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CLIMATE FRESK: APPLIED GAMIFICATION TO STIMULATE SUSTAINABILITY IN ENGINEERING DISCIPLINES

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Abstract 1 *Climate change education is vital for driving individual and societal transformation. Playful and game-based educational methods are emerging as promising alternatives to traditional approaches, with the potential to overcome their limitations. One example of applied gamification is Climate Fresk, a game-based workshop based on the latest IPCC report, designed to enhance participants' understanding of the causes and consequences of climate change and foster action-based responses. This paper evaluates the impact on 1st year students of Electrical Engineering and Facility Management Departments at DHBW-Stuttgart, facilitated by the Emission Free European Universities project (EFEU), before and after participation in a Climate Fresk workshop.*

Keywords *Sustainable Education, Climate Change, Gamification, Future Skills*

Abstract 2 *Bildung über den Klimawandel ist entscheidend, um individuelle und gesellschaftliche Veränderungen voranzutreiben. Spielerische Bildungsmethoden entwickeln sich als vielversprechende Alternativen zu traditionellen Ansätzen und haben das Potenzial, deren Grenzen zu überwinden. Ein Beispiel für angewandtes Gamification ist Climate Fresk, ein spielbasierter Workshop, der auf den Ergebnissen des IPCC-Berichtes basiert und darauf abzielt, das Verständnis der Teilnehmer für die Ursachen und Folgen des Klimawandels zu verbessern und handlungsorientierte Reaktionen zu fördern. In diesem Beitrag werden die Auswirkungen auf Erstsemesterstudierende der Fachrichtungen Elektrotechnik und Facility Management an der DHBW Stuttgart vor und nach der Teilnahme an einem Climate Fresk-Workshop im Rahmen des Projekts Emission Free European Universities (EFEU) untersucht.*

Keywords *Bildung für Nachhaltige Entwicklung, Klimawandel, Gamifikation, Future Skills*

INTRODUCTION

The Emission-Free European Universities (EFEU) project aims to advance sustainability competencies and carbon neutrality in the engineering disciplines through the sustainable transformation of teaching and learning activities.

The project addresses the identified problem: Many HEIs have adopted policies, educational programs, modules, and practices to promote sustainability. Nevertheless, studies have shown that university campuses still have significant carbon footprints, bear other substantial negative environmental impacts and are slow in meeting the mandates of the 2030 Agenda.

Therefore, it begs the question: How can universities encourage and implement sustainable practices and incorporate the necessary changes in learning and teaching activities to improve overall sustainability performance? EFEU will play a critical role and offer impactful approaches. The project is focused on transforming learning and teaching activities so that HEI campuses can evolve into true beacons of sustainability.

Therefore, the transfer of sustainability-focused learning activities is encouraged to build the capacity and competencies of students and staff. One such activity is the application of serious games, as it is an engaging approach to teaching serious topics. Due to its nature and objectives, the serious game, Climate Fresk was identified as an attractive low-threshold offer for the academic community at DHBW-Stuttgart.

Climate Fresk is a serious game designed to educate about the causes and consequences of climate change, raise awareness about the topic and summarise the work of the Intergovernmental Panel on Climate Change. In response to the escalating climate crisis, education is playing an increasingly vital role in raising public awareness, spreading critical knowledge, and fostering active community engagement. Education can “bring about a fundamental shift in how we think, act, and discharge our responsibilities toward one another and the planet” and its power in climate change responses was recognised by the Paris Climate Conference (COP21) in 2015 (UNESCO, 2017).

Drawing from their experiences, the team has selected Climate Fresk as an effective gamification tool to further sustainability learning and teaching, particularly in climate change. Climate Fresk was chosen for its accessibility, acknowledged benefits, and engaging gamification elements, making it an ideal fit for promoting climate literacy.

LITEREATURE REVIEW

Gamification refers to the use of game-based elements such as mechanics, aesthetics, and game thinking in non-game contexts aimed at engaging people, motivating action, enhancing learning, and solving problems Deterding et al. (2011) and Dominiquez et al. (2013). There has been a growing interest in applying gamification to education. To some extent, this growing interest has been influenced by other efforts that have successfully used gamification in other settings Knapp et al. (2012). There is now a growing body of evidence suggesting that gamification has become widely recognized as an effective tool in promoting learning outcomes in various educational settings (Groening and Binnewies, 2019; Lopez and Tucker, 2019).

Climate Fresk is one of these games recognised for its effectiveness. Founded in 2018 by French scientist Cedric Ringenbach, Climate Fresk is a collaborative game based on 42 cards that players use to build an interconnected illustration. It is increasingly being recognised for its widening impact. According to the latest annual report (2022) published by the Climate Fresk Association, there are close to 900,000 participants and over 34,000 facilitators across the globe. The game is also recognised by the World Economic Forum (2023) for making significant inroads in helping individuals understand the climate emergency because of its highly immersive nature and ability to engage people's feelings and intellect.

Additionally, the game is praised for its number of ancillary benefits. Students are able to: a) problem-solve collaboratively, b) develop collective intelligence through serious play, c) delve into emotional impacts and discuss support strategies for mental health and wellbeing, and d) establish clear links between learning innovations and climate action (Leimbach and Milstein, 2022).

A few researchers, however, pointed out weaknesses in the gamification approach. Kyewski and Krämer (2018), Mekler et al. (2017), and Papp and Theresa (2017) have argued that it is wrong to consider gamification as an ideal solution for learners and educators because it has failed to improve students' sense of group and has not substantially enhanced students' talents, desire for achievement, and inner inspiration. According to Zainuddin et al. (2020), the leading reasons why learning by gamified application has been unsuccessful are attributed to the elements of the game, instructional design, and technical problems. The drawbacks to utilising Climate Fresk have not been extensively covered in the literature. One critical reflection came from Spyckerelle (2022), who explained that for the Climate Fresk organisation to effectively drive individual and societal transformation, its workshops must go beyond simply fostering knowledge and thinking skills but also place a stronger emphasis on driving behavioural change.

Nevertheless, there is ample literature that overwhelmingly supports the gamification approach, highlighting its wide range of possibilities and potential applications. Researchers such as Manzano et al. (2021), Nordin and Wahlström (2022) and Oliveira et al.l (2021) have demonstrated that a fundamental element of serious games in all educational stages is the noteworthy effect they have on student motivation, attitudes towards sustainability, learning as well as behavioural changes.

For this report, we aim to evaluate participants' perceptions, experiences, and learnings of the first installation of the Climate Fresk workshop of DHBW Stuttgart. The goal is to determine the value that lies with this approach and, therefore, provide justification for continual implementation at the DHBW-Stuttgart.

METHODOLOGY

This research took an exploratory approach. Exploratory research is an investigative approach used in the early stages of a project to explore a topic with limited existing knowledge, uncover insights, and identify emerging trends (Olawale et al., 2023). This study adopts this approach as intends to evaluate participants' perceptions, experiences, and learnings before and after participation in a Climate Fresk session.

Climate Fresk was piloted at DHBW-Stuttgart on the 25th and 26th of January, 2024. Four Climate Fresk facilitators from the EFEU team guided 62 participants, constituting students and faculty members of the School of Engineering, throughout the game. The Climate Fresk game is divided into three phases: puzzle, creative, and debriefing. In the puzzle phase, participants are provided with the cards, which they must place and align based on their relationships. In the creative phase, the participants are asked to colour their Fresks (map of connected cards), provide a title and add creative elements. During the debrief phase, participants share their thoughts and experiences about the workshop.

Two surveys were administered, one before the puzzle phase and one after the debriefing phase, in paper format. The surveys were coded, and the responses were entered into Questionpro. The results were prepared with the analytical tools available from Questionpro and Microsoft Excel. While we received valuable feedback aligned with the research

objectives, incorporating more in-depth qualitative methods, such as interviews or focus groups, could have enriched the study.

The report was developed through standardised research activities including a foray through relevant academic papers and journal articles, documenting the utilised methodologies, presentation of the results and discussion and ending with concluding remarks and a set of recommendations.

RESULTS/DISCUSSION

In our study group, there were 60 first-year students and only 2 administrative staff from the Facility Management and Electrical Engineering Departments of the Engineering Faculty of DHBW-Stuttgart. The profile of the participants, shown in Table 1, as well as major findings are outlined below.

Table 1 Profile of Participants

Profile of Participants	Number of Participants
Industrial Engineering (Facility Management)	38
Electrical Engioneering	22
Administration	2

When asked about the usefulness of serious games in teaching complex topics such as climate change, 89% of participants agreed that serious games such as Climate Fresk are effective tools. This was a noticeable increase before the game started, with only 66% of the participants citing serious games as suitable for raising awareness on complex topics. Figure 1 illustrates the changes in percentages amongst the participants. The poor perception of serious games was also documented by the findings of Rachels and Rockinson-Szapkiw (2018) who argued that gamification has not proven to be an effective tool. The improved perception after participation in the game is supported by many researchers, including Deterding et al. (2011) and Landers (2014). Manzano-León et al. (2021), who encouraged the use of game-based elements in academic and business settings due to their documented benefits, such as the ability of these games to engage people, motivate action, enhance learning, and solve problems.

Illustration 1 Perception of respondents on the suitability of serious games

Prior to the game, 33% of participants considered themselves well-informed about climate change; post-game, 82% reported a deeper understanding of its causes and consequences. The views of participants on the impact of the Climate Fresk session on learning are illustrated in Figure 2. These values confirmed the efficiency of Climate Fresk, which supports the research performed by Leimbach and Milstein (2022), Spyckerelle (2022) and Strachan (2023) who argued that the intentions of implemented Climate Fresk sessions were mostly achieved, especially regarding climate change understanding as well as enhancing anticipatory, critical and system thinking skills.

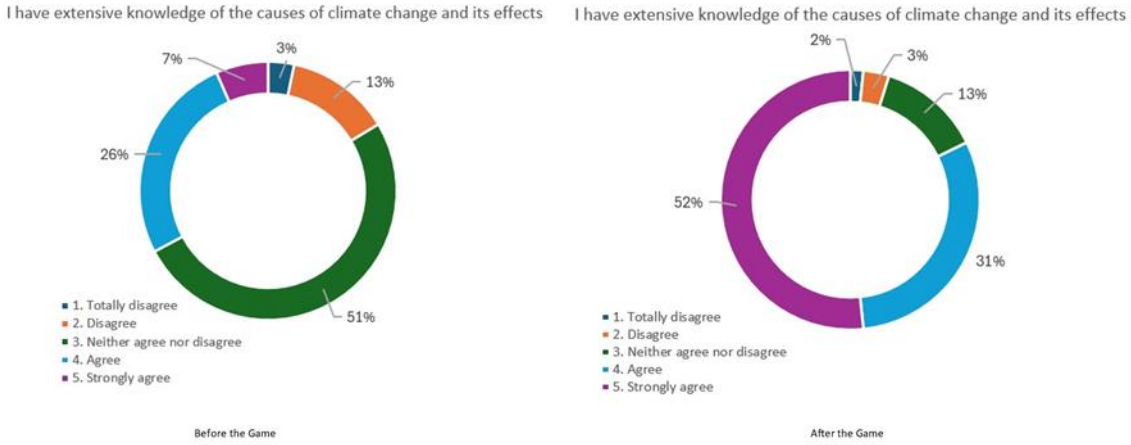

Illustration 2 Participants´ responses on thheir knowlwdge of climate change and its effects

Participants attributed the game's efficacy to its step-by-step approach, comprehensive explanations, illustrative diagrams, visually engaging cards, and the opportunity for group discussions. The visual elements of this workshop were also referenced by Spyckerelle (2022) who explained that participants were actively using the images, graphs and explanations on the cards to build the collage (Fresk). The nature of the game was also discussed by Deloitte (2023) who pointed out that the workshops encourage open discussions, enabling attendees to exchange ideas and cultivate tangible steps to meaningfully impact the crucial issue of climate change.

After the exercise, 66% of the participants felt prepared to make personal changes to combat climate change, and 69% reported that the knowledge of climate change will be useful in their future careers. Therefore, it is important that these games be conducted in a manner that supports substantive behavioural changes and closely aligns with the demands of students' future careers. This view is supported by Spyckerelle (2022), who argued for the integration of approaches by the Climate Fresk organisation that explicitly addresses behaviour change.

Though there is room for enhancement, the implementation of Climate Fresk at DHBW-Stuttgart, however, successfully underscores the effectiveness of serious games, particularly Climate Fresk, as a viable methodology to teach complex topics and meet the demands of increasing sustainability learning at institutes of higher learning. Educational games and playful forms of learning are emergent approaches that promise to overcome the challenges and limitations of the main educational responses to the climate crisis (Spyckerelle, 2022).

CONCLUSION

Innovative knowledge-transfer tools, such as gamification, are gaining traction due to their documented benefits. The inaugural session of the serious game, Climate Fresk, at DHBW-Stuttgart's Engineering Department provided valuable insights into the potential of serious games to address complex topics. Participant feedback has been overwhelmingly positive, emphasizing Climate Fresk as a highly effective tool for climate education. Its engaging design, simple format, and comprehensive instructional guide make it easy to access and implement while fostering deep understanding and meaningful learning outcomes. The experience also underscores how integrating gamification into teaching and learning has the potential to enhance a university's overall sustainability profile, aligning with the intended goals of the EFEU project.

To maximise the impact of these workshops, it is recommended that they be held more frequently, and they are designed to further foster sustainable behaviours both in participants' personal lives and professional roles. Furthermore, the survey should be adjusted to capture deeper reflections before and after the Climate Fresk sessions. This survey should also gauge preferences and evaluate changes in teaching methodologies, ensuring that DHBW-Campus remains responsive to future demands and that its community directly benefits from progressive educational practices.

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