EDULEARN 19

11TH INTERNATIONAL CONFERENCE ON EDUCATION AND NEW LEARNING TECHNOLOGIES

PALMA (SPAIN)
1ST - 3RD OF JULY, 2019

CONFERENCE PROCEEDINGS

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Published by
IATED Academy
iated.org

EDULEARN19 Proceedings
11th International Conference on Education and New Learning Technologies
July 1st-3rd, 2019 — Palma, Mallorca, Spain

Edited by
L. Gómez Chova, A. López Martínez, I. Candel Torres
IATED Academy

ISBN: 978-84-09-12031-4
ISSN: 2340-1117
Depósito Legal: V-1702-2019

Book cover designed by
J.L. Bernat

WE ENERGY GAME: PROMOTING GAME-BASED LEARNING AS AN INNOVATIVE STRATEGY TO EDUCATE ON ENERGY TRANSITION

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Abstract

Countries around the world are expected to speed up the process of an energy transition towards cleaner energy solutions as a way to achieve sustainability and fight against climate change. Education plays an important role in this process, informing and increasing understanding on the benefits and challenges of energy efficiency and renewable energy, especially among young people. In search of innovative approaches, there is increasing attention for game-based learning as an innovative education strategy among scholars and practitioners. In this paper, we present "We-Energy Game" as an innovative educational strategy which makes use of game-based learning to create understanding on the challenges in the provision of affordable energy from renewable sources for an entire town. In addition to introducing the game, a study is presented on the effects of the game on students´ awareness on the energy transition, self-efficacy, and collective efficacy. For that purpose, a survey is conducted with 100 bachelor (Dutch and international) students aged between 18 and 30 years old, at Hanze University of Applied Sciences, before and after playing the game. We also conducted a group discussion with a smaller group of students to understand their opinion about the game. Results reveal an increase in awareness about the energy transition: in a smaller degree, we observe slightly increase in collective efficacy compared to self-efficacy. From the group discussion, findings reveal that the game makes students reflect on the complexity of the process and need for collaboration among different stakeholders.

Keywords: sustainability, energy transition, game-based learning, serious games.

1 INTRODUCTION

Sustainability has become an important blueprint to achieve a better future for all, and as part of this process, nations are called to accelerate an energy transition towards clean energy solutions. However, an often-neglected pillar is educating individuals on the benefits and challenges of energy efficiency and renewable energy, especially among young people. Their support and willingness to use clean energies will be a significant driver in short, medium and long term, but reality shows that attention from youth on these issues has not been sufficient yet. Formal education settings become therefore a key place to educate youth in climate change issues and the energy transition (Flora et al., 2014, Ouariachi et al., 2018). In search of innovative approaches and in response to the limitations of the traditional educational model, game-based learning is gaining popularity among scholars and practitioners. This experiential learning though games is been transferred to formal education under the premise that it can contribute to content development of complex issues by integrating insights from different disciplines in an interactive, fun and engaging manner (Gee, 2004; Prensky, 2001).

In Primary education, games have become a basic element of school activities, but in Secondary education or higher education institutions, this approach has not been adopted so often yet. However, nowadays there is also an increasingly growing interest by professors at higher education institutions due to the fact that students dedicate many hours to playing videogames and surfing the web (Ruiz-Dávila et al., 2008).

In this paper, we introduce "We-Energy Game" as an innovative educational strategy which makes use of game-based learning to create understanding on the challenges in the provision of affordable energy from renewable sources for an entire town. The game can be played on board or on screen by a minimum of five players who take the roles of:

- Production: a project leader who needs to produce a certain amount of energy
- People: the citizens of the area where the game is played
- Planet: how green/clean is the energy production
- Profit: how much profit is made by the different projects

– Balance: how easy to work with is the energy source for the network-operator

While playing, players negotiate, from their respective roles, which energy source they want to employ and on which location, with the goal to make a village or city energy neutral. Once agreement is reached, they place the icon that represents that energy source on the map and they check the consequences for each of the roles (production, people, planet, profit and balance).

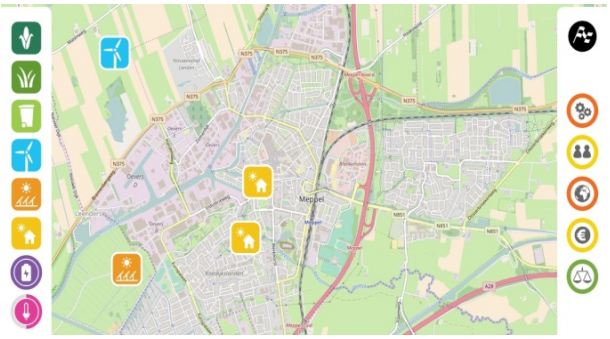

Figure 1. Map of Meppel.

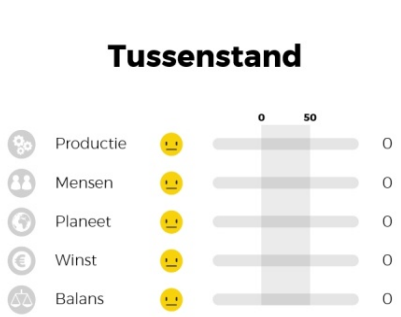

Figure 2. Table with results from the game.

The game has been played by students in higher education institutions in The Netherlands. The aim of this paper is not only introducing We-Energy Game as a case study, but also to explore the effects of the game on students´ awareness on the energy transition, self-efficacy, and collective efficacy. Self-efficacy is understood as the feeling that they can contribute to a sustainable energy transition in their towns by themselves. This factor is considered an important antecedent to predict individuals' intentions to engage in behaviour (Ajzen, 2002). According to the Social Cognitive Theory (Bandura, 1997), two common sources of self-efficacy are enactive experience (learning through direct experience) and observational learning (learning through observation of the experiences of others). Playing games can be considered a "mediated" enactive experience because it offers an environment to imitate behaviors and their consequences, and for Bandura (1997), enactive experiences is the more powerful mechanism to raise self-efficacy. Collective efficacy, on the other hand, refers to the feeling that they can contribute to a sustainable energy transition in their towns together with their community.

2 METHODOLOGY

For the purpose mentioned above, this study uses a pretest-posttest design research. Participants' awareness, self-efficacy and collective efficacy are assessed by using a survey before playing the game and after playing the game, including as main questions: how aware and informed do you feel about the energy transition (awareness), are you optimistic that you can contribute to a sustainable energy transition in your own town (self-efficacy), and are you optimistic that, together with your community, you can contribute to a sustainable energy transition in your own town (collective efficacy). Respondents are asked to rate the first statement on a four-point Likert scale ranging from respectively 'not at all' to 'a lot', and the second and third statement on a five-point Likert scale ranging also from 'not at all' to 'a lot'. The researchers used Google Forms to compose and send the surveys online. We translated the students´ names into numbers to guarantee their anonymity. We also conducted a group discussion with a smaller group of students to understand their opinion about the game and to get more qualitative data about their interaction with the game. The discussion, facilitated by researchers just after playing the game, was aimed to be a collective exchange of ideas to share their opinions about the game and their main take-away. The sample of this study is composed by 100 bachelor (Dutch and international) students aged between 18 and 30 years old, at Hanze University of Applied Sciences.

3 RESULTS

From the survey, results reveal an increase in awareness about the energy transition. Before playing, majority of students feel "not so much" aware and informed about energy transition, while after playing, majority of students feel "quite a lot" aware and informed about the topic. In total, before playing there are only 22,9% students feeling aware (quite a lot + a lot), and after playing there are

74,8% students. Therefore, there is an increase of 51,9% students feeling more aware after playing the game.

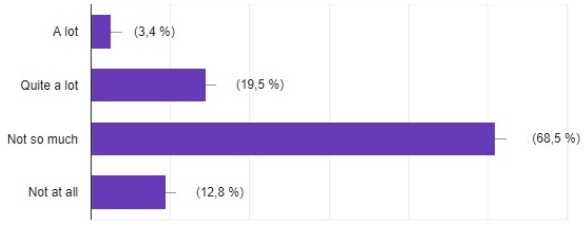

Figure 3. Pretest.

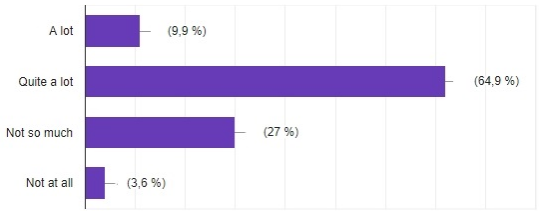

Figure 4. Posttest.

To test their self-efficacy, students were asked if they are optimistic that they can contribute to a sustainable energy transition in their town. Both before and after playing, majority of students "neither agree nor disagree" that they can contribute to a sustainable energy transition in their town (32,9% pretest, 41,4% posttest). Comparing pretest and posttest, there is only an increase of 5,6% students who are optimistic (quite a lot + a lot) that they can contribute to a sustainable energy transition. So changes in responses have hardly been seen.

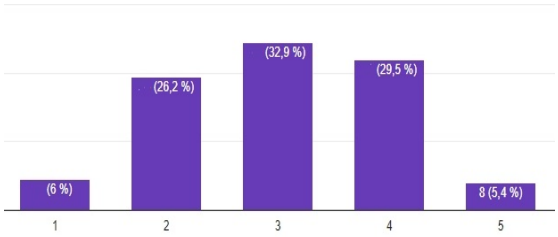

Figure 5. Pretest.

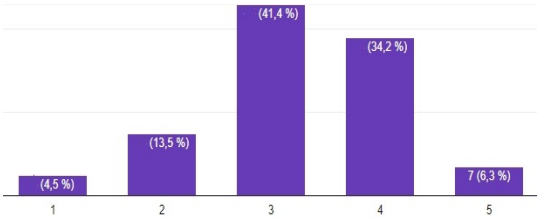

Figure 6. Posttest.

When asked if asked if they are optimistic that, together with their community, they can contribute to a sustainable energy transition in their town (collective efficacy), we observe a slightly increase in responses. Both before and after playing, majority of students are "quite" optimistic" (38,3% pretest, 41,4% posttest) but comparing pretest and posttest, there is an increase of 8,1% students who believe (quite a lot + a lot) that they, together with their community, can contribute to a sustainable energy transition. Therefore, the feeling of collective efficacy seems slightly higher than self-efficacy after playing the game.

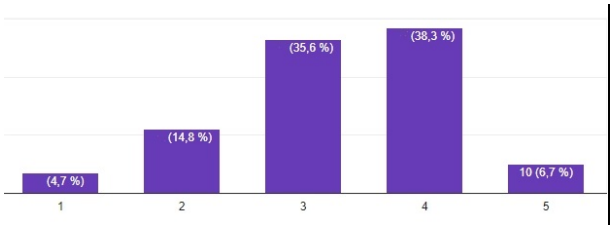

Figure 7. Pretest.

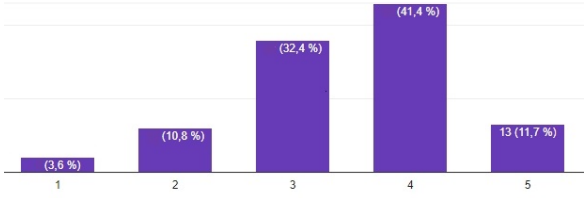

Figure 8. Posttest.

From the group discussion, findings reveal that the game makes students reflect on the complexity of the process and need for collaboration among different stakeholders. In fact this is one of the main objectives of the game: to make players understand that sustainability is not just a technical issue, but also a social one that requires dialogue from all parties involved.

Another finding is that the game is perceived as fun and as a preferred option compared to more traditional pedagogical methodologies:

"It is *a good game, easy and fast to understand, and most importantly it brings the issue of energy transition and climate change to our attention, reminding us about the urgency to work for a sustainable planet*" (student A)

"*The game was fun and interesting. I learned more about the topic with this game that I would have done with a usual lecture"* (student B)

Despite the fact that students still preferred to have this type of interactive practice rather than a traditional class characterized by a unidirectional transmission of information, the discussion also shows how educational games have still a long way to go to achieve the high levels of engagement of commercial games which present better graphics, more challenges and different types of interactive mechanics.

4 CONCLUSIONS

Using We-Energy Game as a case study, this paper offers insights into the opportunities of game-based learning as an innovative strategy to educate young people on complex topics such as energy transition. On the one hand, game-based learning can contribute to raising awareness and understanding on the topic in an interactive, innovative and entertaining manner for students. Although there is still insufficient empirical evidence to prove effectiveness, other authors have found positive changes in awareness and understanding (Van Pelt, 2015). Soekarjo and van Oostendorp (2015) have also found increased knowledge of players in five of the sixty games reviewed after playing them. Less evidence is available on changes in attitudes and behaviors. The same authors state that change in attitude of players was found in only five of sixty games, and change in behavior only in three games (Soekarjo and van Oostendorp, 2017). In our case, when testing self-efficacy (considered an important determinant of intention and behavior) we observe that the effect after playing the game is limited; the same applies to collective efficacy. However, the feeling of collective efficacy seems slightly higher than self-efficacy after playing the game. We attribute this finding to the fact that the game is multi-player and it aims at promoting dialogue and collaboration in order to make players understand that, without each other, a sustainable energy transition will not be successfully achieved. We encourage researchers to further explore this field of study. On the other hand, different implications must be taken into account for educators when interested in implementing game-based learning in class, including immediate feedback, appropriate length of gameplay during class, and time for a reflection and critical thinking after playing the game.

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