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How playing and debriefing/reflecting on two escape games influenced students' perceptions on local climate governance and democracy.

Marine Simon[1], Alexandra Budke[1]

[1]Institute for Geography Education, University of Cologne, Cologne, 50931, Germany

Correspondence to: Marine Simon marine.simon@uni-koeln.de)

Abstract. Climate change presents major challenges for cities and requires local decision-making processes involving diverse stakeholders. At the same time, research shows that secondary students often hold misconceptions about climate-related measures, and that there is sometimes reduced support for democratic principles. Innovative educational approaches are therefore needed to foster students' knowledge and engagement with local climate policy. Although gamification is considered as a promising strategy in climate education, little is known about how escape games supported by a debriefing/reflection phase can support learning about local climate governance and democratic processes. This study presents two educational escape games addressing local climate policy solutions, stakeholder perspectives, and urban decision-making. A pre- and post-test control group design was implemented with 172 secondary students (aged 14–20) from Germany, Italy, and Spain. All students played one of the games; the experimental group participated in a structured debriefing/reflection phase, while the control group did not. We analysed changes in students' perceptions of local political stakeholders and their opinions on democratic decision-making at the city level. Results indicate that playing the escape games led to students' better understanding of stakeholders, of their own role, and of governance processes in the context of addressing climate change-related issues. However, students who engaged in the debriefing demonstrated more differentiated perceptions. Students expressed mostly support for democratic processes; however, after playing without debriefing/reflecting, some students did significantly less support democratic decision-making, whereas students who debriefed/reflected the games did not. The findings underline the crucial role of structured debriefing/reflection in transforming an escape game experience into political and democratic learning.

1 Introduction

Climate change poses significant challenges to urban areas, characterised by the increasing prevalence of extreme weather events, including heatwaves and flooding, which exert considerable pressure on urban populations, economic activities, and infrastructure (IPCC, 2023, p. 50). Concurrently, cities currently represent a key arena for climate policy decision-making. Urban planning addresses climate change through a combination of mitigation strategies aimed at lowering emissions and adaptation approaches designed to cope with unavoidable climatic impacts (e.g. Aboagye & Sharifi, 2024; Grafakos et al., 2019; Reckien et al., 2018). Climate policy is the result of a complex multilevel governance involving different stakeholders and political, economic and societal actors (Bulkeley, 2010; Bulkeley et al., 2010). Civil society members, individual citizens,

https://doi.org/10.5194/egusphere-2026-2308
Preprint. Discussion started: 4 May 2026

and especially younger people and students—who represent both present and future voters and stakeholders in cities—need to be capable of comprehending the complexity of local political decision-making processes that affect their lives now and in the future. It is also imperative that they are made aware of the mechanisms by which they can participate in these processes. However, it has been demonstrated that young people often hold misconceptions regarding climate change processes (Choi et al., 2010; Liarakou et al., 2011; Rajeev Gowda et al., 1997; de Rivas et al., 2024; Shepardson et al., 2011) and climate-related decisions and measures (Bofferding and Kloser, 2015; McNeill and Vaughn, 2012; Özdem et al., 2014; Ratinen, 2021). Furthermore, it has been suggested by political scientists that younger generations may be undergoing a process of "democratic deconsolidation" (Foa and Mounk, 2016, 2017; Grassi et al., 2024; Wuttke et al., 2022). While democratic values continue to enjoy broad support, young people appear increasingly open to non-democratic alternatives such as authoritarian or military rule. In a preceding study, it was demonstrated that a minority of secondary students also endorse anti-democratic approaches to local political decision-making regarding climate change, and that this absence of support for democracy was significantly correlated with a lack of interest in the subject of climate change (Simon & Budke, in rev.). It is, therefore, reasonable to hypothesise that a proportion of students are simultaneously "disengaged" from both climate change and local democracy. As a consequence, there is a need to engage students both with climate change and local democratic decision-making while reinforcing "cognitive (knowing), affective (caring) and behavorial (acting)" aspects of engagement (Fernández Galeote et al. (2021, p. 2; Lorenzoni et al., 2007).

As a discipline situated at the intersection of natural and social sciences, geography education is particularly well suited to this, while advancing political (Budke, 2016) and democratic education (Friedrichs, 2020; Gryl, 2025; Himmelmann, 2005; Schulz et al., 2025) within the broader framework of climate education, which is already embedded in European curricula (Enke and Budke, 2023). Engaging with the complexity of stakeholder constellations and the decision-making processes involved in creating sustainable and climate-friendly cities requires a range of competencies. These include the ability to recognise relevant local actors and their interests, to critically assess urban planning procedures, and to understand, evaluate and take positions in local political debates on climate-related policies. Nonetheless, geography education, climate education and education for sustainable development more generally face numerous challenges when addressing climate change. Climate change education has frequently been criticised for being insufficient, as it often relies on a "deficit model" in which students are passively supplied with climate-related information through top-down instruction (Suldovsky, 2017). In contrast, participatory and empowering teaching approaches remain relatively underused (Crandon et al., 2022). Therefore, alternative teaching strategies may be more relevant or more engaging such as experiential or inquiry-based interventions (Crookall, 2014; Kolb & Kolb, 2009; Monroe et al., 2017).

One such strategy, known as gamification, is defined as the utilisation of game-based elements for objectives that extend beyond mere entertainment, particularly in the context of educational pursuits. This approach has been proposed as a potential strategy for climate education (Fernández Galeote et al., 2021; Koivisto & Hamari, 2019; Ouariachi et al., 2020). A significant argument put forward is that games have the capacity to facilitate engagement and learning (Crookall, 2014) due to their motivational component (Malone and Lepper, 1987; Przybylski et al., 2010). However, it is imperative to incorporate a

https://doi.org/10.5194/egusphere-2026-2308
Preprint. Discussion started: 4 May 2026

structured debriefing component within games to facilitate effective learning (Crookall, 2010, 2014, 2023). For instance, the mere engagement in digital games that deal with socially relevant themes does not result in deeper reflection concerning real-world problems (Lux and Budke, 2023). A significant number of climate games have been developed and evaluated for enhancing climate education, although this research field is still in its early stages (Fernández Galeote et al., 2021; Flood et al., 2018; Reckien and Eisenack, 2013). Escape games have been identified as a potentially effective pedagogical tool in the context of climate education (Grepperud, 2025). They have been shown to imply an urgency that can be related to climate urgency (Ouariachi and Wim, 2020).

However, to date, no escape game is available in which the game mechanics reflect the complexity of local stakeholders' opinions on local solutions, of their arguments and conflicts between them, and of the local decisions on possible urban solutions to tackle climate change. Furthermore, there is no debriefing or reflection material centred on this particular complexity of local climate policy. Moreover, no game or debriefing was evaluated with the intention of instructing participants on the intricacies of local politics and stakeholders, as well as the processes of local decision-making and democracy. In summary, the extent to which escape games could foster student engagement and interest in local climate policies remains to be ascertained.

Consequently, the present study developed two escape games addressing local possible solutions, stakeholders' opinions and decision-making processes for climate policies. An intervention was also led with a pre- and post-test control group design with 172 secondary students (14-20 years old) from Germany, Italy and Spain in which students played and debriefed/reflected the games. We analysed the students' perceptions of political local stakeholders responsible for climate change policies and opinions on decision-taking processes at the city level before and after playing the game(s), with one group being tested without debriefing. We examined the following research questions (RQ):

1) To what extent did playing and debrief/reflect on the games change students' perceptions on political and local stakeholders responsible for climate policies?

2) To what extent did the playing and debrief/reflect on the games change students' post-game opinions on local democratic processes?

This article begins with a literature review used as a basis for the study (Theoretical background). Afterwards, a description of the games, debriefing/reflection materials, and of our methodology (Materials and Methods) is proposed. Then we present the questionnaire results and effects of the game and of the debriefing/reflection on students' perceptions and opinions (Results). Finally, we discuss the implications for designing educational escape games and debriefing/reflection phases, and present the study's limitations and possible further research (Discussion).

https://doi.org/10.5194/egusphere-2026-2308
Preprint. Discussion started: 4 May 2026

2 Theoretical Background

2.1 The need to foster students' knowledge on climate policy actors and governance at the local level

A discrepancy has been identified between the multi-actor, multi-level configuration through which local climate governance is implemented and the actors perceived by the public, including younger generations, as accountable for addressing climate change (e.g. Klein et al., 2018; Persson et al., 2021; Storbjörk et al., 2019; Thaler & Levin-Keitel, 2016). While climate governance at the local level in democratic countries involves a range of stakeholders operating across different tiers of responsibility, public opinion tends to attribute primary responsibility to governmental institutions. In particular, citizens most frequently identify national, regional, and local authorities as the actors best positioned to design and implement effective climate policy (European Commission. Directorate General for Climate Action, 2025; Grahn and Jaldell, 2019; Persson et al., 2021; Trell and Van Geet, 2019). Furthermore, young people also attribute responsibility for insufficient climate action primarily to national governments (Hickman et al., 2021). Although additional stakeholders, such as private sector actors, are occasionally acknowledged as playing a significant role, civil society organisations and individual actors are less commonly regarded as central to climate action (Brock et al., 2023; European Commission. Directorate General for Climate Action, 2025; Persson et al., 2021). Research focusing on younger populations, including secondary school students, indicates a more pluralistic understanding of responsibility than that observed among the broader public (European Commission. Directorate General for Climate Action, 2025; Hui, 2024; Özdem et al., 2014). (Hickman et al., 2021).

Concurrently, in geography and ESD (Education for Sustainable Development) lessons, students are frequently made individually responsible for problem-solving without any discussion of structural or political measures (Gryl and Budke, 2016). This phenomenon is rooted in the prevailing perception that future generations will bear the greatest burden of the repercussions of climate change and environmental degradation. Consequently, it falls upon them to implement the requisite measures and to make the consequential decisions (Appel and Schreiber, 2024). Children are thus given an "ambivalent role" (Appel & Schreiber, 2024, p. 99), whereby they are expected to change their own practices and formulate strategies to implement sustainable measures, yet simultaneously find themselves marginalised in urban settings and excluded from political decision-making processes (Christensen et al., 2017; Hadfield-Hill and Christensen, 2021). This has the potential to overwhelm students and inhibit their capacity for political engagement. More broadly, education about climate change frequently concentrates on imparting scientific concepts regarding climate change and on potential actions on an individual or private level. Such efforts, however, overlook public-level, collective, and political actions (Bhattacharya et al., 2021; Jorgenson et al., 2019). Consequently, climate education thus often "avoids the political aspect of climate change" (Kranz et al., 2022, p. 20). To counter this, geography, ESD and climate change education have to incorporate a political dimension. This would enable students to become informed about local political actors and stakeholders, as well as climate governance structures and experience local political ways of democratic decision-making.

https://doi.org/10.5194/egusphere-2026-2308
Preprint. Discussion started: 4 May 2026

2.2 The need to enhance students' democratic opinions

Recent years have seen an increasing number of studies indicating a decline in support for democracy among younger generations in Europe. This trend has been conceptualised as "democratic deconsolidation", a phenomenon that has been demonstrated to affect even long-established democratic regimes (Foa and Mounk, 2016, 2017; Grassi et al., 2024; Wuttke et al., 2022). Empirical studies point to diminishing levels of democratic support among young people in countries such as Germany, Spain, and Italy (Franke et al., 2026; Lorente and Jiménez-Bravo, 2025; Tsatsanis et al., 2021; Wuttke et al., 2022). Whilst most researchers concur that diffuse support for democracy (Easton, 1975) remains comparatively stable (Franke et al., 2026; Tsatsanis et al., 2021; Wuttke et al., 2022), they simultaneously identify increasing dissatisfaction with the functioning of democratic systems and with political representatives (Belchior and Teixeira, 2024; Foa and Mounk, 2017; Grassi et al., 2024). Young citizens frequently report feelings of inadequate political representation and display lower electoral participation rates (Angelucci et al., 2025; Henn and Weinstein, 2006; Improta and Mannoni, 2025; Tiberj, 2017). Moreover, recent evidence highlights shifts in voting behaviour, including a growing tendency to endorse far-right political actors and, in some cases, to express support for authoritarian or military-led forms of governance (Bedock, 2024; Franke et al., 2026; Zagórski et al., 2021). In a prior investigation to this study, we demonstrated that a minority of secondary school students express support for non-democratic procedures in local decision-making processes concerning climate change. Furthermore, this limited endorsement of democratic principles was associated with a lack of interest in climate change as a topic (Simon & Budke, in rev.). These findings suggest that a segment of students may be simultaneously disengaged from both climate-related issues and local democratic governance. Therefore, there is a need to develop innovative pedagogical approaches to teaching climate politics. In particular, pedagogical strategies should aim not only to convey knowledge, but also to foster emotional investment and promote participatory action, thereby strengthening all three dimensions of student engagement: cognitive, affective and behavioural (Lorenzoni et al., 2007).

2.3 Gamification to teach about climate change

The idea of imparting more knowledge about climate change in a vertical, or top-down, manner has long been considered a solution to the aforementioned problems in the context of Education for Sustainable Development (ESD). This "deficit model" is based on the idea that a change in individual attitudes and behaviours can only occur once gaps in the target audience's knowledge have been filled (Moser and Dilling, 2012; Nisbet and Scheufele, 2009; Suldovsky, 2017). Nevertheless, there are numerous potential disadvantages associated with this. Firstly, learners adopt a passive role. Second, the approach is founded upon the condescending assumption that these learners are ignorant (Moser and Dilling, 2012). Furthermore, a greater understanding of climate change or potential solutions does not inherently result in increased concern or commitment on the part of the individual (Moser and Dilling, 2012). In order to facilitate a shift in knowledge, attitudes and behaviours, it is imperative to consider additional factors when teaching about climate change. Monroe et al (2019) identify different criteria which define effective climate change education. These include the focus on personally relevant information, the use of active

https://doi.org/10.5194/egusphere-2026-2308
Preprint. Discussion started: 4 May 2026

and engaging teaching methods, the facilitation of deliberative discussions, interaction with scientists, the addressing of misconceptions and the implementation of projects.

Among the potential educational strategies, gamification is a recent and promising approach to combine knowledge transmission and learners' motivation (Fernández Galeote et al., 2021; Fernández Galeote and Hamari, 2021; Ouariachi et al., 2020b). Games have frequently been demonstrated to be a motivating factor in learning, with the capacity to stimulate positive emotions and promote behavioural change (Koivisto and Hamari, 2019; Meya and Eisenack, 2018; Rooney-Varga et al., 2018). Games have been shown to support learning by providing a "safe space" within a simulation context (Kolb, 2014). For example, games can enhance the practice of decision-making (Czauderna and Budke, 2020). Games that facilitate social learning have been shown to result in outcomes that extend beyond cognitive or normative domains, encompassing relational aspects. These outcomes include an enhanced comprehension of others' perspectives and an elevated level of trust and cooperation among stakeholders (Den Haan and Van der Voort, 2018). Specifically, the utilisation of climate games has been demonstrated to facilitate the acquisition of knowledge regarding climate change, the modification of behavioural patterns, and the alteration of attitudes concerning climate change (Faranda et al., 2026; Fernández Galeote et al., 2021). Furthermore, role-play simulations for climate change adaptation education have been demonstrated to enhance collaborative capacity by "highlighting the interdependency of stakeholders, increasing empathy for different perspectives, building support for collaborative decision-making" (Rumore et al., 2016, p. 748).

Among the various game types, collaborative ones such as escape games are of particular interest due to their potential to convey the urgency and complexity of climate change themes. Escape games are a genre of game in which small teams of players collaborate to find clues and solve a series of challenges to accomplish a specific goal ("escape") and win within a limited timeframe (Ouariachi and Elving, 2024; Ouariachi and Wim, 2020; Wiemker et al., 2015). These learning environments task students with the collaborative resolution of puzzles, the integration of information, and the formulation of decisions within a time-constrained framework. Escape games specifically promote decision-making because they confront learners with complex, problem-oriented scenarios. At the same time, they strengthen cooperation, as "escaping" is only possible through communication and coordination within the team. The majority of escape games addressing climate change have been found to have the primary aims of increasing or maintaining players' knowledge and raising awareness of climate change mitigation and adaptation (Ouariachi and Wim, 2020). Games designed to facilitate learning about local situations and stakeholders are more often found in other game genres, such as serious, strategy or role-play games (Den Haan and Van der Voort, 2018; Lux and Budke, 2020; Rumore et al., 2016). To date, no escape game has been developed nor tested for its capacity to teach about the diversity of stakeholders or on decision-making processes related to climate change policies at the city level; therefore, in this study, we developed and tested an escape game related to these topics (see Materials and methods).

2.4 The necessity to provide a subject-specific structured debriefing/reflection phase

In addition to playing, a debriefing and reflection phase is required in order to facilitate a comprehensive understanding of the gaming experience by the learners, thereby enabling the establishment of connections between this experience and their pre-

https://doi.org/10.5194/egusphere-2026-2308
Preprint. Discussion started: 4 May 2026

existing knowledge and attitudes (Crookall, 2010, 2023; Kriz, 2010; Lederman, 1992; Nicholson, 2013; Schwägele et al., 2021). According to experiential learning theory, the experiential learning cycle encompasses not only the concrete experience (for example, playing a game) but also subsequent phases, such as reflective observation (i.e. reflecting on the experience), abstract conceptualisation (i.e. learning from the experience), and active experimentation (i.e. planning the next steps or trying out what has been learned; Kolb, 2015). Debriefing after playing a game allows the phases "reflective observation" and "abstract conceptualisation" from this learning cycle to take place (Crookall, 2023). Therefore, trough the debriefing process, participants can reflect on their experience, "transform it into learning" (Crookall, 2023, p. 4), and "deduce applications for real situations beyond the game simulation experience" (Kriz, 2010, p. 669). Different authors in different disciplines have proposed distinct methodologies for the development of a debriefing process (Crookall, 2023; Nicholson, 2013; Oriot and Alinier, 2018; Thiagarajan, 1992). In the field of geography education, Lux and Budke (2023, p. 194) have designed a specific model for the reflection of digital games, comprising four distinct steps, each of which is associated to specific geographical competences (see Fig. 1).

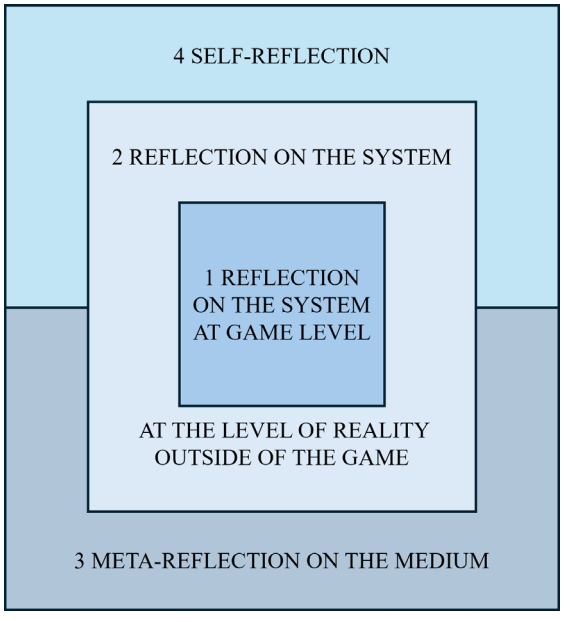


Figure 1: Model on the levels of reflection of digital games (translated and changed from Lux & Budke, 2023, p. 194). In the original model, levels 3 and 4 are interchanged (the original levels are: "Level 3: Self-reflection"; "Level 4: Reflection on the medium", see (Lux & Budke, 2023, p. 194). For this study we changed the level order after two game and debriefing test iterations which showed that the "self-reflection" activities led to more student participation and engagement during the debriefing.

In this model, four stages of reflection must be undertaken: firstly, the game must be reflected in terms of its mechanisms, system and actors, logic and inner sense ("1: reflection on the system at game level", see Fig. 1). In many digital games, these aspects are intricately interwoven into complex systems that closely resemble real-world geographic systems at their core, such as cities, transportation, and climate (Lux and Budke, 2020). At this level, the (perceived) internal logic of the game is

https://doi.org/10.5194/egusphere-2026-2308
Preprint. Discussion started: 4 May 2026

examined from a geographical perspective. On this basis, a reflection can be carried out at the second level ("2: reflection on the system at the level of reality outside the game", see Fig. 1), in which the similarities and differences between the geographical systems in the game and in reality outside the game are to be considered. This includes the current state of scientific knowledge on geographical topics, such as the discussion of climate policies in real-world situations and cities. The third level of analysis addresses meta-reflection on the medium of "game" in the context of the topics under consideration ("3: meta-reflection on the medium", see Fig. 1). In order to be able to classify the content presented by the game and draw conclusions for one's own world view or actions, a deeper level of media literacy is required. In particular, it is necessary to be able to identify the strengths and weaknesses of the game as a medium and to reflect critically on it (Schorb, 1997). The fourth level of analysis ("4: self-reflection", see Fig. 1), focuses on reflexivity according to Gryl (2012). This level entails introspection, encompassing the examination of one's personal motivations, principles, outlooks, cognitive processes, and personality traits that have influenced one's behaviour within the context of the game. It also involves a comparison of these factors with one's actions, attitudes, and values outside the game.

The necessity and efficiency of debriefing/reflection after a game or an experience has already been evaluated in different studies (e.g., Tannenbaum & Cerasoli, 2013). Studies employing pre- and post-test designs in the context of climate games are often of the one-group design variety (e.g., (Meya and Eisenack, 2018; Rumore et al., 2016). Alternatively, they may compare climate games with other teaching media (e.g., Fernández Galeote et al., 2023). Baßeng and Budke (2024, 2025) used the model from Lux & Budke (2023) as a basis to structure debriefing questions in two other studies. Students used reflection diaries and cooperative reflection coaching phases to debrief the games (reflection-in-action, see Clapper, 2018). Students' reflection skills were enhanced using this structure in comparison to a reflection without structure (Baßeng and Budke, 2024, 2025). However, the efficiency of material built on this model to debrief/reflect after an escape game – which can as per design only be played once – thus, a reflection-on-action debriefing, has yet to be tested using an experimental and a control group – with or without debriefing.

3 Materials and methods

3.1 The ERASMUS + « ECCI – Escape climate change initiative » project and the game development process

The study presented in this article was conducted as part of the ERASMUS+ project "ECCI – Escape Climate Change Initiative".[1]. In this project, two escape games were developed, tested and improved in several cycles in Germany, Italy and

[1] The ERASMUS + Project Escape Climate Change Initiative (Project number: KA220-SCH-D224FD32) took place between 2022 and 2024 and involved following partners: two high education institutions, the Institute for Geography Education from the University of Cologne (Germany) and the Universita Politecnica della Marcha (Italy); two firms specialised in game development and game design, Biosentinelle (France) for the paper game and Melazeta (Italy) for the digital game; and two NGOs, Association pour la transition Bas Carbone (ABC, France) and Design for Change (DFC, Spain). More information can be found on the project website: https://www.ecciproject.eu/ and the games can be played or downloaded while accessing the learning platform: https://app.ecciproject.eu/.

https://doi.org/10.5194/egusphere-2026-2308
Preprint. Discussion started: 4 May 2026

Spain, the four countries of the consortium. In the initial phase, an analysis of the needs and school curricula of the four countries was conducted (Enke & Budke, 2023). Subsequently, in a second phase, the games (comprising one paper-based game and one digital game) were developed based on the content of the school curricula, as well as supporting documents and teaching sequences to introduce and debrief/reflect on the games. Two preliminary testing phases were conducted in June 2023 (61 pupils) and February 2024 (91 pupils). A large-scale test was finally conducted in June 2024, with 314 students from the four countries participating. The games and debriefing/reflection documents were subsequently published.

3.2 The games Beat the Heat (paper game) and Climate Wardens (digital game): games' designs and descriptions (more information on the games' platform: https://app.ecciproject.eu/)

Both games were designed based on principles decided upon following a needs and curricula analysis conducted in the first phase of the project (Enke and Budke, 2023). Firstly, the games focused on urban green spaces, mobility and housing policy, all of which are key considerations in local political decision-making processes (e.g. Kabisch et al., 2017; Klemm et al., 2017; Kuss & Nicholas, 2022; Mi et al., 2019; Wynes et al., 2018). Secondly, the local complexity of stakeholders and climate governance was integrated in the games. For each thematic, a diverse range of stakeholders and their respective opinions were integrated as characters or as claims. This approach was adopted to reflect the diversity of local governance (Bulkeley, 2010; Bulkeley et al., 2010) and the competing interests that influence local policies. In both games, the players were tasked with assisting the mayor throughout the gameplay. In both games, stakeholders' opinions would not constitute a "right" answer: discussions around solutions and the complexity of local interests were the focus of the games. Despite their shared underlying principles, these games differ significantly, and a more detailed comparison is provided in the subsequent paragraphs.

"Beat the Heat" is a paper-based game that can be played in teams of three to five students in the presence of a game master. The game itself is designed to span one teaching session, with a duration of between 45 and 60 minutes. The debriefing phase is scheduled to take between 45 and 90 minutes (two versions of this phase are available for those requiring a shorter or longer debriefing). The game's design comprises three distinct modules, each focusing on a specific thematic area in relation to climate change-related solutions: urban green, mobility, and housing. This modular structure enables the segmentation of a group or student class into three distinct groups, with each group functioning autonomously. This attribute renders the game highly adaptable to diverse classroom settings, facilitating its integration into a variety of educational contexts. Each of the game modules is comprised of two main enigmas. In the first enigma, students are tasked with the identification of stakeholders' opinions on a proposed solution to address climate change in the city, and the subsequent classification of these opinions on a scale that illustrates their diversity. In the second enigma, players are required to allocate resources in order to implement a solution. As illustrated in Fig. 2 and Fig. 3, the first enigma game mechanic demonstrates the intricacies of local stakeholders' opinions.

https://doi.org/10.5194/egusphere-2026-2308
Preprint. Discussion started: 4 May 2026

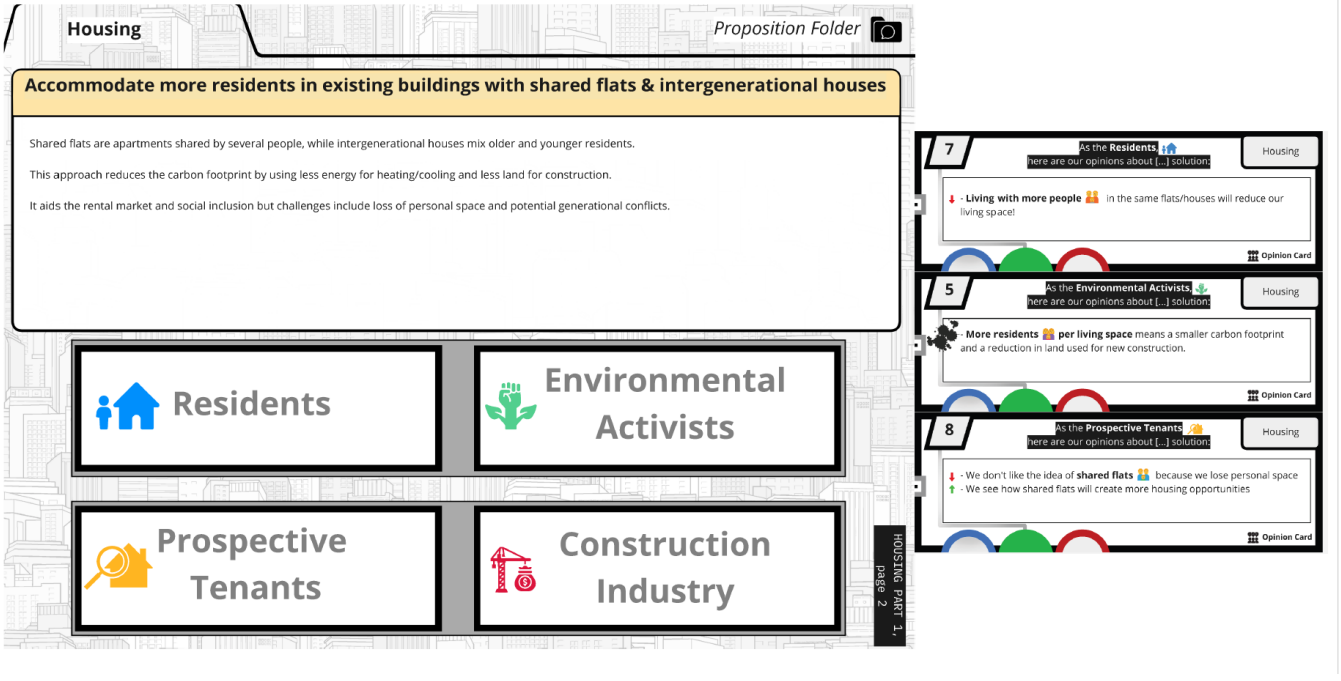


Figure 2: Example of game mechanics and materials for the first enigma of "Beat the Heat" by Rev(e) studio (Biosentinelle) (https://www.reve.studio/), licensed under CC BY SA 4.0 (http://creativecommons.org/licenses/by/4.0/). In this enigma, different opinion cards (four are displayed as an example on the right side) from different stakeholders are to be positioned in relation to different climate-related political measures (on the left side, for example, the densification of existing housing infrastructure). Game available on https://app.ecciproject.eu/physical-game/.

https://doi.org/10.5194/egusphere-2026-2308
Preprint. Discussion started: 4 May 2026

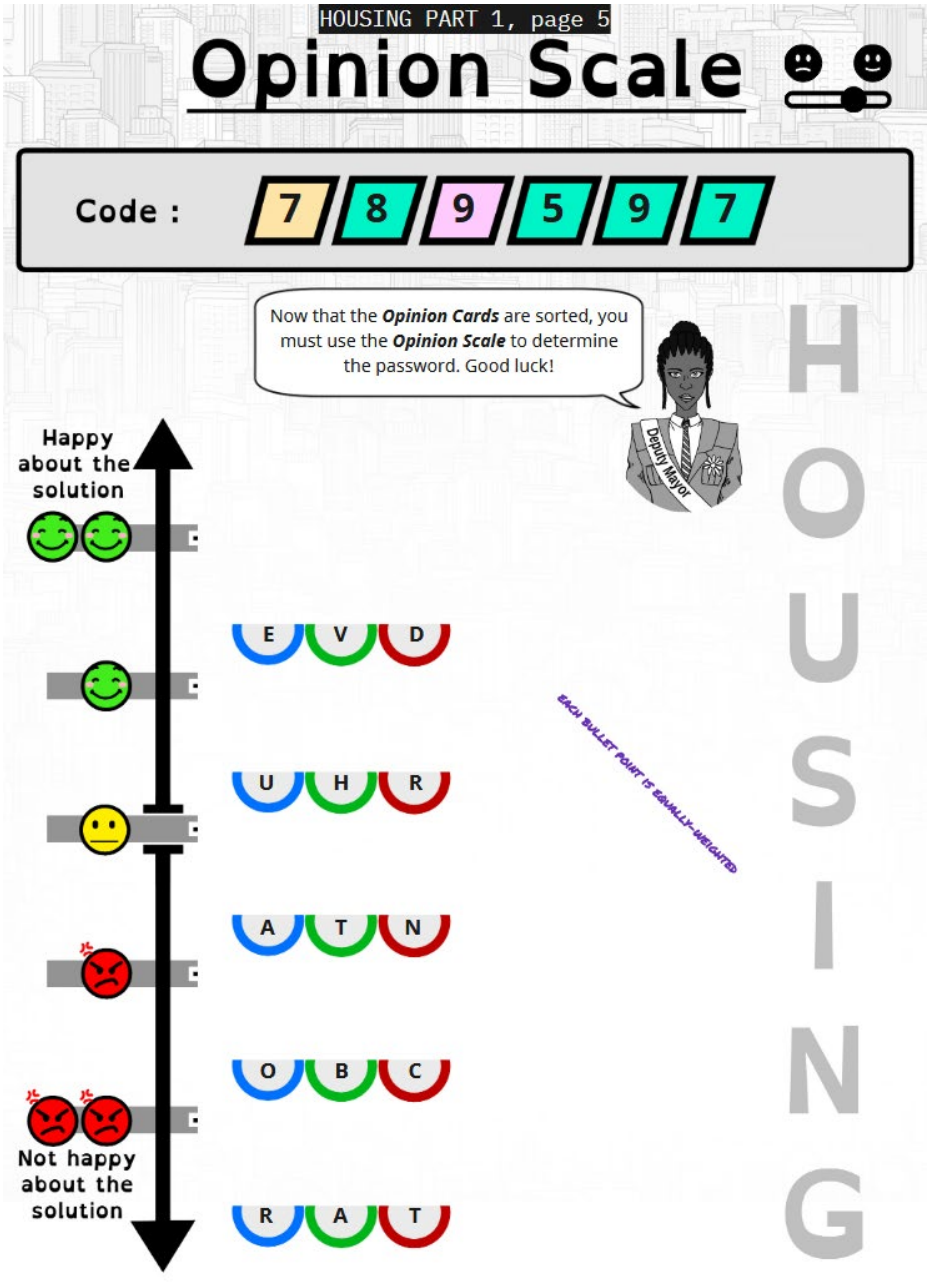


Figure 3: Example of game mechanics and materials for the first enigma of "Beat the Heat" by Rev(e) studio (Biosentinelle) (https://www.reve.studio/), licensed under CC BY SA 4.0 (http://creativecommons.org/licenses/by/4.0/). After completing the first part (see Fig. 2), the opinion cards have to be sorted on an opinion scale to highlight the controversy of the proposed measure and the differing interests of local stakeholders. Game available on https://app.ecciproject.eu/physical-game/.

"Climate Wardens" is a digital game which is supposed to be played individually but is based on the same thematic areas as the paper game. Given its intended implementation in classroom settings, the game and the platform enable educators to

https://doi.org/10.5194/egusphere-2026-2308
Preprint. Discussion started: 4 May 2026

establish groups and monitor students' achievements and progress. The duration of play is typically between thirty and ninety minutes. In this game, the player resolves small knowledge quizzes allowing for resources or information to be released and to progress in the game. The player is tasked with the responsibility of assisting in the decision-making process concerning urban planning, taking into consideration the competing interests and viewpoints of various stakeholders. The three game levels are to be played sequentially and reflect the three different thematics urban green, housing and mobility. Figure 4 shows an example of the game mechanics highlighting the complexity of the democratic decision-making process and the presence of divergent interests.

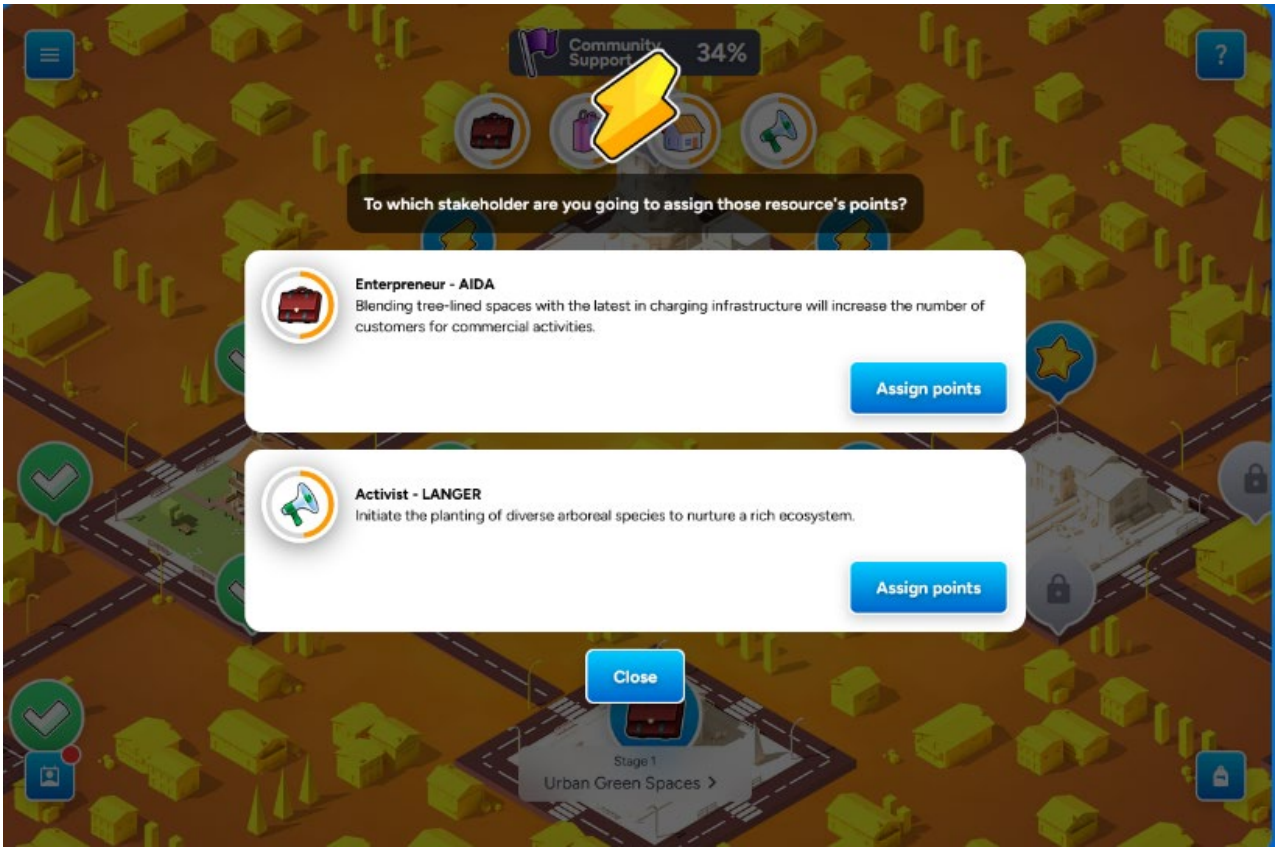


Figure 4: Screenshot from the game "Climate wardens" by Melazeta (https://www.melazeta.com/), licensed under CC BY SA 4.0 (http://creativecommons.org/licenses/by/4.0/). The player has to allocate points or resources to stakeholders taking into account the community's support. Game available on https://app.ecciproject.eu/digital-game/.

Both games are available online on the e-learning platform of the ECCI project (https://app.ecciproject.eu/). For both games and all materials, five languages are available (English, French, German, Italian and Spanish). The platform includes materials to prepare the games, to play, to debrief the games and to take action, all steps following the experiential learning cycle (Kolb, 2015).

https://doi.org/10.5194/egusphere-2026-2308
Preprint. Discussion started: 4 May 2026

3.3 The debriefing / reflection material

The debriefing / reflection phase was designed following the modified model for reflection from Lux and Budke (2023, see Fig. 1, Theoretical background) and is intended for (geography) teachers to use in class with their students. Teachers are provided with an explanation of the rationale for the debriefing, a lesson plan, sample solutions and material for students with documents and tasks. The debriefing material is similar for both the paper-based and for the digital game, with minor adjustments in the initial phase, where students reflect on the content of the games. The four levels of reflection (Lux & Budke, 2023, see Fig. 1) are implemented in the four phases of the debriefing. In the first phase, initial impressions and emotions on the game are gathered, and the games' system is recalled, highlighting stakeholders' opinions on the different game thematics urban green, mobility and housing (following level 1 in Lux and Budke (2023)). In phase 2, a real-world example is developed and analysed using authentic documents showing a local conflict about a possible solution to climate-related problems. Students have to compare the fictitious examples from the games with this real-life example to put the games into perspective. This allows the game experience to be analysed following level 2 of the model by Lux and Budke (2023) and to reflect on the games' fidelity to real-world situations and potential limitations (Crookall, 2023). In phase 3, students debate on the possibilities offered by the escape game and on its limits to learn about climate-related local decisions and stakeholders (level 3 of the model by Lux and Budle (2023)). In the fourth phase, they have to reflect on their action as players, on their own learning process, but also on their own agency and action possibilities with regard to influencing or participating in local climate policies (level 4 of the model by Lux and Budke (2023)).

3.4 Study's sample

The present study was conducted during the final major test of the project in June 2024. It focuses on a sample of 172 secondary students (21 German, 122 Italian and 29 Spanish students) aged from 14 to 20 years old who responded to a pre- and a post-questionnaire before and after playing and debriefing/reflecting on the games. From these students, 61 were female and 106 male, while one identified as diverse and two refused to answer. An overview of the study's participants and of the games played is presented in Table 1.

	Experimental group (game + debrief/reflection)		Control group (game only)		**Total**
	Paper-based game "Beat the Heat"	Digital game "Climate wardens"	Paper-based game "Beat the Heat"	Digital game "Climate wardens"	
Germany	10	11	0	0	**21**
Italy	0	95	0	27	**122**
Spain	0	0	29	0	**29**

https://doi.org/10.5194/egusphere-2026-2308
Preprint. Discussion started: 4 May 2026

Total	**116**	**56**	**172**

Table 1: Overview of study' participants: experimental and control groups, game played, country. Own elaboration.

The games and debriefing/reflection materials were tested in students' regular classroom and school settings. Of the 172 students, 133 played the digital game and 39 played the paper game. The games and the material for the debriefing/reflection were provided to all students and facilitators (members of the Erasmus + consortium). However, a proportion of the students were requested to complete the post-questionnaire immediately after playing the game and prior to debriefing (see Fig. 5). This enabled the differentiation of two distinct groups: an experimental group, who played and subsequently debriefed prior to answering the questionnaire (116 students, see Table 1), and a control group, who played but did not debrief prior to answering the questionnaire (56 students, see Table 1 and Fig. 5).

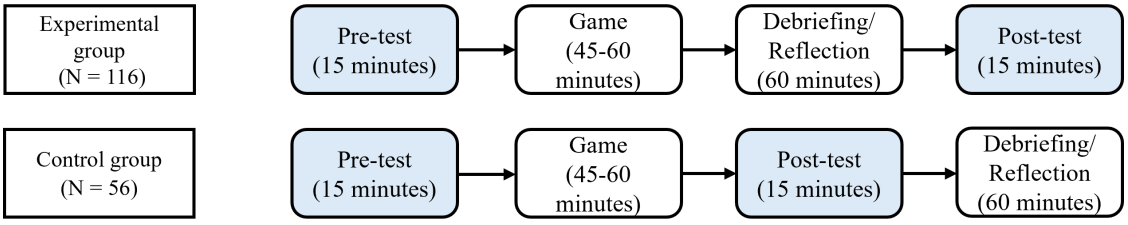


Figure 5: Study design (analysed and presented data are presented in blue). Own elaboration.

To ensure that students from the three countries could be grouped together for analysis, a Kruskal–Wallis test was conducted using the mean of all the responses given on the Likert items (Cohen, 2008). This was necessary given the marked differences in numbers between the groups, with Italian students predominating. This test showed that there were no statistically significant differences in the central tendencies of the three groups ($\chi^2(2) = 5.9255$, $p = .05$), indicating that they could be considered together in subsequent analyses. In order to confirm that we could form an experimental and a control group and answer our research questions, four Kruskal-Wallis tests were again calculated using the means of the Likert scales and items. There was no statistically significant differences between students in the experimental group ($\chi^2(1) = .8584$, $p = .35$ and $\chi^2(1) = .0329$, $p = .08$) and between students in the control group ($\chi^2(1) = .4520$, $p = .50$ and $\chi^2(1) = 2.9757$, $p = .08$).

The questions from the questionnaires were translated into the four languages of the project. The German translation of "Moderately important" and "Neutral" as a middle point answer in the Likert scales and items was made using the wording "teilweise" and "teils/teils", which mean "partly" and "half/half". After translation, the questionnaires were distributed in the different schools by the project partners. The school principals, students and parents had previously been informed of the study to which they had all consented. All questionnaires and data were anonymised for analysis.

3.5 The measurement of students' perceptions of stakeholders responsible for climate policy at city level

Perceptions and opinions are constructs that are shaped by the information accessible to respondents, along with their beliefs, values, and personal choices (Dowler et al., 2006). In addition, they are influenced by individuals' social interactions and lived

https://doi.org/10.5194/egusphere-2026-2308
Preprint. Discussion started: 4 May 2026

experiences (Dowler et al., 2006; Filho et al., 2023; Weber, 2010). The perceptions and opinions captured in a study represent a an aggregation of individual viewpoints at a particular point in time. Therefore, they are subject to change as contexts evolve (Dowler et al., 2006). In academic literature, the terms "perception" and "opinion" are often used interchangeably (Dowler et al., 2006; Filho et al., 2023). However, disciplinary conventions differ in this regard. Climate change research tends to favour the term "perception", whereas in sociology and political science, particularly in the studies of democratic development, the term "opinion" is more commonly utilised (Bergman, 1998). This distinction provides the rationale for differentiating between the two concepts and their corresponding research questions in this article. Furthermore, we propose a nuanced difference in meaning between the terms, as other authors do too (for example Crisol-Moya et al., 2020). The identification of stakeholders in climate policy primarily relates to respondents' level of knowledge regarding local climate governance. Conversely, the assessment of their opinion on local decision-making processes relates to their normative judgments and underlying value orientations.

To assess perceptions of responsibility for climate policy at the municipal level, a Likert-scale instrument was developed. This instrument consisted of multiple items, each representing a specific local or broader political actor (see Box 1). To enhance the content validity of the study, the initial selection of actors was derived from previous research. The European Commission's Eurobarometer survey lists the following actors: national governments; the European Union; large companies; local and regional authorities; civil society actors such as environmental NGOs; individual respondents; and educational institutions (European Commission. Directorate General for Climate Action, 2025). Further studies have identified experts, scientists, and local associations as relevant stakeholders (Grahn and Jaldell, 2019; Persson et al., 2021; Trell and Van Geet, 2019). In accordance with these aforementioned sources, the stakeholders most frequently cited by valid respondents were selected for inclusion in our local-level study. The labels underwent minor modifications to enhance specificity, resulting in the following categories: "The government," "The mayor," "Big companies," "Various interest groups," "Environmental activists," and "Scientists." The introduction of the term "Students" was also made, with the intention of enabling respondents to recognise themselves as potential stakeholders, in alignment with the approach used in the European survey (see Box 1). Furthermore, the item "Political parties in the city" was incorporated to encapsulate the diversity of local political actors and the potential for contestation within democratic decision-making processes (see Box 1). The finalised list was further validated using data from earlier exploratory tests of the Erasmus + European project conducted in June 2023 and February 2024. In those tests, participants were invited to respond to an open-ended question: "Who is responsible? Name as many individuals and groups as possible who, in your opinion, are responsible for greater climate protection" (see Box 1). A significant proportion of the responses from students could be integrated within the predefined categories: 77% in June 2023 (N = 82) and 68% in February 2024 (N = 134). Responses that could not be classified often reflected misunderstandings, with some students naming those they considered responsible for causing climate change rather than those accountable for implementing policy solutions. One recurring example, "Rich people" (4.5% of mentions), was nevertheless added to the scale as a negatively framed item, since including both positively and negatively formulated items is recommended in the methodological literature to reduce response bias (Chen et al., 2007; Croasmun & Ostrom, 2011, see Box 1). The overarching question was formulated as follows: "How

https://doi.org/10.5194/egusphere-2026-2308
Preprint. Discussion started: 4 May 2026

important are the following stakeholders in deciding which measures should be taken in European cities to tackle climate change?“ For each actor, respondents were invited to select one of six options: “Very important“, “Important“, “Moderately important“, “Of little importance“, “Not important at all“ or “Don’t know“. To reflect the multi-actor, multi-level nature of contemporary governance and local democracy, the scale allowed all stakeholders to be rated as important. This supported the construction of a coherent measurement instrument.

Question: “How important are the following stakeholders in deciding which measures should be taken in European cities to tackle climate change?“

Item 1: “The mayor”
Item 2: “Various interest groups”
Item 3: “Scientists”
Item 4: “The government”
Item 5: “Political parties in the city”
Item 6: “Environmental activists”
Item 7: “Rich people”
Item 8: “Big companies”
Item 9: “Students”

Box 1: Likert scale to measure perceptions of stakeholders responsible for climate policy at the city level. Own elaboration.

The nine items included in the Likert scale (see Box 1) were tested for internal consistency using Cronbach’s alpha, yielding a coefficient of $\alpha = .68$. Although this value falls slightly below the commonly cited threshold of .70 for acceptable reliability, the scale can be considered sufficiently robust in light of its grounding in the literature and the validation provided by the two prior pilot phases (Taber, 2018).

3.6 The measurement of opinions on democratic climate policy decision-making at the city level

A significant body of research into public attitudes towards democracy is based on datasets such as the World Values Survey (Gorman et al., 2019) or the European Values Survey (Tsatsanis et al., 2021; Wuttke et al., 2022). However, indices derived from these sources have been shown to lack consistent reliability (e.g. Ciftci, 2010). Furthermore, the central concept they seek to measure—“support for democracy”—is not always stable, which complicates cross-national comparability (Ariely and Davidov, 2011). Comparable limitations apply to our study. European cities differ in the extent of their competences in climate-related policy domains (Shtjefni et al., 2024), as well as in the maturity of their stakeholder networks and local political cultures surrounding climate governance (Kern et al., 2008; Rutherford and Jaglin, 2015; Shtjefni et al., 2024). Therefore, the analysis presented in this article is grounded in a set of dependent variables constructed from Likert-type items (see Box 2). Each item measured respondents’ support for local democracy or the local governance system for climate policy. Participants were invited

https://doi.org/10.5194/egusphere-2026-2308
Preprint. Discussion started: 4 May 2026

to indicate their degree of agreement with a series of statements using the response options: “I strongly agree”, “I agree”, “Neutral”, “I disagree”, “I strongly disagree”, “Don’t know”. The introductory question was phrased as follows: “How much do you agree with the following claims?” All items are listed in Fig. 7. Four items were designed to assess support for local democratic processes. Two of these were positively framed, measuring endorsement of local democracy as a participatory system and as a pluralistic, electoral system (for example, Claim 2: “As many people as possible should develop proposals and argue for them on how European cities can adapt to climate change. The proposals should then be put to a vote.” Two items assessed lack of support for democratic processes, with Claim 4 (“If everyone proposes different solutions for adapting to the consequences of climate change in European cities, it is very difficult to reach decisions. It is better if one person, e.g. the mayor, makes the decision alone”) assessing support for more authoritarian forms of local decision-making on climate issues, similar to items employed in the World Values Survey (Bedock, 2024; Gorman et al., 2019; Wuttke et al., 2022). In addition to democratic support, three further items were created to measure attitudes towards local governance understood as a process shaped by negotiation and, at times, conflict among stakeholders and political actors. Two statements were positively formulated and one negatively (Claims 5 to 7, see Fig. 7). Some items from this set also allowed to measure support for different forms of democratic decision-making processes such as consensus-oriented processes (Claim 7), deliberative processes (Claims 1 and 6), and majoritarian processes (Claims 2 and 5) (Held, 2006; Hendriks, 2010; Lijphart, 1971).

3.7 Statistics

The analysis comprised two stages. Firstly, the frequency distribution of responses and descriptive statistics for each set of variables were calculated. Secondly, non-parametric tests were employed to compare students’ responses to the Likert items in both the pre- and post-tests. The Wilcoxon signed rank test with continuity correction was used for each item (Rey and Neuhäuser, 2011). We considered, for each item, differences between the results obtained from the pre- and post-test for the entire sample, and subsequently, the differences for the two experimental and control group were calculated. To complete the analysis, the variable of whether the respondents played the paper-based or the digital game was also taken into account.

3.8 Limitations

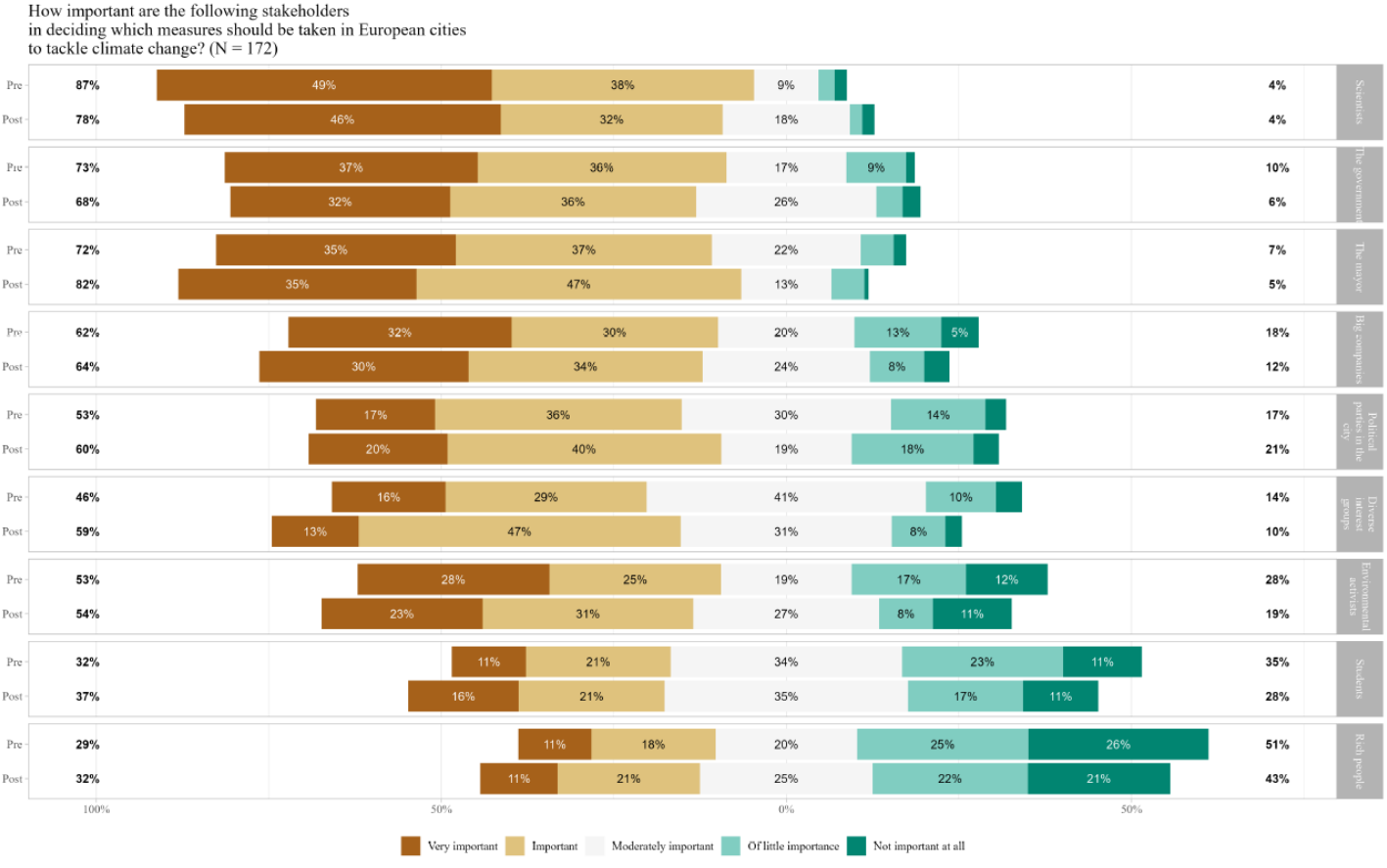
The present study is subject to several limitations. It is important to note that the subgroups of Italian students and those of German and Spanish students are not of equal size, and that the sample size is limited when it comes to comparing the subgroups, for example in terms of the use of digital or paper-based games. The sample is not representative since it was selected on a convenience basis by the Erasmus + European partners. The participants were drawn from large and medium-sized cities, which can influence political perceptions generally and the level of engagement in local politics. Consequently, the findings should not be interpreted as representative, and the study remains largely exploratory.

https://doi.org/10.5194/egusphere-2026-2308
Preprint. Discussion started: 4 May 2026

4 Results

4.1 Students' perceptions on local political stakeholders responsible for local climate change policies: results from pre- and post-tests

The results on the first research question (RQ1) are presented in Fig. 6.



Positive responses are on the left, while negative responses are on the right, with neutral responses occupying the central area. Percentages in bold are used to calculate the sum of positive responses on the left and the sum of negative responses on the right.

Figure 6: Students' perceptions on local political stakeholders before and after playing the escape games. Own elaboration.

When students from our study were asked in the pre-test to assess the relevance of various stakeholders in determining which actions European cities should adopt to address climate change, they showed a multilateral perception of local stakeholders with six categories out of nine possible actors or groups attaining more than 50% positive ratings (see Fig. 6). Scientists emerged as the most influential group, receiving positive evaluations from 87% of respondents (see Fig. 6). National and local public authorities followed, with "The government" and "The mayor" placed second and third, obtaining positive ratings of 73% and 72%, respectively. "Big companies" were likewise regarded as being of considerable importance, with 62% of respondents giving then a positive assessment. A similar level of positive regard was observed for local political parties and

https://doi.org/10.5194/egusphere-2026-2308
Preprint. Discussion started: 4 May 2026

environmental activists, with both receiving 53% of positive assessments (see Fig. 6). Opinions were more divided regarding "Diverse interest groups," which gained a 46% positive rating, alongside a substantial share of 41% who viewed them as only moderately important (see Fig. 6). The students' own group was judged to have comparatively low relevance, with just 32% positive ratings, 34% describing their role as moderate, and 35% considering it of little or no importance (see Fig. 6). Lastly, "Rich people" were predominantly seen as having minimal or no importance, as evidenced by 43% of respondents providing a negative rating (see Fig. 6).

Following the completion of the game, no significant alterations were observed in the distribution of responsibilities among the students. However, a number of stakeholders were identified as being of significantly greater importance in the post-test than in the pre-test, with a corresponding decrease in ratings as "moderately important". Both "The mayor" and "Diverse interest groups" gained 10% or more in positive ratings (see Fig. 6). Other stakeholders such as "Political parties in the city" and "Students" gained 5% or more positive ratings (see Fig. 6). To evaluate the significance of these changes, Wilcoxon signed rank tests were calculated for the entire student sample and for the two experimental and control groups. For the entire student sample, the category "Student" was the only one for which there were statistically significant changes between the pre- and the post-test ($Z = -2.361$, $p = .018$, $r = .211$). In the experimental group, only the categories "The mayor" and "Diverse interest groups" were significantly more highly rated after playing and debriefing/reflecting on the games (respectively $Z = -3.608$, $p < .001$, $r = .321$ and $Z = -2.155$, $p = .031$, $r = .227$). In the control group, only the category "The mayor" was significantly rated as more important after playing the games ($Z = -2.399$, $p = .016$, $r = .356$).

To further evaluate the possible different effects of the paper-based and the digital games, we conducted Wilcoxon signed rank tests within the experimental group. Students who played the paper-based game and debriefed/reflected on it evaluated their own role as significantly more important in the post-test than in the pre-test ($Z = -2.0$, $p = .046$, $r = .632$). Students who played the digital game and debriefed/reflected on it did not evaluate their own role as significantly more important ($Z = -1.362$, $p = .173$). Within the control group, no significant differences were found between the pre- and post-tests when considering the type of game played.

4.2 Students' opinions on democratic and governance processes for local climate decision making: results from pre- and post-tests

The results on the second research question are presented in Figure 7.

https://doi.org/10.5194/egusphere-2026-2308
Preprint. Discussion started: 4 May 2026

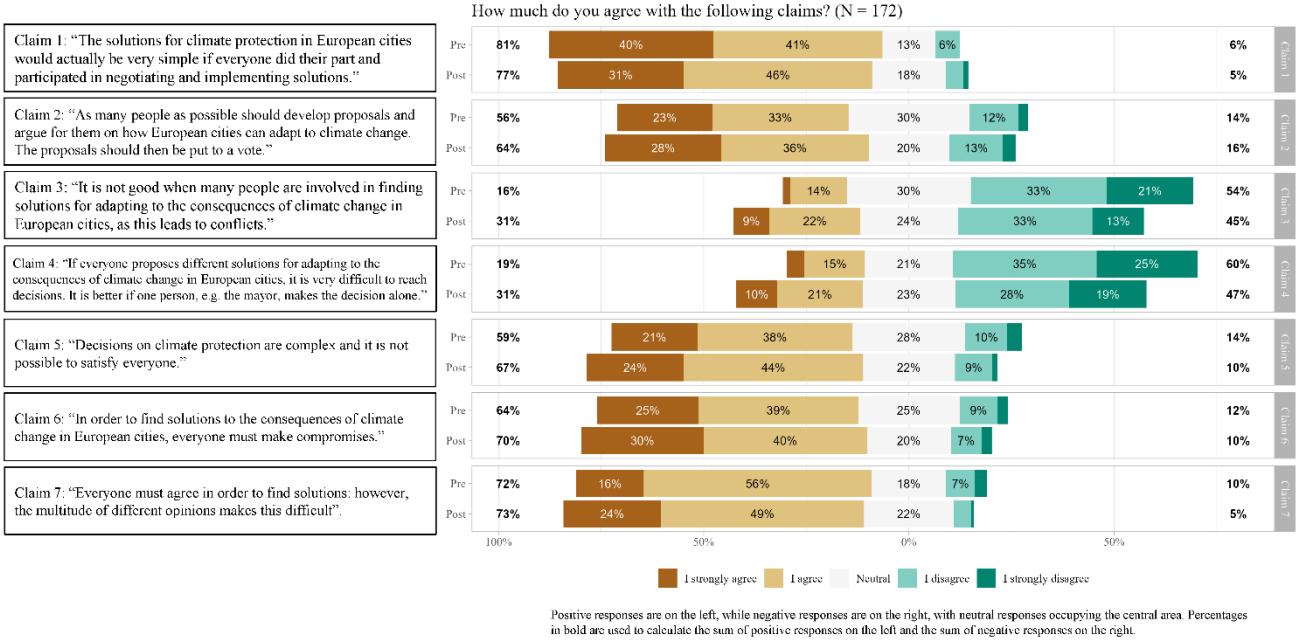


Figure 7: Students' opinions on local democratic and governance processes for climate decision making before and after playing the escape games. Own elaboration.

Claims 1 to 4 aimed to assess students' support for, or opposition to, democratic decision-making at the municipal level. The results suggest a general endorsement of democratic procedures. Claim 1 received the highest level of approval, with 81% of students expressing agreement (40% strongly agreed and 41% agreed; see Fig. 8). A majority also supported Claim 2: 23% strongly agreed, 33% agreed, and 30% selected a neutral response (see Fig. 7). In contrast, Claims 3 and 4 reflected scepticism towards democratic processes and were endorsed by only 16% and 19% of respondents, respectively (see Fig. 7).

Claims 5 to 7 sought to evaluate students' attitudes toward governance processes at the city level, with a particular focus on those involving negotiation and/or conflict among various stakeholders. The findings reveal a somewhat paradoxical pattern, with students expressing support for all these items. Claims 5 and 6 were approved by 59% and 64% of students, respectively (see Fig. 7), while Claim 7 received even greater support at 72% (16% strongly agreed and 56% agreed; see Fig. 7). It is also noteworthy that neutral responses were relatively prevalent, with five statements (Statements 2–6) receiving more than 20% neutral evaluations.

In the post-test, democratic opinions were still prevalent, with no major alteration observed between the pre- and post-test. However, Claims 3 and 4, which measured lack of support for democratic processes, were much more supported in the post-test, with Claim 3 gaining 15% positive ratings from 16% to 31% and Claim 4 gaining 12% positive ratings from 19% to 31% (see Fig. 7). With slightly lower positive ratings for Claim 1 (from 81% to 77%, see Fig. 7), these elements appear to suggest

https://doi.org/10.5194/egusphere-2026-2308
Preprint. Discussion started: 4 May 2026

reduced support for local democratic processes after playing the games, although Claim 2 was more supported in the post-test (64%) than in the pre-test (56%). Claims measuring support for governance processes were found to be more endorsed in the post-test than in the pre-test, with Claims 5 and 6 gaining, respectively, 8% and 6% (see Fig. 7). Claim 7 was also paradoxically reinforced by an increase in positive ratings going from 72% to 73% (see Fig. 7). To evaluate the significance of these changes, Wilcoxon signed rank tests were calculated for the entire student sample and for the two experimental and control groups. The tests indicated that Claims 3 and 4, which measured lack of support for democratic processes, were significantly more supported following game play across the entire student sample (with results respectively being $Z = -3.794$, $p < .001$, $r = .306$ and $Z = -3.558$, $p < .001$, $r = .295$). However, the most significant results were observed in the control group, which played without undergoing debriefing following the completion of the games, with not only Claims 3 and 4 being significantly more supported (respectively $Z = -3.233$, $p = .001$, $r = .462$ and $Z = -3.956$, $p < .001$, $r = .533$) but also Claim 1 (measuring support for democratic processes) being significantly less supported ($Z = -2.113$, $p < .035$, $r = .279$). In the experimental group, only Claim 3 demonstrated a significant change between the pre- and the post-tests ($Z = -2.424$, $p = .015$, $r = .231$). In no group were changes in items related to governance processes significant. To complete the analysis, we differentiated between the type of game played within the experimental group. Students having played the digital game and debriefed/reflected on the game supported Claim 3 significantly more in the post- than in the pre-test ($Z = -2.336$, $p = .018$, $r = .246$), whereas there was no significant change for students having played the paper-based game ($Z = -.577$, $p = .564$). In the control group, students having played the digital game without debriefing supported Claims 3 and 4 significantly more ($Z = -2.858$, $p = .004$, $r = .571$ and $Z = -2.683$, $p = .007$, $r = .547$ respectively), whereas students having played the paper-based game only supported Claim 4 significantly more ($Z = -2.2930$, $p = .003$, $r = .425$).

5 Discussion

In this exploratory study, we examined 172 German, Italian and Spanish students' perceptions of local stakeholders and opinions on democratic processes and governance in climate policy decision-making before and after playing and debriefing/reflecting two escape games which were developed in our European project. One group responded to the post-test after playing and debriefing, while another group responded to the survey directly after playing. The analysis suggests that both escape games "Beat the heat" and "Climate Wardens" with their debriefing/reflection material were effective in conveying the fundamental principles of local climate governance. This is particularly important in a context where cities and the local level are becoming increasingly important for climate policy, with multiple local stakeholders involved and local governance characterised by negotiation and collaboration.

In response to the initial research question, the results of the pre-test demonstrated that students exhibited a multilateral perception of responsibilities in determining the locale climate policy, as evidenced by their identification of the majority of stakeholders as being significant. This finding is consistent with the conclusions of other studies (European Commission. Directorate General for Climate Action, 2025, see Fig. 7). As in other works, respondents identified local authorities, the

https://doi.org/10.5194/egusphere-2026-2308
Preprint. Discussion started: 4 May 2026

national government, large companies and scientists as the most important (European Commission. Directorate General for Climate Action, 2025; Persson et al., 2021; Trell & Van Geet, 2019, see Fig. 7). However, only a few proportion of students identified the stakeholders that are specific for local climate governance, such as interest groups, NGOs or political parties in the city, as important (see Fig. 7). This shows a basic comprehension of the multiplicity of involved actors in climate policies, yet it also reveals a lack of knowledge concerning local climate governance processes and the specific stakeholders present in urban areas. This result is not surprising, since other studies have shown that climate education often "avoids" the political and collective dimension of climate mitigation or adaptation strategies and policies (Jorgenson et al., 2019; Kranz et al., 2022, p. 20). A majority of students did not perceive their own role as being of significative importance (see Fig. 7), even if there are opportunities for them to contribute or participate. This is indicative of a deficiency in both knowledge and information with regard to potential climate action and the agency possibilities available to them.

In the post-test, alterations were only identified in a few aspects. However, the stakeholder categories present in both the games and the debriefing and reflection materials were evaluated as being more important than in the pre-test. First, more students evaluated their own role as being significantly more important (see Table 2) which indicates a positive outcome of the intervention towards a possible empowerment of the students. Playing and debriefing/reflecting on the games may have precipitated a potential shift in their perception of their own agency. This may be explained by the fact that they played their own role in both games: young people summoned to help the mayor. The debriefing material also included, in Phase 4, a task listing their possible actions as individuals or collectively which may have contributed to this more positive result. A more thorough analysis of the results revealed that the observed change was only significant for the subgroup of students who played the paper-based game and subsequently debriefed/reflected on it. This suggests that students may have achieved better results in the paper-based game, which could be explained by the fact that students played the paper game version in groups and could discuss with another, while students who played the digital game played alone. Nevertheless, the effect size of this change was small, and the results would need to be confirmed over a longer time period or following a subsequent test. Second, both the experimental and the control groups identified "The mayor" as being significantly more important in the post-test than in the pre-test (see Table 2). This outcome is consistent with the notion that local municipalities play a pivotal role in the development of local-scale climate governance (Bulkeley, 2010; Bulkeley et al., 2010). Nevertheless, the focus on a single individual may also be interpreted as problematic, given that decisions within the municipal level are frequently made through collaborative processes, a fact that was not reflected in the games. This may also suggest a potential bias in the games, stemming from their utilisation of the mayor as a narrative and omnipotent decision-maker in the allocation of resources (a common practice in many games), which does not accurately reflect the collaborative and multifaceted nature of real-world local climate governance in democratic countries. This may have been counterbalanced by the finding that students from the experimental group also identified other local stakeholders present in both the games and the debriefing/reflection material, "Diverse interest groups" (see Table 2), as being more important. Consequently, it can be hypothesised that there was an enhancement in the students' understanding of local governance following the completion of the games. However, this enhancement was exclusively observed in the experimental group, who played the games and subsequently engaged in debriefing and reflection.

https://doi.org/10.5194/egusphere-2026-2308
Preprint. Discussion started: 4 May 2026

In contrast, the control group, who played the games but did not engage in debriefing, merely attributed greater importance to the mayor in the post-test compared to the pre-test.

With regard to the second research question, the results of the pre-test on students' opinions about local democratic and governance processes indicate that students mostly support democratic decision-making processes or characteristics (such as plurality, voting, collaboration and negotiation; see Fig. 8.). This was supported through the collective rejection of negative items, specifically Claim 4, which measured the support of a decision made by a single person, such as the mayor (Claim 4, see Fig. 8). As a consequence, this study is consistent with existing literature (Franke et al., 2026; Tsatsanis et al., 2021, p.2026; Wuttke et al., 2022) confirming the absence of a general "democratic deconsolidation" at the local level. However, as demonstrated in other studies (Bedock, 2024; Belchior and Teixeira, 2024; Foa and Mounk, 2016, 2017; Grassi et al., 2024; Tsatsanis et al., 2021; Wuttke et al., 2022), in this study, between 16% and 19% of students appear to not support democratic processes regarding local climate policy. This suggests the possible existence, for a small proportion of students, of a "democratic deconsolidation", even at the local scale. Many students supported governance processes but also showed a lacking understanding of governance as a negotiating local decision-making process, since they favoured consensus in decision-making (Claim 7, see Fig. 8). Indeed, governance implies collaboration, but also negotiation and conflict resolution between competing interests (Linke et al., 2022; Reckien et al., 2018; Trell and Van Geet, 2019).

After the games and the subsequent debriefing and reflection, no substantial changes were observed, and support for both democratic and governance processes remained predominant. However, significantly more support was observed for Claim 3 (see Table 3) across the entire sample, as well as within both the experimental and control groups. The fact that a greater proportion of students supported this claim ("It is not good when many people are involved in finding solutions for adapting to the consequences of climate change in European cities, as this leads to conflicts") suggests that the multitude of local stakeholders and the complexity of the decision-making processes in the games may have overwhelmed the students. This was particularly evident among the control group, who played without debriefing or reflection. These students also supported Claim 1 significantly less and supported Claim 4 significantly more, thus generally supporting democratic processes less. This demonstrates how important debriefing/reflection phases were in helping students to make sense of the game experience. Although the time constraints in escape games create a sense of urgency, reflecting the climate crisis, the gaming experience can be discouraging or overwhelming. This emphasises the importance of meaningful debriefing and reflection time to process the experience, especially in a context where the game can only be played once and in one session.

The present study demonstrated the significance of debriefing and reflection following the game, with the objective of transforming the gaming experience into knowledge about local climate policy actors and local climate governance. The suitability of Lux & Budke's model (2023) for the reflection of a geographical escape game could be asserted. The study also suggests a number of lessons for future development. The simplification of reality is imperative in the creation of a game that addresses complex societal themes (Lux et al., 2021). However, the findings of this study indicate that this simplification should be given careful consideration, especially with regard to the characters and actors in the game and particularly in phase 3 of the Lux & Budke reflection model (Phase 3: "Reflection of the medium", see Fig. 1). In a game where the actors and

https://doi.org/10.5194/egusphere-2026-2308
Preprint. Discussion started: 4 May 2026

controversy are important, if not essential, this should be reinforced with specific questions and/or elements in the reflection material.

The debriefing/reflection session appeared to help counteract the feeling of being overwhelmed that the students may have experienced at the conclusion of the games, and to temper any possible shift in opinion towards less support for local democratic processes. This result can be interpreted in several ways. Firstly, it would be necessary to conduct a follow-up test or repeat the experiment in order to verify the results and assess the long-term impact of the games and debriefing session. Secondly, these results demonstrate the necessity of incorporating political issues into climate education, not merely through a solitary game in a single session, but rather through a long-term, integrated approach that combines diverse methodologies and resources. Indeed, the phenomenon of feeling overwhelmed may be attributable to the students' lack of political culture and awareness of local politics, as well as their introduction to local climate governance through the medium of the game. This governance is undeniably intricate but by no means extraordinary. It is therefore essential to address these issues, which are an integral part of climate and geography education, on the long term, in order to empower students and help them build their participatory competence (Jekel et al., 2025).

Data availability

Datasets from this study may be provided from the corresponding author on request via e-mail.

Author contributions

Conceptualization, M.S. and A.B.; Data curation, M.S.; Formal analysis, M.S.; Funding acquisition, A.B.; Investigation, M.S.; Methodology, M.S. and A.B.; Project administration, A.B. and M.S.; Supervision, A.B.; Visualization, M.S.; Writing—original draft, M.S.; Writing—review & editing, M.S. and A.B. All authors have read and agreed to the published version of the manuscript.

Competing interests

The authors declare that they have no conflict of interest.

Ethical statement

Our department is not subject to any ethics committee. Consequently, no ethical approval has been obtained. However, the study was conducted in accordance with the Declaration of Helsinki the established ethical standards and guidelines. Data

https://doi.org/10.5194/egusphere-2026-2308
Preprint. Discussion started: 4 May 2026

collection did not pose any threats and did not imply physical or psychological stress for the respondents, as the German Research Foundation (DFG) states. All participants and parents provided written informed consent before participating in the study, and the research ensured the confidentiality and anonymity of the participants. No personal identifying information was collected, and all responses were anonymised. The participants were informed about the purpose of the study, their right to withdraw at any time, and how their data would be used and protected.

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