Field trip in the region of UBI	Water sampling in Casteleiro (Figure 1), Quarta-feira (radium old mining), Covilhã and Águas Radium (old SPA). Each group took two samples for radon measurement in RAD7 equipment.
Work @Lab	Each group measured radon in their water samples using the RAD7 on LabExpoRad as an 'hands-on' practice.

of the completed game, as they had to reflect on the best way to convey what they had learned in a playful manner.

One important aspect to mention is that gamification demands clear objectives and immediate feedback. When designing a personalized game, the concept of *flow*, a theory developed by Mihaly Csikszentmihalyi (*13*), should be kept in mind. It involves maintaining activities, challenges, and tasks with the goal of continuous self-awareness and self-improvement. As shown in Figure 2, any activity should not be too easy to avoid becoming tedious (A_2), nor too difficult to generate anxiety (A_3). Therefore, when encountering a limitation, we must self-challenge or learn more to maintain the *flow* (A_1 and A_4) (*13*). As previously mentioned, during the discussions for the preparation of the CERAMUG program, efforts were made to maintain the *flow*, and the students were guided to do the same while

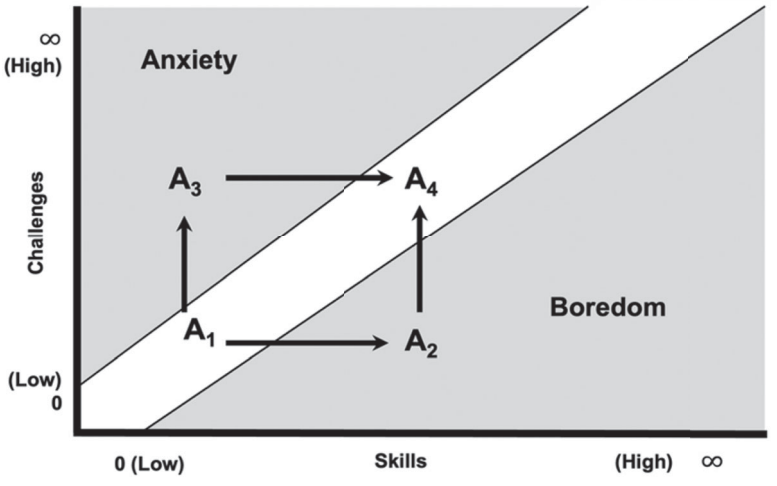

Figure 2. Explanatory diagram illustrating how *flow* relates to an activity and how the complexity of this activity contributes to growth and understanding. Adapted from original (13, p.74).

Table 5. Missions and respective subjects for the questions/challenges assigned for all work groups of students, included in game template.

Mission – Group	Subject for the questions/challenges
01 – 1	SDGs
02 – 2	Radioactivity in general – background radioactivity
03 – 3	Natural radioactivity everywhere
04 – 4	Radon in water from sampling to measurements
05 – 5	Radon in building from detection to measurement
06 – 6	Monitoring in environment

designing the game. This approach proved to be a great asset for this course, as the game created by the students contains missions and questions precisely within this premise.

Each group was assigned a specific subject mission to interpret and develop in the form of questions and/or challenges (Table 5), based on an escape-room game model previously designed and provided to the students during the virtual component. To facilitate integration among the groups, it was requested that one member of each group act as the spokesman/spokeswoman-leader to maintain a connection with all the other groups in order to unite their work as a cohesive whole, even though the 6 missions were developed separately. Thus, after each group completed their task, all the missions were merged into a single game and as mentioned before, presented on the last day of the in-person activities (F2F).

The entire game was developed within the framework represented in Figure 3, incorporating a storyline and a scenario as a background, with the purpose of linking together each group's missions to enable a logical sequence of challenges and tasks, leading to the game's conclusion.

3. Discussions and future research directions

In this study, we were able to comprehend that the pandemic, in a way, allowed teachers and students to have a different perspective on teaching and learning and it could be very

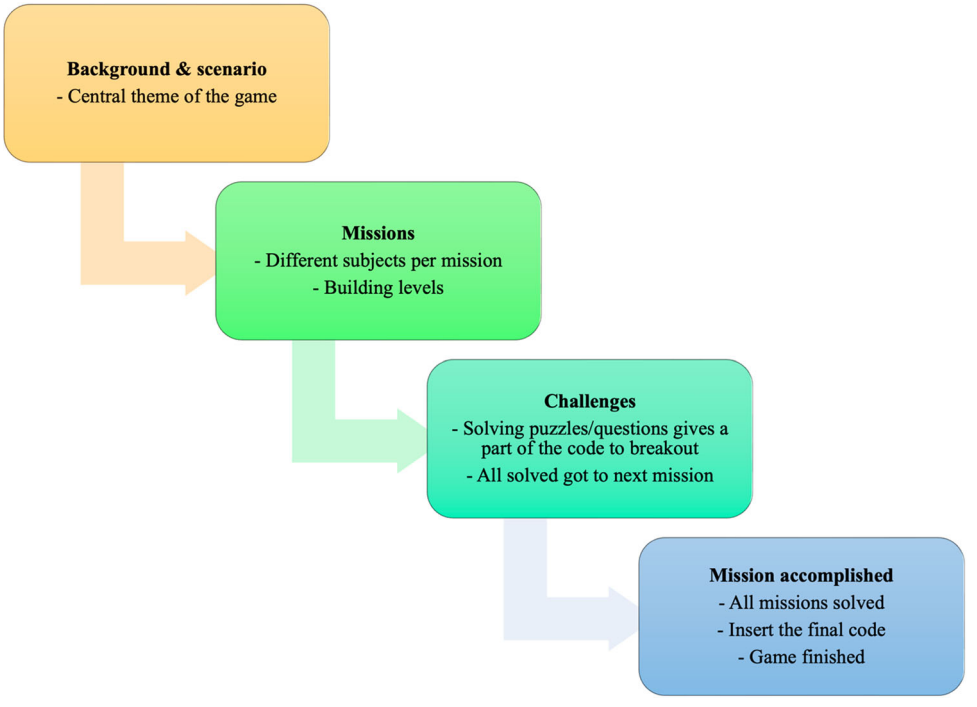

Figure 3. Diagram representing how the game was designed by the students and the sequence used to connect all the missions delivered for each group.

satisfactory despite previously studies (*14*). The diverse approach of this course, encompassing scientific, digital, professional, and social competencies, provided students with a range of knowledge that they can apply in their professional careers and also exposed them to various research lines in the field of environmental radiation and future work prospects. Many participants did not have the opportunity, during their academic journey, to learn more about these subjects or experience such activities, as most of them had to stay confined for almost two years due to the rules imposed during the COVID-19 pandemic in most European Union countries.

Regarding the use of gamification and serious games in learning, it gave us the opportunity to gather information about students' behaviours and learning during the game creation process and when they used the game in a unique context, allowing us to learn more about how to best utilize this pedagogical resource. The integration that occurred among the students during the game development was the most engaging and enriching factor, as it brought together the knowledge received in this course with their previously acquired competencies, enabling everyone to learn from each other and work as a team. We acknowledge that the way this project was developed adheres to the *flow* proposed by Mihaly, as we constantly had to observe and, at times, adapt the theoretical and practical classes and their applications to strike a balance between avoiding boredom and preventing excessive difficulty, thus delivering this conception to the students.

4. Conclusions

Due to the success of this project's conclusion and the reported satisfaction of the students during the course, we intend to continue using this approach keeping in mind the lessons learned from this first edition, so that more data and results can be gathered, eventually providing a guide of best practices for teachers and educators to be applied not only in a Blended Intensive Programme (BIP) but also in regular university courses or throughout the academic journey. It has been demonstrated that the combination of remote and in-person teaching can bring many benefits to both teachers and students.

Finally, this work serves as a model and potential approach for future projects in any area of knowledge that involves gamification, digital competence development, laboratory and professional techniques, sustainability, and social interactions.

Acknowledgements

We thank all professors and specialists whose collaborate with the lectures, the owner of Águas Radium (old SPA) for the permission to visit the place, the coordinators from Institute for Nuclear Sciences Applied to Health and Laboratory of Natural Radioactivity both in Universidade de Coimbra, and Genially platform. The course was funded by Erasmus + project for Blended Intensive Programmes in KA131 Higher Education.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Notes on contributors

L. Lopes began her career as a chemical technician, working in the food additives industry and in food analysis laboratories for label composition. She pursued her undergraduate degree in the exact sciences with a focus on education, where she remained for an extended period. She holds specializations in medicinal chemistry and in teaching physics and chemistry. Currently a doctoral student, she is dedicated to researching natural radiation at the Laboratory for the Study of the Effects of Radon Exposure (LabExpoRad) and is part of the team at the Laboratory for Instrumentation and Experimental Particle Physics (LIP – Lisbon).

Prof. Dr. S. Schreurs obtained her PhD in analytical and theoretical chemistry in UHasselt in 1999.She works as a professor at the Faculty of Engineering Technology of Hasselt University since 2001 and she coordinates the research group Nuclear Technology Center (NuTeC). Her research focuses on 'Valorisation of inorganic and organic residues including naturally occurring radioactive materials (NORM), nuclear waste management and decommissioning'. She teaches courses in analytical, environmental and radiochemistry, master and bachelor thesisses in nuclear technology and environmental radioactivity. She (co)-organizes international training schools incorporating new educational approaches mostly in the framework of Erasmus SP or BIP projects. She is also involved in the Educational Master of Sciences and Technology for STEM education and SDG workshops.

C. Licour has a master's degree in chemistry (1989) and a master's degree in Nuclear Sciences (1990) from the University of Liège (Belgium). She has been working since 1990 at the University college HE2B (Brussels, Belgium), in the department of Nuclear and Medical Physics. She teaches courses in analytical chemistry, radiochemistry, nuclear metrology, and radioecology. She is supervisor of master thesis in the field of radiochemistry and radioecology. She collaborates in international training schools and workshops in the frame of Erasmus SP and BIP projects. As a researcher, she participates in projects focusing on radon assessment in the environment. Currently, she's involved in a research

project in the field of radioecology in collaboration with the University of Beira Interior (UBI, Covilhã, Portugal) in the frame of a PhD.

S. Soares completed her Ph.D. in Nuclear Physics in 2007 and her Master's in Physics in 2001 at the Faculty of Sciences of the University of Lisbon. She is the Coordinator of the LabExpoRad laboratory (UBIMedical-UBI), a Researcher at the Laboratory of Instrumentation and Experimental Particle Physics (LIP-Lisbon), and collaborates with the Center for Mathematics and Applications of UBI (CMA-UBI). At the University of Beira Interior, she holds the position of Assistant Professor with a permanent appointment in the Department of Physics. Additionally, she serves as the Director of the 2nd Cycle of Physics and Chemistry Teaching in the 3rd Cycle of Basic Education and Secondary Education, as well as the President of the Committee for Equality. Since graduating in Physics, she has pursued an active career in the dissemination and teaching of Physics. Simultaneously, she has conducted research in various areas of Physics, including Nuclear Physics, Solid State Physics, High Energy Physics, Applied Physics in Medicine, and currently, Ionizing Radiation Physics from a health and environmental perspective. She (co)-organizes international training schools incorporating new educational approaches mostly in the framework of Erasmus SP or BIP projects.

ORCID

L. Lopes http://orcid.org/0000-0002-4420-6890
S. Schreurs http://orcid.org/0000-0002-6816-8737
C. Licour http://orcid.org/0009-0009-6052-394X
S. Soares http://orcid.org/0000-0002-6401-5290

References

(1) Rodrigues, H., Almeida, F., Figueiredo, V., & Lopes, S. L. Tracking e-Learning Through Published Papers: A Systematic Review. *Comput. Educ.* **2019**, *136*, 87-98.
(2) Fang, J.; Pechenkina, E.; Rayner, G.M. Undergraduate Business Students' Learning Experiences During the COVID-19 Pandemic: Insights for Remediation of Future Disruption. *Int. J. Manage. Edu.* **2023,** *21*(1).
(3) Wagiran, W.; Suharjana, S.; Nurtanto, M.; Mutohhari, F. Determining the e-Learning Readiness of Higher Education Students: A Study During the COVID-19 Pandemic. *Heliyon* **2022,** *8*, e11160.
(4) Alammary, A.; Sheard, J.; Carbone, A. Blended Learning in Higher Education: Three Different Design Approaches. *Aust. J. Educ. Technol.* **2014,** *30* (4), 440–454.
(5) European Commission. *Blended Intensive Programmes in KA131 Higher Education projects*. Brussels: European Commission, 2023. Erasmus+projects: https://wikis.ec.europa.eu/display/NAITDOC/Blended+Intensive+Programmes+in+KA131+Higher+Education+projects
(6) Inácio, M.; Soares, S.; Almeida, P. Radon Concentration Assessment Inwater Sources of Public Drinking of Covilhã's County, Portugal. *J. Radiat. Res. Appl. Sci.* **2017**, *10* (2), 135–139.
(7) UN Sustainable Development. *United Nations Department of Global Communications*. https://sdgs.un.org/goals
(8) Dlouhá, J.; Heras, R.; Mulà, I.; Salgado, F.P.; Henderson, L. Competences to Address SDGs in Higher Education – A Reflection on the Equilibrium Between Systemic and Personal Approaches to Achieve Transformative Action. *Sustentability*. **2019,** *11*, 3664.
(9) Moncada, S.M.; Moncada, T.P. Gamification of Learning in Accounting Education. *J. Higher Edu. Theor. Pract.* **2014,** *14* (3), 9–19.
(10) Limantara, N.; Hidayanto, A.N.; Prabowo, H. The Elements of Gamification Learning in Higher Education: A Systematic Literature Review. *Int. J. Mech. Eng. Technol.* **2019,** *10* (2), 982–991.
(11) Bilro, R.G.; Loureiro, S.M.; Angelino, F.J. The Role of Creative Communications and Gamification in Student Engagement in Higher Education: A Sentiment Analysis Approach. *J. Creative Commun.* **2022,** *17* (1), 7–21.

(12) Oliveira, W.; Hamari, J.; Shi, L.; Toda, A.M.; Rodrigues, L.; Palomino, P.T.; Isotani, S. Tailored Gamification in Education: A Literature Review and Future Agenda. *Educ. Inf. Technol.* **2023,** *28*, 373–406.
(13) Csikszentmihalyi, M. *Flow: The Psychology of Optimal Experience*; New York: Harper & Row, 1990.
(14) Banihashema, S.K.; Noroozib, O.; Brokb, P.d.; Biemansb, H.J.; Kermanc, N.T. Modeling Teachers' and Students' Attitudes, Emotions, and Perceptions in Blended Education: Towards Post-Pandemic Education. *Int. J. Manage. Educ.* **2023,** *21*, 100803.