

# Experimenting with an Interdisciplinary Approach for Sustainability Education in secondary schools: The case of D.Game, YOUth play the future

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## 1. Introduction

Teachers and educators hold the key to the development of future generations. With the right knowledge and competencies, they can become powerful agents of change who can unlock the potential of young people and deliver the educational response needed to achieve the sustainability transition (Rieckmann, 2017). Research has shown that teachers' beliefs have important impacts on students' perspectives and that teachers often align teaching strategies with their own knowledge and beliefs (Duschl, 1990; Waters-Adams, 2006). Their competencies are therefore essential for restructuring educational processes and educational institutions towards sustainability.

For teachers to play a more central role in the transition to a sustainable society, sustainable education programs need to empower them with the key competencies needed for promoting societal transformation. Research conducted prevalently in Europe has shown that efforts to prepare teachers to fulfil this key role in society have not advanced sufficiently and that more work needs still to be done to build their capacities and reorienting teacher education programs changing their content and learning methods (Straková & Cimermanová, 2018). In contrast, the need for greater recognition of the role of sustainable education is acknowledged in the European Strategy for Sustainable Development (European Council, 2009), which encourages member states to promote high quality education for sustainable development at all levels of education.

Depending on the country setting, studies focusing on environmental education have found that most teachers are unfamiliar to educate students about issues such as climate change since they tend to base their teaching on traditional didactic strategies (Papadimitriou, 2004). Therefore, recent research emphasises the importance of offering in-service teacher training workshops aiming to increase both teachers' awareness and to develop their skills and teaching strategies in environmental education.

In this paper, we aim at investigating the impact of a novel online training program for teachers in high schools. Despite the many advantages of implementing web-based learning (in terms of paper-less and eco-friendly initiatives) a review of the literature shows that traditional

training methods in environmental education are still most widely used; while newer learning methods (gamification, online, mobile learning, storytelling) are rarely employed (Rozman & Rozman, 2020).

Remote education had been introduced already in numerous countries before the Covid-19 crisis, but as countries continue to battle with the virus, it has rapidly come at the forefront of educational programs around the world. We investigate through an experimental design leveraging the Randomized Controlled Trial (RCT) research protocol the impact of a three-week online training on teachers' positive and negative affects and values as antecedents of environmental behaviour. Moreover, we explore the interconnection between environmental attitudes and systems thinking.

As the research is still ongoing, in this paper we limit ourselves to present a review of the supporting literature and chosen research design. The rest of this paper is organized as follows: Section 2 offers an overview of the extant literature on environmental attitudes, transformative learning and sustainability education evaluation, Section 3 illustrates our data and methods, and Section 4 the context in which the research is being carried out.

## **2. Literature review**

### **2.1. Environmental attitudes studies**

Several studies analysed teachers' environmental attitudes, both in-service (Liu et al., 2015) and pre-service (Aznar et al., 2018) often involving large-scale surveys (e.g. Tomlins & Froud, 1999; Lee, 1996; Ballantyne, 1999; Grace & Sharp, 2000). In European countries, studies on geographical locations and cultural characteristics showed a clear difference among teachers' environmental values, attitudes, and behaviour (Kelly et al., 2004).

Through the 1970s and 1980s much of the focus of environmental education was on influencing attitudes, values and behaviours. Early models of environmental education, beginning in the 1970s, assumed a linear relationship between attitudes and behaviour, where positive attitudes lead to positive behaviour and positive behaviour was perceived as an ultimate goal of environmental education (Kollmuss & Agyeman, 2002). This "instrumentalist" approach assumed a simplistic causal relationship between individuals' attitudes and how they behaved, and that it was the role of schools to teach "correct" behaviour (Blythe & Harré, 2020). According to Varela-Losada et al. (2016), research that builds on an instrumentalist approach represents about half of the extant literature (Varela-Losada, et al., 2016).

During the 1990s more attention was given to facilitating critical awareness of social systems including through reflection and discussion (Gough & Robottom, 1993), as well as learning about the environment through action within a local context (Elliott, 1999). The turn of the century and the new millennium saw a shift in the focus of environmental education (Eilam & Trop, 2012), new elements such as the development of systems thinking (Sterling, 2005; Hollweg et al., 2011; Orion & Libarkin, 2014), resilience (Sterling, 2010) the idea of 'ecological intelligence' and of 'transformative learning' (Sterling, 2009; Sterling, 2011) were emphasized.

### **2.2. Transformative learning**

The literature indicates that many core principles of integrating sustainability into teaching and learning require substantial shifts in thinking and practice, some of which may be out of the reach of the individual teachers and more challenging for some disciplines than others. Sterling (Sterling, 2004; Sterling, 2011) argues that sustainability education implies a transformation in educational thinking and practice through which education becomes transformative learning. This indicates a paradigm that is holistic, systemic, and participative (Iyer-Raniga & Andamon, 2016).

The concept of “transformation” that stands at the core of transformative learning theory originated in the work of adult educationalist (Mezirow, 1978). In the context of sustainability programs, transformative learning aims at empowering learners to question and change the ways they see and think about the world in order to deepen their understanding of it (Mezirow, 2000; Slavich & Zimbardo, 2012). Rather than by defining any concrete teaching or learning strategy, in transformative learning the teacher becomes a facilitator who empowers and challenges learners to rebuild their worldviews (Rieckmann, 2018).

In the definition of Mezirow, the process of transformative learning is a: “a rational process of learning within awareness, a metacognitive application of critical thinking that transforms an acquired frame of reference—a mindset or worldview of orienting assumptions and expectations involving values, beliefs, and concepts—by assessing its epistemic assumptions” (Dirkx & Cranton, 2006).

Transformative learning is hence not a linear process. Mezirow’s phases of transformative learning propose a spiral-like movement that involves learner and teacher in a progressive exposure, self-reflection, critical assessment and implementation of successive viewpoints (Cranton, 2002). This spiral-like process of learning takes place when we face “disorienting dilemmas” in which we can no longer interpret our current experience through our old assumptions (Mezirow, 2000). The process involves self-examination leading to self-awareness through different steps or stages leading to transformation, starting with the disorienting dilemma and ending with a restored equilibrium (Cranton, 2002).

This paradigm of learning aims to disrupt the closed loop of the behavioural cycle and set a spiral course of learning that empower students and teachers together through “a deep, structural shift in basic premises of thought, feelings, and actions...that dramatically and permanently alters our way of being in the world” (O’Sullivan & O’Connor, 2002). The process brings to light possibilities of alternative ways of living as well as a sense of the self as “more fully in transaction with others and the environment” (Blythe & Harré, 2020).

One of the proposed actions to integrate transformative learning into pre-service and in-service teacher education programmes is to prepare teachers by developing a set of sustainability key competencies including knowledge, skills, attitudes, values, motivation, and commitment. These teacher competencies are described in a number of different conceptual frameworks such as the CSCT model (Sleurs, 2008), the UNECE model (UNECE, 2012), the KOM-BiNE model (Rauch & Steiner, 2013), and the approach by (Bertschy & Lehmann, 2013). Teacher education programmes must be further developed to meet these standards (Rieckmann, 2018). UNESCO suggested the following set of key competencies to be applied in any sphere of education: anticipatory, normative and strategic competency, systems thinking, critical thinking, collaboration, integrated problem-solving and self-awareness competency (Rieckmann, 2017).

### 2.3. Quality and evaluation issues

To facilitate the development of education for sustainability competencies in teacher education, effective evaluation strategies are necessary (Keene & Blumstein, 2010). However, several researchers have lamented the lack of quality evaluations in environmental education (Bourke, 2011; Carleton-Hug & Hug, 2010; Keene & Blumstein, 2010). Current evaluation strategies provide limited evidence of the effectiveness of environmental programs and policies. In this regard, (Keene & Blumstein, 2010) call researchers and educators in environmental and sustainability education to embrace a culture of evaluation to ensure effective environmental education strategies (Keene & Blumstein, 2010). Similarly, several studies investigated the impact of sustainability and climate education training courses. However, few of these studies have employed treatment/control designs. Yoon et al. (2007) surveyed 1300 studies of teacher professional development programs published between 1986 and 2003 and found that only nine met evidence standards – six were published in peer-

reviewed journals and three were doctoral dissertations, and six were randomized controlled trials (RCTs) while three were quasi-experimental estimates (Shand, 2016).

Regarding the non-experimental studies, most of the research on in-service training is primarily correlational, descriptive, or qualitative, and does not explicitly address selection of teachers into training as a potentially confounding variable (Shand, 2016). When analysing the effect of climate education training courses on teachers, most of the studies focus on teacher-reported satisfaction with training, while others go in more detail by distinguishing between the impact of the training on environmental attitudes and on behaviour (Eilam & Trop, 2012).

Most evaluations have taken place in a relatively short time frame (Engels & Jacobson, 2007). Barriers to longer implementation come from a variety of logistical, administrative and budgetary reasons. As described above, the most common evaluative approach has been to implement pre- and postintervention surveys, often within a few days of program completion. However, survey data indicating program impact on the day of program completion is of limited utility since research has shown that repeated or sustained interventions over a longer time period are needed to increase the likelihood that program effects will be sustained beyond the initial involvement (Covitt et al., 2005; Ernst, 2005; Powers, 2004). There are several examples of studies that administered later post-tests: 4–5 weeks (Randler, & Kern, 2005), and 3 months (Dettmann-Easler & Pease, 1999) after program completion (Carleton-Hug & Hug, 2010).

A critique of the state of evaluation in environmental education concluded that most published evaluation efforts have been based on “a narrow and short-term ‘objectives-outcomes’ model of evaluation” (Fien, & Tilbury, 2001, p. 380). Many published articles have relied on pre- and post-intervention surveys to address changes in knowledge and attitudes (see, e.g. Aivazidis et al., 2006); D’Agostino et al., 2007 ; Gerakis, 1998; Gillilan, et al., 1996; O’Brien & Pease, 2004; Smith-Sebasto & Semrau, 2004). There were far fewer published reports on evaluations that involved a mixed-methods design. Two notable examples of the use of mixed-method evaluations included interviews, surveys and observations (Ernst, 2005; Powers, 2004; Carleton-Hug & Hug, 2010).

The integration of new perspectives in formal educational contexts requires researchers and practitioners to have access to useful information on how to implement educational strategies which can help to achieve this objective. As Mogensen and Schnack (2010) note, to improve the quality of focus on competency for action, we must concentrate on improving teaching and learning (Mogensen & Schnack, 2010). A concern regarding what is done in education to ensure that students are not only informed and aware, but capable of acting sustainably when faced with current and future environmental problems, has inspired the literature review of (Varela-Losada et al., 2016).

It is not enough to acquire concepts; it is necessary to learn to put them into action, integrate them and use them adequately under different real-life circumstances. Thus, competencies turn into learning achievements, instead of the mere acquisition of knowledge, fully affecting the teaching and learning process and, particularly, the role of the teacher. From this viewpoint, sustainable competencies can be defined as complexes of knowledge, skills and attitudes that enable successful task performance and problem solving with respect to real-world sustainability problems, challenges, and opportunities. However, the integration of this new viewpoint poses some challenges; it is necessary to clarify what these sustainable competencies are, to design educational proposals that contribute toward their development and to evaluate their achievement (Vega-Marcote et al., 2015). The introduction of sustainable competencies in the curriculum implies a change in the teaching culture, which lays down the foundations to achieve the model of human beings and society that we want to establish (Vega-Marcote et al., 2015).

### 3. Background of the research

#### 3.1. Developing a novel approach to sustainable education: The D.Game project

The “D.Game: YOUth play the future” is a project financed by EIT Climate-KIC and will run in secondary schools in three European countries (Italy, Finland and Spain). It promotes transformative and experiential learning inspired by the spiral-shape progression of learning identified by Mezirow (2000). The pedagogical method of the D.Game incorporates the key competencies for sustainable development identified by the UNESCO framework (Rieckmann, 2017). These competencies are adapted from (Rieckmann, 2012) and (Wiek, et al., 2011) and divided in three main domains, which are described below.

##### 3.1.1. *Cognitive domain (systems thinking, anticipatory and normative abilities, and critical thinking)*

The training module begins by bringing learners on a journey to their “ideal world” in terms of societal, environmental, and economic settings. The ability to understand and evaluate multiple futures – possible, probable, and desirable and to create one’s own ideal vision for the future through critical discussion, is the first step in the process (see Hicks, 2014). The objective is to create a collective, deep, and constructive “pathway of hope” concerning climate change while strengthening anticipatory abilities as well as system and critical thinking. Hence, the training starts by defining how teachers and the future generations conceptualise their ideal future. Research suggests that people feel more hopeful about climate change when they know there are things that they can do personally to address the issue (Ojala, 2012), and the simple act of imagining preferable futures for their community can itself be an empowering experience for children (Hicks & Holden, 2007; Kelsey & Armstrong, 2012).

Although many young people think climate change is an important societal issue, studies indicate that pessimism is quite common (Ojala, 2015). According to Ojala (2015), hope is not only a pleasant feeling but could also work as a motivational force. When hope is associated with trust in laypeople’s and other societal actors’ capability, it turns into a motivational force, beneficial for environmental engagement. Finding ways to instill hope could therefore be a vital aspect of education concerning sustainable development (Ojala, 2012).

Research shows that when people perceive that a concrete positive goal is within reach, positive feelings—for instance the emotional part of hope, excitement, and joy—can be evoked (Lazarus, 1991; Snyder et al., 2002). Positive emotions have been found to broaden people’s perception of reality, making them more creative and open-minded (Fredrickson, 2001; Fredrickson & Joiner, 2002). This can help them anticipate the future in a more open way and come up with new ideas. In addition, positive emotions can buffer anxiety, helping people to face and bear the reality, for instance, of climate change (Folkman, 2013; Ojala, 2017).

After envisioning an “ideal world” and living there for one year, on the journey home, the learners go through different facilitated workshops to discover their own values and talents, as a foundation to start understanding how to contribute to improve our planet Earth. The ability to understand and reflect on the norms and values that underlie one’s actions and to negotiate sustainability values, principles, goals, and targets, stands at the core of the normative competency (Rieckmann, 2017). Different views of desirable futures and pathways to reach these future goals are hence critically discussed. It could also be argued that disrupting unsustainable habits, norms, and practices is not enough for transformative learning to take place; one also needs critical awareness and disruption of ‘unsustainable’ ways of regulating emotions (Ojala, 2017).

### *3.1.2. Socio-emotional domain (collaboration, participatory methods, emotional awareness, and self-awareness)*

In recent years, researchers have acknowledged that education about global environmental issues entails also emotional aspects due to the seriousness and complexity of these problems. Elements such as emotional stability and self-awareness are at the core of this emotion-based frame. However, the social aspect is equally important. Research shows that most environmental education programs are "highly individualized" and look upon "small things that young people can do in their everyday life, more or less in isolation" (Ojala, 2017), p. 80). The D.Game approach challenges the predominant emphasis on competition, consumerism, and individualism (Hayward, 2012; Hicks, 2014) focusing on empowering children's collaborative climate change action by creating conditions that allow them to feel part of a collaborative effort rather than acting in isolation (Kelsey & Armstrong, 2012; Trott, 2019). This is critical because focusing exclusively on lifestyles and behavioural choices can misrepresent the root causes of climate change, which are embedded in global economic and political systems, and divert the attention from the actions that are necessary to address them (i.e., structural, institutional, and policy change; (Kenis & Mathijs, 2012)).

Hence, in the socio-emotional domain, the D.Game approach aims to stimulate learners' critical reflection skills, behavioural and cognitive engagement to create a new mindset supporting the sustainability transition. This will not only bring learners to think about objects, but also about themselves, leading to getting to know themselves. The development of these competencies uses both deep experimentation techniques as well as embedded innovative methodologies for peer-to-peer learning and learning diffusion.

### *3.1.3. Behavioural domain (action competencies, strategic abilities and problem-solving)*

Taking action on learned concepts is key to cultivating agency in the context of climate change (Riemer et al., 2014). The second phase of the D.Game project funnels the experiential learnings from schools into society. Inspired by a EIT Climate-KIC Climathon, the "Transition Arena" proposed for the second phase of the project is a multi-stakeholder and collaborative platform that enables community members to raise awareness around environmental issues and encourages teachers and students, along with other societal stakeholders, to partake in long-term planning for local transitions. The project culminates in a "Lighthouse" event, where students and teachers from Finland, Spain and Italy will gather to exchange their experiences and share best practices.

These activities are designed to supplement classroom-based climate change education with action-based opportunities to mitigate students' sense of paralysis and promote their empowerment (Chawla & Cushing, 2007). The "action competency" methods involved in this last phase involve multi-stakeholder action and experiential learning. As there is no way of determining what is "really sustainable" other than through processes of collective and contextual deliberation and mutual learning', tackling sustainability transitions requires building social intelligence and 'collective problem-solving capacity' among the youth as well as forging inter-generational trust to contribute to a collective learning process.

## **3.2. Research design**

The research is designed with the purpose of evaluating the impact of a three-week online training course (9 hours with trainers plus individual work) on teachers' emotions and values as antecedents of environmental behaviour. Moreover, the research aims to understand whether the course has an influence on environmental attitudes and systems thinking. The research follows an experimental design; therefore, the participants have been assigned randomly to one of two groups, where Group A represents the experimental group and Group B the control group.

Group A follows a novel training course blending short lectures focusing on notions of ecology, sustainable development and systems thinking, facilitation techniques and short sessions of meditation. Group B instead follows the basic training provided by the Young Innovators Programme by EIT-Climate KIC, which aims at providing teachers with visual tools for systems thinking and show how they can be utilized to generate systemic innovation. The data are collected through pre-post questionnaires and will be obtained from three countries, Finland, Spain, and Italy.

The questionnaires utilized include various scales that were previously built and validated. They are:

- The Short Schwartz's Value Survey gives insight in the ten broad values, each named after its central goal (Struch et al., 2002)). People in virtually all cultures implicitly recognize these values.
- The Positive and Negative Affect Schedule or (PANAS) is a scale that consists of different words that describe feelings and emotions. It was developed (Watson et al., 1988). Here we use PANAS-SF, which is a more concise version of the original measurement.
- The Environmental Attitudes Inventory (EAI) was developed from a pool of 200 scale items, many of which were drawn from existing environmental attitude measures, to measure environmental attitudes (Sutton & Gyuris, 2015).
- Two Major Environmental Value model (2-MEV) as an anchoring scale for EAI, in case the first would not turn out to be reliable with the expected number of participants, (EAI utilizes two elements for each sub-scale one of which is the reverse question, the scale may not be reliable for smaller samples).
- Systems thinking scale by (Watson et al., 1988). Systems thinking is defined as “a trans-disciplinary construct that has been promoted as a means of being able to better comprehend and mitigate complex social-ecological dilemmas”
- Willingness to act (for the climate) by Tobler et al., (2012).

As the study is cross-national, the questionnaires are translated from their original version in English to the local language and then back to English to guarantee reliable translations. Prior to the analysis of differences between the groups, factor analysis will be carried out to assess variable relationships.

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