Master thesis

Growing Greener: The Effectiveness of an Educational Card Game on Pro-Environmental Attitudes and Behaviour in Children

R. Rochelle Hurenkamp
S2546604

First supervisor: Dr. A.M. van Dijk
Second supervisor: L. Hogenkamp
External: Dr. S. Vrielink

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Faculty of Behavioural, Managements and Social Sciences
Educational Science & Technology

Abstract

This study investigates the effectiveness of the educational card game “Growing Greener” on fostering pro-environmental attitudes and behavior in elementary school children in the Netherlands. Recognizing the urgent need for climate education, the game aims to promote environmental awareness and practical actions in elementary school children. The research uses a pretest-posttest design with 33 Dutch elementary school students, aged 9-12. It explores the relationships between perceived climate knowledge, self-efficacy, feelings of helplessness, climate concern, perceived urgency of climate change, and pro-environmental behaviors, as well as changes in these variables before and after the intervention.

A negative correlation was observed between perceived climate knowledge and self-efficacy in the posttest, suggesting that as students' perceived knowledge increased, their sense of self-efficacy decreased. Additionally, there was a negative correlation between self-efficacy and climate concern, indicating that higher levels of self-efficacy were associated with lower levels of concern about climate change. Contrary to expectations, the perceived urgency of climate change did not increase after the intervention. However, there was a strong positive relationship between perceived urgency and pro-environmental behaviors. The game did have a positive impact on reducing feelings of helplessness, showing that students felt more empowered about climate change after playing the game.

This research underscores the importance of addressing psychological dimensions such as perceived climate knowledge, self-efficacy, feelings of helplessness, climate concern, and perceived urgency of climate change in climate education, highlighting the need for further investigation into effective strategies for engaging young learners in environmental issues.

Growing Greener: The Effectiveness of an Educational Card Game on Pro-Environmental Attitudes and Behaviour in Children

As the earth's temperature is rising (Blunden & Boyer, 2020), it becomes increasingly important to prepare and equip the future generation to address the challenges and impacts of climate change. Issues such as climate change, deforestation, and pollution require urgent action to ensure a sustainable future for generations to come (Morganti et al., 2017). The profound influence that climate change is expected to have on children's lives creates a moral obligation to consider their rights and the necessity for them to be informed and involved (Chawla & Heft, 2002; Hicks & Holden, 2007). Recognizing this obligation is not only crucial for the children's future but also for the well-being of society as a whole, as they will grow to become the next generation of leaders and decision-makers. In order to effectively equip children for these challenges, it is essential to educate them about climate change and engage them in related discussions (Seddighi et al., 2020).

Research suggests that late childhood and early adolescence are critical phases for the development of interest and agency regarding global environmental issues (Blanchet-Cohen, 2008; Chawla & Flanders Cushing, 2007). During these stages, children are not only capable of advocating for climate change mitigation themselves (Seddighi et al., 2020) but can also influence their parents' attitudes, preferences, and behaviours (Kuczynski et al., 2016). Through their actions, children can raise climate change awareness among their parents (Lawson et al., 2019), effectively influencing society even before they become adults. Moreover, child-to-parent intergenerational learning has been identified as a promising way to promote conversations about biodiversity—an important aspect of climate change—among adults (Lawson et al., 2018). By fostering these discussions, we can help the next generation become more knowledgeable and engaged in addressing climate change.

One way to foster knowledge building and engagement in climate change is to offer climate education (Ledley et al., 2016). Climate education is increasingly recognized as crucial for driving societal change towards sustainability (Mochizuki & Bryan, 2015). Research shows that environmental education enhances children's awareness of climate change, influences their attitudes towards climate change, and increases pro-environmental behaviour (Busch et al., 2018; Iliopoulou, 2018; Seikkula-Leino et al., 2021; Sund, 2015). As a distinct discipline, climate change education focuses on equipping students with the knowledge and skills needed to address climate challenges and become agents of change (Armstrong & Krasny, 2020; Azevedo & Marques, 2017; Blum et al., 2013; Da Rocha et al., 2020). A Dutch study found that while most children believe in collective climate action, many are unsure of the specific actions they can take (Nederlands Jeugdinstituut, n.d.). Therefore, it is important to provide children with this knowledge and foster a sense of self-efficacy, which is a critical predictor of pro-

environmental behaviour (Loy et al., 2020). To help children take constructive steps, it's vital to positively influence their emotions, attitudes, and perceived control, preventing them from feeling overwhelmed by the magnitude of the problem (Rasmussen, 2023). A meta-analysis of 50 years of research confirms that environmental education significantly improves knowledge about climate change, pro-environmental attitudes and behaviour (Iwasaki, 2022; van de Wetering et al., 2022).

Educational games have been recognized as effective tools for teaching and engaging children in various subjects (Ouariachi et al., 2018), including biology (Gutierrez (2014), climate resilience (Bontchev et al., 2021), and pro-environmental engagement (Vázquez-Vílchez et al., 2021). They provide an interactive, hands-on approach that promotes active learning and problem-solving skills. Moreover, educational card games have the potential to improve knowledge, attitudes and behaviours regarding climate change (Pfirman et al., 2021). For instance, Ro et al. (2017) found that participating in the "Cool Choices" game resulted in higher self-reported levels of household energy conservation efforts and a greater emphasis on sustainability.

Although there have been some examples of research on educational card games related to pro-environmental behaviour, not many studies specifically investigate the effectiveness of non-digital, card-based educational games in shaping environmental attitudes and behaviours in young learners. The existing literature indicates that while learning through games can enhance educational outcomes, there is insufficient exploration of how these dynamics play out in the context of environmental education games specifically designed for younger children (Hamdan, 2023). Therefore, there is still a need for more comprehensive research to explore the impact of educational card games on environmental attitudes and behaviours specifically in elementary school-aged children. This study will investigate the impact of the Dutch version of the card game ‘Growing Greener’ on elementary school children in the Netherlands in terms of their pro-environmental attitudes and behaviours. The goal is to gain insight into the way children’s attitudes influence climate-related behaviour, as well as investigating to what extent the card game supports children throughout this process.

Theoretical Framework

When developing climate change education for children, it is essential to understand the psychological aspects that foster their learning about climate change and encourage pro-environmental behaviours. Environmental knowledge, self-efficacy, climate change helplessness, climate concern and the perceived urgency are among these psychological aspects (Akakpo et al., 2024; Qin et al., 2024; Tucholska et al., 2024; Vrselja et al., 2024; Zacher, 2023).

Pro-Environmental Behaviour

Pro-environmental behaviour can be defined as "behaviour that is intended to consciously minimise the negative impact of an individual's actions on the natural and built world" (Kollmuss & Agyeman, 2002, p. 240). Stern (2000) uses the term 'environmentally significant behaviour', which is separated into three major types: environmental activism, non-activist public-sphere behaviours, and private-sphere behaviours. Environmental activism refers to actions taken to promote environmental causes and advocate for change, such as participating in protests or signing petitions. Non-activist public-sphere behaviours include actions taken within the community or society, such as recycling, reducing water consumption, or using public transportation. Private-sphere behaviours refer to actions taken within one's personal life and household, such as conserving energy, reducing waste, or using environmentally friendly products. Elementary school-aged children primarily engage in private-sphere pro-environmental behaviours, which include actions taken within their personal lives and households, such as recycling, conserving energy and water, using environmentally friendly products, and reducing waste (Awalina, 2023; Ebersbach et al., 2019; Handayani et al., 2021; Zimmo et al., 2017). Additionally, children participate in non-activist public-sphere behaviours, such as walking or using alternative transportation (Nurizza, 2022; Zimmo et al., 2017).

The impact of pro-environmental behaviour of children can be far-reaching (Iwasaki, 2022; Gülay, 2011). Not only can it contribute to the immediate preservation and protection of the environment (Křepelková et al., 2020), but it can also shape their attitudes and behaviours as they grow into adulthood (Evans et al., 2018; Lacasse, 2016). Research has shown that childhood experiences, such as spending time outdoors, can positively influence pro-environmental attitudes and behaviour in young adulthood (Evans et al., 2018; Schultz et al., 2004). Numerous other elements could impact pro-environmental behaviour, including environmental attitudes, values and beliefs, knowledge about climate change, personality and skills (Biswas & Roy, 2015; Obery & Bangert, 2017). There has not yet been one model that captures all these factors in full. Such a model would provide a more comprehensive understanding of how various elements such as climate attitudes and knowledge interact to shape pro-environmental behaviour. Three models that are proposed to explain environmentally friendly behaviour are: 1) the theory of planned behaviour (Ajzen, 1991), 2) norm activation theory (Schwartz, 1977), and 3) the value-belief-norm model (Stern, 2000).

First, the theory of planned behaviour (Ajzen, 1991) is a theory that has successfully explained various types of environmental behaviour, such as water usage (Harland et al., 1999), household recycling (Kaiser & Gutscher, 2003), and eco-friendly behaviour in general (Kaiser et al., 1999). The theory originates from social psychology and posits that there is a fundamental conscious thought process at play in the development of the decision to partake

in specific actions. Therefore, an individual should be able to influence this behaviour at least to a certain extent. The theory of planned behaviour posits that determining factors of behavioural intent are attitudes, subjective norms and perceived behavioural control (Ajzen, 1985, 1987).

Second, Schwartz's (1977) norm activation theory posits that altruistic behaviour is influenced by perceived moral obligation to take specific actions. These moral responsibilities arise from an individual's cognitive framework of standards and principles in particular circumstances. However, they may be neutralised before an action takes place if the relevance or appropriateness of the obligation is questioned. Therefore, environmental knowledge and attitudes play a mitigating role in the perceived moral obligations leading to actions and behaviours.

Third, the value-belief-norm model, developed by Stern (2000) builds upon norm activation theory by linking values to the theory. The connection between values and environmentalism is influenced by specific beliefs, such as who or what is impacted by environmental conditions and whether individual actions can mitigate risks to valued people or things.

None of these models are exhaustive, since many studies have suggested the expansions of these models to include other personal and/or social factors (e.g. Chen & Tung, 2010; Heath & Gifford, 2002; Hinds & Sparks, 2008). However, each of the aforementioned theories suggest that attitudinal components such as an individual's beliefs, affections and values play a crucial role in the emergence of specific actions or behaviour.

Climate Attitudes

Although the concept of attitudes is widely studied in psychology, consensus on an exact definition has not been reached (Dijkstra & Goedhart, 2012). In their study, Dijkstra and Goedhart (2012) use the conceptualization of Oskamp and Schultz (2005), where attitudes are described as "a summary of an individual's affective reactions toward, behavioural responses to and evaluative beliefs about an attitude object" (as cited in Dijkstra & Goedhart, 2012, p. 734). Oskamp & Schultz (2005) propose a latent process viewpoint, positioning attitudes as an underlying (latent) variable that can clarify the link between specific observable stimulus events and observable responses. This conceptualization is also adopted in this study. Larson et al. (2011) proposed that children's environmental attitudes are characterised by two elements: ecological awareness, which relates to their understanding of environmental concerns and the significance of nature, and eco-affinity, which reflects their attraction to nature and willingness to engage in pro-environmental behaviour.

Attitudes towards climate change, such as a sense of responsibility towards the environment, concern for sustainability, and a connection to nature, are a critical factor in

promoting pro-environmental behaviour, as research has demonstrated a significantly positive correlation between individuals' environmental attitudes and their tendency to engage in pro-environmental behaviours and climate action (Nepraš et al., 2023). Those with positive environmental attitudes are more likely to engage in environmentally friendly behaviours and support conservation efforts (Nepraš et al., 2023; Pooley & O'Connor, 2000).

Perceived Environmental Knowledge

One factor that has been shown to influence climate attitudes, which subsequently affects pro-environmental behaviour, is environmental knowledge (Hossain et al., 2022; Itasanmi & Tosin, 2019). Environmental knowledge involves understanding basic facts, ideas, and connections related to the natural environment and its ecosystems (Chen et al, 2011). It refers to what people know about the environment, including the relationships between human actions and environmental effects, as well as an understanding of the interconnected ecological system and collective responsibilities for sustainable development (Teng et al., 2018). Perceived environmental knowledge can be defined as an individual's subjective belief or understanding of a particular topic or concept, regardless of the actual accuracy of that knowledge. Like factual knowledge, perception of knowledge can drive behaviour and decision-making processes (Eberman, 2008).

Studies have shown that individuals with higher levels of perceived environmental knowledge tend to exhibit more positive attitudes towards the mitigation of environmental issues (Kalantari et al., 2007; Tahkol & Öztürk Haney, 2023). For example, knowledge about climate change has been linked to greater awareness of the urgency of the situation, leading to increased motivation to undertake pro-environmental behaviours (Tucholska, 2024). This positive relationship between knowledge and attitudes is essential as it provides individuals with the understanding and awareness needed to recognize the importance of environmental conservation and sustainability (Kalantari et al., 2007).

Another way in which environmental knowledge influences pro-environmental behaviour is in the relationship between environmental knowledge and self-efficacy: research has suggested there is a positive association between environmental knowledge and self-efficacy, which in turn influences pro-environmental behaviour and willingness to help tackle climate change (Milfont, 2012). Supporting this idea, Rooney-Varga et al. (2018) found that participants experienced hope after gaining knowledge about climate change causes, dynamics, and impacts. Moreover, research has indicated that climate change knowledge is inversely related to climate concern, suggesting that a deeper understanding of environmental issues can lead to reduced levels of anxiety and increased confidence in addressing climate challenges (Zacher & Rudolph, 2023). However, Kolenatý et al. (2022) conversely demonstrated that increased climate change knowledge significantly enhanced participants'

concerns about climate change, which in turn positively influenced their self-efficacy and motivation to engage in pro-environmental actions.

Self-Efficacy

Building on the foundational role of environmental knowledge in shaping attitudes and behaviours, self-efficacy emerges as a critical psychological factor that further drives individuals to translate their knowledge into concrete pro-environmental actions. Self-efficacy, as defined by Bandura (1977), refers to an individual's belief in their ability to successfully execute a specific behaviour or achieve a desired outcome. It is a personal judgement of one's capabilities to perform tasks effectively and is closely linked to motivation and goal attainment (Bandura, 1977). Research has shown that self-efficacy is a strong predictor of intention and behaviour, with high levels of self-efficacy being associated with greater likelihood of engaging in specific actions (Myers & Horswill, 2006; Norman & Hoyle, 2004). This aligns with the previously mentioned theory of planned behaviour (Ajzer, 1991), which posits that perceived control is an important predictor for intention and behaviour. An individual's perceived severity and susceptibility to climate change and self-efficacy for engaging in climate change prevention are positively related to pro-environmental behavioural intentions, highlighting the importance of self-efficacy in driving environmentally conscious actions (Kim et al., 2012).

Climate Change Helplessness

Low self-efficacy can create feelings of helplessness, leading individuals to avoid problems and adopt negative coping strategies (Cai & Chaplin, 2019). Conversely, studies indicate that feelings of helplessness can contribute to low self-efficacy, demoralization, and a sense of giving up (Berardelli et al., 2019; Flett et al., 2011). Whereas self-efficacy is rooted in personal beliefs about one's own capabilities to achieve desired outcomes, helplessness stems from a perceived lack of control and the belief that one's actions cannot influence outcomes, leading to passivity, resignation, and negative emotional states (Trent et al., 2023). The perception that individual actions have little or no impact on climate change outcomes, a phenomenon known as climate change helplessness, can hinder efforts to promote pro-environmental behaviours (Kaplan, 2000; Salomon et al., 2017). Feelings of helplessness may be rooted in the large, complex challenges of global climate change, which can make people feel powerless to address these issues (Burley, 2022), and can be worsened or relieved by various factors that influence how individuals perceive and respond to climate change issues. For example, overemphasis on the negative consequences of climate change in educational contexts can produce feelings of helplessness and disengagement among students (Bentz & O'Brien, 2019).

Furthermore, using fear and crisis narratives in typical climate change education can make students feel powerless and disengaged, leading to a sense of helplessness (Bartlett et al., 2022). Increased knowledge about climate change can help students better understand how to reduce its effects and engage in pro-environmental actions, thereby lowering their anxiety and stress related to feelings of helplessness and despair (Ulrich et al., 1991). However, focusing only on imparting knowledge, without addressing emotional aspects, can be counterproductive, as it may increase climate anxiety and feelings of helplessness and despair (Abousoliman, 2024). This is further illustrated by a study by Rooney-Varga et al. (2018), which showed that their intervention enhanced knowledge and understanding of climate change while fostering affective engagement, resulting in positive outcomes such as greater feelings of hope and urgency.

Although climate change helplessness is generally not considered to be helpful in supporting pro-environmental behaviour, as evidenced by the aforementioned sources, Adamus et al. (2022) found that self-centred individuals still showed increased pro-environmental behaviour despite expressing feelings of helplessness, but only when their environmental concerns were amplified, meaning climate concern might play a mediating role in the relationship between feelings of helplessness and pro-environmental behaviour. Additionally, it has been suggested that connecting individual actions to their impact on climate change can help reduce feelings of helplessness towards the issue (Salomon et al., 2017).

Concluding, climate change helplessness generally hinders pro-environmental behaviours by fostering feelings of powerlessness and disengagement (Kaplan et al., 2000; Salomon et al., 2017). However, framing the issue in a sensitive manner by avoiding fear mongering (Bartlett et al., 2022), paying attention to emotional aspects (Abousoliman, 2024), and increasing climate concern (Adamus et al., 2022) may mitigate these effects.

Climate Concern

Another important attitudinal factor to consider is the climate concern, worry and grief the great burden of climate change issues may cause (Chawla, 2020; Ojala et al., 2021). This is a concern in terms of children's mental health but may also hinder steps they may take towards a healthier planet. Although research has shown that climate change anxiety or concern can lead to enhanced pro-environmental behaviours in some individuals, it can also result in eco-paralysis in others, causing them to avoid taking any action against climate change (Shantz, 2024). This aligns with the Yerkes-Dodson Law, which states that both indifference and too much stress have a negative impact on performance (Yerkes & Dodson, 1908). This idea is further supported by research in adults, which has shown that great amounts of grief and feelings of disempowerment can cause distance between individuals and the issue and may be

portrayed as scepticism or apathy (Haltinner & Sarathchandra, 2018; Verlie, 2021). The desire to withdraw or avoid the subject has also been observed in children outside of educational settings (Ojala, 2016). Moreover, climate concern has been associated with increased levels of distress, avoidance of climate change-related activities, and frustration of basic psychological needs (Turcotte-Tremblay et al., 2023). However, studies have also indicated that climate anxiety or worry can positively correlate with pro-environmental behaviours, such as using public transportation or reducing food waste (Heeren et al., 2022). This dual effect underscores the complex relationship between climate anxiety and environmental behaviours.

In conclusion, climate anxiety or concern plays a multifaceted role in influencing pro-environmental behaviour. While it can lead to increased engagement in sustainable practices, it can also have adverse effects such as eco-paralysis (Shantz, 2024). Understanding the impact of climate anxiety on individuals' attitudes and behaviours is therefore essential for developing effective interventions to address both psychological distress and promote environmental conservation efforts.

Perceived Urgency of Climate Change

Studies have shown that people who perceive climate change as an immediate and pressing issue are more likely to embrace sustainable behaviours because of their increased concern about its impact (Langenbach et al., 2019). The urgent nature of climate change can influence how risks are perceived, which in turn can affect behaviours related to environmental protection (Zeng et al., 2020). This sense of urgency plays a crucial role in motivating people to take steps towards addressing climate change and advancing sustainability (Langenbach et al., 2019). The urgency of climate change is interconnected with individuals' attitudes towards climate change prevention, perceived severity of climate change, response efficacy, and self-efficacy regarding climate change prevention (Kim et al., 2012). In summary, the perception of climate change as an urgent issue significantly influences individuals' attitudes and behaviours towards environmental protection and sustainability.

This Study

The goal of this study is to measure if playing a card game in Dutch elementary education can impact children’s climate change-related attitudes and behaviours. One way to achieve the goal of positively influencing children’s attitudes towards climate change and pro-environmental behaviour through climate change education can be found in the climate card game developed by Growing Greener (Growing Greener, n.d.-a). The game serves as a conversation starter for families to talk about climate change. It is an easy, low threshold way to not only help the player see which steps they could or could not take, but also the things

they are already doing well. The game is designed to move people from anxiety to action, using psychological frameworks and design principles. It focuses on behavioural goals and actions that are social, short and positive. Social is interpreted as goals that focus on places or people that the player cares about. Short means focusing on a human-scale timeframe that players are able to envision. Positive, meaning the player can leave with a clear next step that they can carry out to have a (small) positive impact. In this study, the focus is mostly on private-sphere and non-activist public-sphere behaviours, since this is most attainable for children and aligns with the design principles of the game.

The card game is designed to increase players' knowledge about climate change and pro-environmental behaviours by presenting actionable steps and information. As children engage with the cards, they are exposed to specific environmental actions they could take, along with explanations on why these actions matter (e.g., "Heating water to wash clothes uses extra energy"). This repeated exposure to climate-related facts in a playful and interactive manner is meant to enhance their knowledge of environmental issues and the importance of certain behaviours.

The game encourages players to categorize actions into "I already do this," "I could do this," and "I cannot do this." A possible outcome of this process is that children recognize that they are already capable of making positive environmental choices. This is expected to boost their sense of self-efficacy, since positive experiences related to personal choices can improve environmental self-efficacy (Plechatá et al., 2022). By identifying actions they can realistically undertake, children might feel more confident in their ability to make a difference, reinforcing their sense of efficacy in tackling environmental issues. Lakhmani et al. (2012) found that a realistic context in serious games enhances self-efficacy by making actions feel more feasible. It is expected that realistic, achievable actions in real-life contexts may similarly boost children's confidence and effectiveness in environmental efforts, leading to increased self-efficacy.

As children play the game and discuss various climate actions, the intent is that they become more aware of the issues and challenges related to climate change. The game's design, which incorporates social and emotionally resonant goals, encourages players to think about how climate change impacts their immediate environment and people they care about. This personal connection to the issue can heighten their concern about climate change, as they start to see its relevance to their own lives and communities (Graham et al., 2022).

The game's emphasis on short-term, actionable goals may help children perceive climate change as an urgent issue that requires immediate attention. By framing actions within a human-scale timeframe that children can envision, the game makes the concept of climate action more tangible and pressing (Rooney-Varga et al., 2018). As players realize that they can

and should take steps now to mitigate climate change, their sense of urgency around the issue is expected to increase.

As outlined in the theoretical framework, environmental knowledge, self-efficacy, feelings of helplessness, climate concern, and perceived climate urgency are all important factors to keep in mind when attempting to foster pro-environmental behaviour. The game not only educates but also motivates children by giving them the tools and confidence to take action. By making the process interactive and social, the game is designed to encourage children to adopt and sustain pro-environmental behaviours in their daily lives. The group setting also reinforces these behaviours through social support and shared commitment, which should increase the likelihood that they will follow through on the actions discussed during the game (El-Deeb et al., 2020; Villacorta, Koestner & Lekes, 2003).

The study examines specific variables to evaluate the effectiveness of the card game in fostering educated, empowered, and proactive environmental caretakers: perceived climate knowledge, attitudes towards the urgency of climate change, feelings of helplessness, self-efficacy, climate concern, and pro-environmental behaviour. Perceived climate knowledge is included because it gauges students' understanding of climate change, which is foundational for recognizing its urgency (Tucholska, 2024). Feelings of helplessness and self-efficacy are examined to measure students' perceived control and ability to take effective action, addressing psychological barriers to engagement (Kim et al., 2012). Climate worry is studied as it reflects students' concern about climate change, balancing the motivation to act against the risk of eco-paralysis (Heeren et al., 2022; Shantz, 2024). Lastly, pro-environmental behaviour is assessed to evaluate the actual actions taken to mitigate climate change impacts (Huang, 2016). These variables are assessed within the context of the classroom to provide a comprehensive framework for evaluating the effectiveness of the card game.

The aim of this study is to answer the following research question(s):

1. To what extent does the Dutch elementary school adaptation of the ‘Growing Greener’ climate card game impact elementary school children’s perceived knowledge about the climate and climate change, their sense of efficacy, feelings of helplessness, concern about climate change, perceived urgency of climate change, and pro-environmental behaviour?

2. What are the relationships between perceived knowledge, sense of efficacy, feelings of helplessness, concern about climate change, perceived urgency of climate change, and pro-environmental behaviour?

Hypotheses

To understand the game's impact, we first need to measure its effectiveness in increasing students' perceived knowledge about climate change. The initial hypothesis is as follows:

Hypothesis 1. After playing the game, elementary school students will report higher perceived knowledge about climate change than before playing the game.

It was expected that increased perceived knowledge would lead to reduced feelings of helplessness and an improved sense of efficacy, resulting in the following hypotheses:

Hypothesis 2. Increased perceived knowledge about climate and climate change will be linked to higher scores on sense of efficacy among elementary school students before and after playing the game.

Hypothesis 3. Increased perceived knowledge about climate and climate change will be linked to lower scores on feelings of helplessness among elementary school students before and after playing the game.

It was also expected that there would be a positive correlation between self-efficacy and climate concern, and a negative correlation between helplessness and climate concern. Therefore, the following hypotheses were formulated:

Hypothesis 4. There is a positive relationship between self-efficacy and climate concern among elementary school students before and after playing the game.

Hypothesis 5. There is a negative relationship between feelings of helplessness and climate concern among elementary school students before and after playing the game.

The game was expected to influence students' attitudes towards the urgency of climate change, ultimately affecting their pro-environmental behaviour. As a result, the following hypotheses were formulated:

Hypothesis 6. Perceived urgency of climate change will increase among elementary school students three weeks after playing the game, compared to the pretest.

Hypothesis 7. There is a relationship between perceived urgency of climate change and pro-environmental behaviours among elementary school students before and after playing the game.

Finally, the impact of the game on students' pro-environmental behaviour needed to be measured. The expectation was that through these mediating variables, playing the game would lead to an increase in pro-environmental behaviour, resulting in the following final hypothesis:

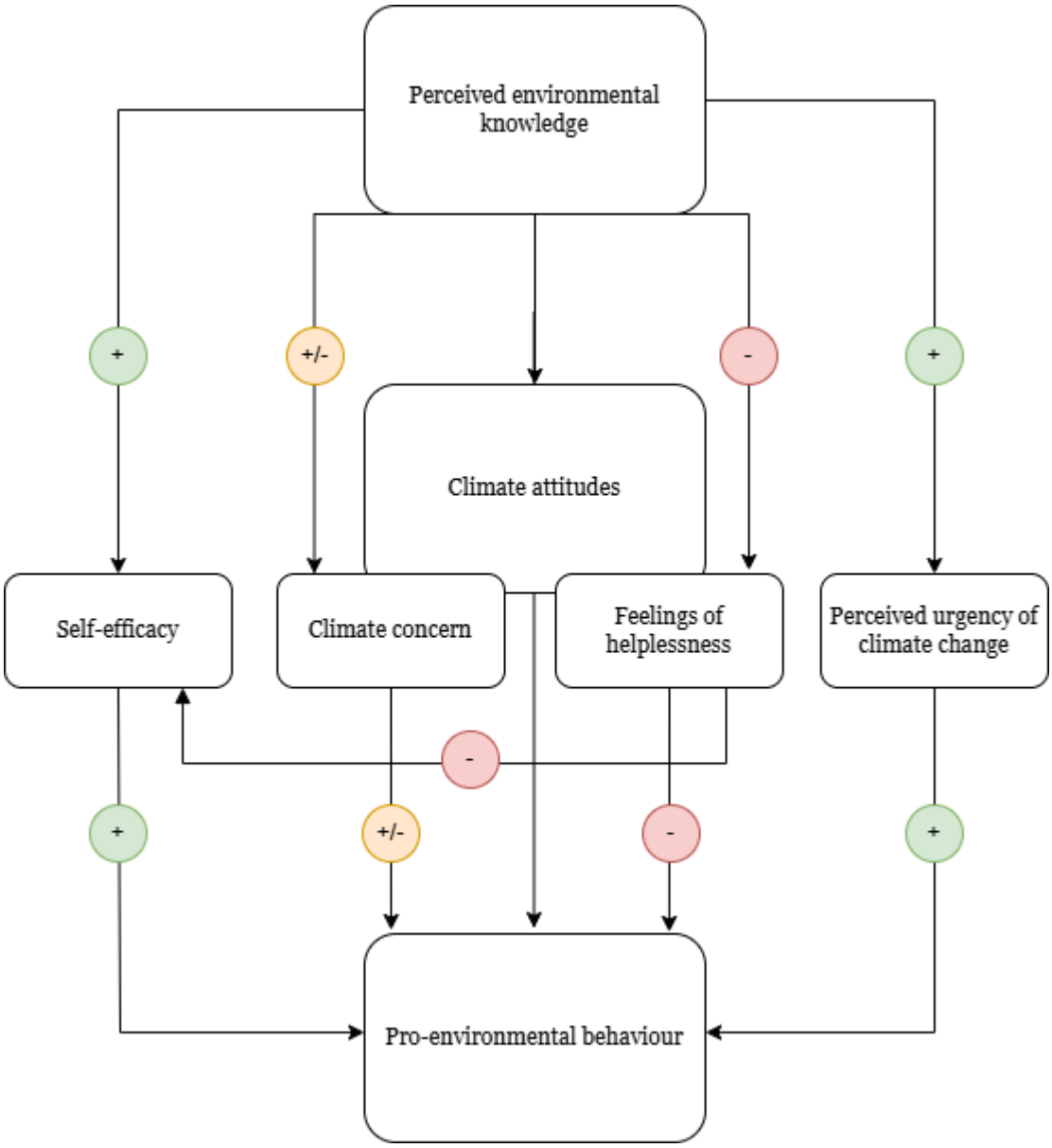
Hypothesis 8. Two to three weeks after playing the game, elementary school students will report more pro-environmental behaviours than before playing the game.

Conceptual Model of Pro-Environmental Behaviour

Based on the theoretical framework, the following diagram was created to illustrate a conceptual model of pro-environmental behaviour, as used in the current study.

Figure 1

Conceptual Model of Pro-environmental Behaviour



This conceptual model proposes relationships between several key variables hypothesized to influence pro-environmental behaviour, particularly in the context of climate change. First, it is hypothesized that perceived environmental knowledge serves as a foundational element, positively influencing both self-efficacy and feelings of climate change helplessness. Specifically, individuals with higher perceived environmental knowledge are expected to exhibit more positive attitudes towards environmental issues (Kalantari et al., 2007; Tahkol & Öztürk Haney, 2023), which in turn may enhance their self-efficacy—the belief in their ability to take effective action (Milfont, 2012). Conversely, low perceived environmental knowledge is expected to contribute to feelings of climate change helplessness, which are hypothesized to

be negatively associated with self-efficacy and may hinder pro-environmental behaviour (Berardelli et al., 2019).

Additionally, climate concern is hypothesized to be a significant but complex factor in motivating pro-environmental behaviours. Some research suggests that increased climate change knowledge may enhance climate concern, positively influencing self-efficacy and the motivation to engage in pro-environmental actions (Kolenatý et al., 2022), while other studies have found that perceived climate change knowledge reduced climate concern (Zacher & Rudolph, 2023). Furthermore, it is anticipated that perceived urgency of climate change will play a crucial role, with individuals who perceive climate change as an urgent issue being more likely to adopt sustainable behaviours (Langenbach et al., 2019; Zeng et al., 2020).

Finally, self-efficacy is hypothesized to be a crucial determinant of pro-environmental behaviour. Educational interventions that increase climate change knowledge may enhance both feelings of urgency and hope, thus motivating individuals to take action (Rooney-Varga et al., 2018). This model therefore emphasizes the importance of addressing both cognitive and emotional aspects in climate change education to effectively promote pro-environmental behaviour (Trott, 2021).

Methods

Pro-Environmental Behaviour and Attitudes

Nepraš et al. (2022) conducted a qualitative content analysis revealing that the most commonly discussed subjects relating to climate education in primary and lower secondary education are knowledge, behaviour, actions, experiences, and attitudes. The current study chooses to focus on pro-environmental behaviour and attitudes, since those factors are most closely tied to the contents and goals of the educational card game.

Participants

In total, 173 students from eight different classrooms of three Dutch elementary schools were asked to participate in the study. Parents were asked for their informed consent to the use of their child's data for the purpose of the research. Out of 173 participants, 34 parents gave their informed consent. One of these participants was excluded due to missing data, resulting in a total of 33 students (14 female, 18 male, 1 other). The participants were aged 8-12 (M = 10.36, SD = 1.08), and in elementary school grades six (10 students), seven (8 students) or eight (15 students).

Research Design

This study used a pretest-posttest design, in which every student was given the opportunity to play the game, and results were compared before and after playing the game. The choice to not use a (quasi-)experimental design using an experimental group and a control group was made to prevent the exclusion of students from playing the game and making participation more appealing to schools. The participating schools were selected through convenience sampling.

Materials

Growing Greener: Educational Card Game

The Growing Greener card game was originally developed for adults, but recently a card deck was created for children (Growing Greener, n.d.-b). This card deck was translated to the Dutch language and adapted to the Dutch context, resulting in a card deck of 26 cards that was used in this study. On the front, each card contains a climate change action depicted by a drawing and a statement. On the back, additional information about the action is provided. For example, for the card with the action "Use cold water when helping with the laundry", the text on the back says: "Heating water to wash clothes uses extra energy. The clothes get just as clean in cold water."

The goal of the card game is raising awareness on climate change and possible pro-environmental behaviours. It is played in groups of two to four players, each receiving a deck of cards. The deck is identical and presented in the same order for each player. The players are also presented with three category cards: "I already do this", "I could do this" and "I cannot do this". To start the game, players take the first action card from the deck, read it and discuss among themselves under which of the category cards they would place this action. For example, if a player is not already doing this action, but would be willing to do so, they would place the card on the "I could do this" pile. Each player places their own card under the category fitting to their personal choice.

Translation of the Game to the Dutch Context

For the purpose of this study, the card game was translated to the Dutch language and context (see Appendix A). Since the card game was developed in the United States, the original game was in English. Translation was done by the researcher, who is a native Dutch speaker, and checked for accuracy by the thesis supervisor and a fellow researcher (also native Dutch speakers). Furthermore, three cards were relevant to the American context, but not to the Dutch context. They were either removed or adapted. Examples include the card "Ride the bus to school", which was changed to "Ride your bike to school", since school buses are uncommon

in the Netherlands, but many children ride their bikes to school. Because of this change, a different card “Ride your bike to nearby places” became redundant and was removed. Furthermore, the card “Say NO to bottled water. Use a reusable water bottle” was adapted. Although water bottles are still used in the Netherlands, Dutch tap water is clean and safe, and therefore common to drink. Consequently, the card was changed to a more general “Say no to disposable cups. Use a reusable cup”.

Questionnaires

Three questionnaires were compiled for this study to be taken at different time points: before the intervention (pretest), directly after the intervention (posttest) and three weeks after the intervention (follow-up); see Appendix B, C and D.

Each questionnaire consisted of items from the Attitudes towards Climate Change and Science Questionnaire (ACSI) by Dijkstra & Goedhart (2012) and The Climate Change Engagement Questionnaire (Morrison et al., 2019). In this study, three questionnaires were developed: the pre-test, post-test, and follow-up. Each questionnaire included selected items from two validated scales—the Attitudes towards Climate Change and Science Questionnaire (ACSI) and the Climate Change Engagement Questionnaire (CCEQ). The pre-test and follow-up included items from both the ACSI and CCEQ, while the post-test consisted solely of CCEQ items. This structure was designed to facilitate combined data analysis for two separate but related studies. Although the post-test was initially intended for use in the related study by Augustijn (2023), relevant post-test data were included in this study’s analysis to enhance the depth of insights on participant responses across time points.

Questions that are listed in the appendices but not described below were not used for this study, but for the related study by Augustijn (2023).

Attitudes towards Climate Change and Science (ACSI)

The ACSI was developed to measure, among other related topics, pro-environmental behaviour and attitudes about the urgency of climate change, and thus aligns well with the purpose of this study. The questionnaire was adapted from the 63-item Attitudes towards Climate Change and Science Questionnaire (ACSI), developed by Dijkstra & Goedhart (2012). Since not all questions were relevant to this study since they regarded other topics like students’ opinions about scientists or careers in science, and it was important to limit the number of questions to retain children’s attention, only questions from the subsets ‘Background variables’, ‘Attitudes about the urgency of climate change’ and ‘Pro-environmental behaviour’ were used.

The subset 'Background variables' originally consisted of twelve items, including basic demographics such as name, age, school, grade and gender, as well as other background information such as the educational levels of both parents. Of those twelve items, five relevant items were selected: the participants' name, age, school, grade and gender.

In order to measure perceived urgency of climate change, the subset 'Attitudes towards the urgency of climate change' was used. It consisted of six statement items measured on a Likert-scale from 1 ("strongly disagree") to 5 ("strongly agree"), which were all used in this study. Examples of statements were "People should care more about climate change." or "The seriousness of climate change has been exaggerated".

The subset 'Pro-environmental behaviour' was used to measure pro-environmental behaviour. It originally consisted of eight statement items measured on a Likert-scale from 1 ("strongly disagree") to 5 ("strongly agree"). One item ("I always turn off the computer when I do not use it") was eventually excluded because 9 out of 33 students did not respond to the question. Some of them explained their choice by writing down that they either did not own a computer at home, did not understand the question or were not in charge of the family computer. Remaining items included statements such as "I am careful not to waste water", or "I always switch off the lights when I leave a room".

Reliability was measured using Cronbach's alpha, with a value greater than 0.6 indicating sufficient reliability. The reliability for the subset 'Attitudes about the urgency of climate change' was sufficient in the pretest (6 items; $\alpha = 0.684$) and acceptable in the posttest (6 items; $\alpha = 0.732$). For the subset 'Pro-environmental behaviour', the reliability was very good (7 items; $\alpha = 0.897$) in the pretest as well as in the posttest (7 items; $\alpha = 0.877$). For the total questionnaire, reliability was also very good ($\alpha = 0.886$) in the pretest as well as the posttest (6 items; $\alpha = .892$)

The Climate Change Engagement Questionnaire (CCEQ)

The Climate Change Engagement questionnaire (Morrison et al., 2019) was developed to measure the engagement in climate change-related educational activities that deviate from traditional lectures and focuses on students' knowledge and feelings regarding climate change. In this study, perceived climate knowledge, feelings of helplessness, and climate concern were measured using items from the Climate Change Engagement Questionnaire (CCEQ).

The CCEQ originally consisted of eight items, like "How much do you know about climate change?" and "Do you worry a lot about climate change?". However, two items ("How sure are you that climate change is happening?" and "How often do you talk to friends about climate change?" were excluded due to redundancy and overlap with other questions in the combined questionnaire, leaving six items remaining in the questionnaire. Of those six items, three were

used in this study: “How much do you know about climate change?” to measure perceived climate knowledge, “Do you feel helpless when you think about climate change?” to measure feelings of helplessness, and “Do you worry a lot about climate change?” to measure climate concern. The remaining three questions were used in a related study by E. Augustijn. All items were measured on a scale from 1 to 3 (i.e. “No”, “A little”, “Yes”).

The Climate Change Engagement Questionnaire's reliability was assessed using Cronbach’s alpha, with a value greater than 0.6 indicating sufficient reliability. The reliability of the pretest was sufficient (6 items; $\alpha = 0.639$), while reliability in the post-test was acceptable (6 items; $\alpha = 0.757$).

Procedure

Quantitative data was gathered through surveys administered to the children before (pretest), directly after (posttest) and three weeks after (follow-up) playing the educational card game.

The procedure consisted of three different components: 1) the pretest, 2) the intervention and the posttest, and 3) the follow-up questionnaire. The pretest was administered to the students by the teacher on a digital device or on paper, a minimum of one day before the intervention, and took circa 15 minutes to complete. The researchers were not present for the posttest.

The intervention was executed by the researchers and included an introduction of the research, a video and discussion on the topic of climate change, and a workshop that was part of the research of Augustijn (2023). It was guided by a PowerPoint presentation (see Appendix E). This took around 25 minutes in total. After this, the students played the educational card game in duos or groups of three. Playing the card game took around 20 minutes. A short plenary debriefing followed, after which students were asked to fill in the posttest.

Two to three weeks after the intervention, teachers were asked to administer the follow-up questionnaire to their students, either digitally or on paper, at their earliest convenience. The researchers were not present for the follow-up.

Data Analysis

Perceived Climate Knowledge

Perceived climate knowledge was measured using the item ‘How much do you know about climate change?’ from the Climate Change Engagement Questionnaire. Scores ranging from 1 to 3 were assigned to the answers (1 = A lot, 2 = A little, 3 = Almost nothing). A descriptive analysis was done for both the pretest and the posttest.

As the data was not normally distributed in the pretest (p = < 0,001), the related-samples Wilcoxon signed rank test was used to compare pretest and posttest scores on the item 'perceived climate knowledge' to determine if there was a significant increase in perceived knowledge, in order to test hypothesis 1 ('Immediately following the game (posttest), elementary school students will report higher perceived knowledge about climate change compared to their pretest assessments').

Climate Change Helplessness

Students' feeling of helplessness in relation to climate change was assessed using the item 'Do you feel helpless when you think about climate change?' from the Climate Change Engagement Questionnaire. Scores ranging from 1 to 3 were assigned to the answers (1 = Very, 2 = A little, 3 = Barely). A descriptive analysis was done for both the pretest and the posttest.

Helplessness was a component of hypothesis 2, which aimed to explore the association between increased self-reported knowledge about climate and climate change on self-efficacy and feelings of helplessness among elementary school students. To test this hypothesis, pre- and posttest data were analysed using Spearman's correlation analysis to examine the relationships between perceived climate knowledge, combined self-efficacy items, and feelings of helplessness. Hypothesis 3 sought to determine the relationship between scores on sense of efficacy, feelings of helplessness, and concern about climate change among elementary school students through calculating correlation coefficients for both pre- and posttests.

Climate Concern

Climate concern was assessed using the question "Do you worry a lot about climate change?" from the Climate Change Engagement Questionnaire. Scores ranging from 1 to 3 were assigned to the answers (1 = A lot, 2 = Sometimes, 3 = Almost never). Descriptive analyses were conducted for both the pretest and posttest.

Climate concern factored into hypotheses 2 and 3, which were examined through correlation analyses of perceived climate knowledge, self-efficacy, and helplessness for hypothesis 2; and self-efficacy, helplessness, and climate worry for hypothesis 3. Both sets of correlations were calculated for both the pretest and posttest.

Self-Efficacy

Self-efficacy in relation to climate change was assessed using two questions, one formulated negatively and the other positively. Scores ranging from 1 to 3 were assigned to the answers (1 = Yes, 2 = A little, 3 = No). The scoring for the negatively formulated item was reversed. This

approach was adapted from ACSI in order to enhance reliability (Dijkstra & Goedhart, 2012). The scores on both items were then averaged to generate an overall self-efficacy score.

Self-efficacy served as a variable in hypotheses 2 and 3. Hypothesis 2 was tested by analysing pre- and posttest data through correlation analysis to explore the links between perceived climate knowledge, combined self-efficacy items, and feelings of helplessness. Hypothesis 3 was evaluated by calculating correlation coefficients between self-efficacy, helplessness, and climate worry both before and after testing.

Perceived Urgency of Climate Change

Attitudes towards the perceived urgency of climate change were measured using the corresponding six item subset in the ACSI. The score for perceived urgency of climate change was calculated by summing the scores for each item, leading to a possible range from six to 30.

The perceived urgency of climate change played a role in hypotheses 4 and 5. Hypothesis 4 was tested through a paired samples t-test on the combined scores for perceived urgency, comparing pre- and posttest scores. The testing of hypothesis 5 involved calculating correlations between attitudes about the urgency of climate change and pro-environmental behaviour.

Pro-environmental Behaviour

Pro-environmental behaviour was measured using the similarly named seven item subset in the ACSI. The scores for each of the seven items were calculated on a scale from 1 (totally disagree) to 5 (totally agree), and then summed to achieve a total score ranging from seven to 35.

This measurement featured in hypotheses 5 and 6. Hypothesis 5 was tested by calculating correlations between combined scores for attitudes towards the urgency of climate change and pro-environmental behaviour. To test hypothesis 6, a paired samples t-test compared pretest and follow-up scores to determine if there was a significant increase in pro-environmental behaviours after playing the game.

Results

Hypothesis 1: Perceived Climate Knowledge Increases Post-Intervention

Perceived Climate Knowledge

During the pre-test, the majority of students felt they had at least some knowledge about climate change, with a relatively moderate variation in perceived knowledge (see Tables 1 and

2). In the post-test, students' perceptions of their knowledge about climate change was moderate, with some variation among participants (see Table 1).

Table 1

Descriptive Statistics for All Variables

Variable	Pretest			Post-test / Follow-up		
	N	M	SD	N	M	SD
Perceived climate knowledge	33	2.24	0.56	33	2.09	0.68
Self-efficacy	33	1.82	0.65	33	1.84	0.66
Feelings of helplessness	33	1.85	0.62	33	1.52	0.62
Climate concern	33	2.12	0.65	33	1.97	0.65
Perceived urgency of climate change	33	21.91	3.85	33	20.45	4.13
Pro-environmental behaviour	31	26.45	6.46	31	24.35	6.02

Hypothesis Testing

The Wilcoxon signed-rank test indicated the difference in perceived climate knowledge was not statistically significant (W = 10.00, Z = -1.67, p = .096). This means that hypothesis 1 is rejected. Elementary school students' perceived knowledge about climate change remained largely unchanged immediately following the game compared to their pretest assessments.

Table 2

Frequencies and Percentages of Perceived Climate Knowledge

Response	Pre-test		Post-test	
	N	%	N	%
No	14	42.4	14	42.4
A little	11	33.3	12	36.4
Yes	9	24.4	5	18.2
No response	0	0	1	3

Hypothesis 2: Increased Perceived Climate Knowledge Correlates to Higher Scores on Self-Efficacy

Self-Efficacy

During the pre-test, most students felt there was at least some action they could take regarding climate change, though a notable portion felt quite helpless (see Table 1 and 3).

When asked if they felt there was *something* they could do about climate change, responses indicated that the majority felt at least somewhat empowered, though this varied among students (see Tables 1 and 3). Similarly, when asked if they felt there was *nothing* they could do about climate change, most students indicated some level of empowerment (see Tables 1 and 4). These scores were averaged to create a general score for self-efficacy.

The difference in self-efficacy between the pretest and the posttest was explored using the Wilcoxon signed-rank test, which showed no significant change ($W = 72.00$, $Z = .211$, $p = .833$).

Spearman's rank-order correlation revealed a significant positive correlation between the pretest self-efficacy scores and post-test self-efficacy scores, $r_s(30) = 0.463$, $p = 0.008$. The correlation is statistically significant at the 0.01 level (two-tailed). This indicates a moderate positive relationship between the scores at the two time points, suggesting that students' self-efficacy levels are somewhat consistent across the pretest and posttest.

Table 3

Frequencies and Percentages of Self-Efficacy Responses (Negatively Formulated)

Response	Pre-test		Post-test	
	N	%	N	%
No	14	42.4	14	42.4
A little	11	33.3	12	36.4
Yes	9	24.4	5	18.2
No response	0	0	1	3

Table 4

Frequencies and Percentages of Self-Efficacy Responses (Positively Formulated)

Response	Pre-test		Post-test	
	N	%	N	%
No	5	15.2	10	30.3
A little	17	51.5	10	30.3
Yes	11	33.3	12	36.4

Hypothesis Testing

Based on the pretest data, hypothesis 2 is rejected. As shown in Table 5, Spearman's rank-order correlation revealed that the relationship between perceived climate knowledge and self-efficacy was not statistically significant, indicating no association between these variables based on the pretest data.

Similarly, based on the post-test data, hypothesis 2 is rejected. As shown in Table 6.1, there was a significant negative association between perceived climate knowledge and self-efficacy, which was not the expected outcome. This significant negative correlation suggests that higher self-efficacy is associated with lower perceived climate knowledge.

Table 5

Correlations Between Perceived Climate Knowledge and Self-efficacy in the Pretest and Posttest

Variable	N	M	SD	1	2
Pretest					
1. Perceived climate knowledge	33	2.24	0.56	-	-.136
2. Self-efficacy	33	1.82	0.65	-.136	-
Posttest					
1. Perceived climate knowledge	33	2.09	0.68	-	-.391*
2. Self-efficacy	33	1.84	0.66	-.391*	-

Hypothesis 3: Increased Perceived Climate Knowledge Correlates to Lower Scores on Climate Change Helplessness

Climate Change Helplessness

During the pre-test, most students felt some level of climate change helplessness, with the majority feeling only a little helpless (see Tables 1 and 6). This suggests that while most students feel some level of helplessness, the overall sentiment leans towards feeling only a little helpless.

In the post-test, the responses showed a reduction in feelings of climate change helplessness (see Table 1 and 6). The mean and standard deviation suggest that most students feel only a little helpless about climate change, with relatively low variability in their responses.

A Wilcoxon signed-rank test indicated the difference in feelings of helplessness between the pretest and the posttest was statistically significant (W = 24.00, Z = -2.52, p = .012).This suggests that the intervention significantly decreased students' feelings of helplessness about climate change.

A Spearman's correlation was conducted to evaluate the correlation between the pretest and the posttest. There was a significant positive relationship between pretest and post-test helplessness scores, $r_s(31) = 0.356$, $p = 0.042$, indicating that higher levels of helplessness at the pre-test are associated with higher levels of helplessness at the post-test. The correlation is statistically significant at the 0.05 level (two-tailed).

Table 6

Frequencies and Percentages of Helplessness Responses

Response	Pre-test		Post-test	
	n	%	n	%
Almost never	9	27.3	18	54.5
A little	20	60.6	13	39.4
Very	4	12.1	2	6.1

Hypothesis Testing

Based on the pretest data, hypothesis 3 is rejected. As shown in Table 6, Spearman's rank-order correlation revealed that the relationship between perceived climate knowledge and helplessness was not statistically significant, indicating no association between these variables based on the pretest data.

Similarly, based on the post-test data, hypothesis 3 is rejected. As shown in Table 6, there was no significant association between perceived climate knowledge and helplessness, suggesting that perceived climate knowledge did not meaningfully influence feelings of helplessness among students in the post-test.

Table 6

Correlations Between Perceived Climate Knowledge and Feelings of Helplessness in the Pretest and Posttest

Variable	N	M	SD	1	2
Pretest					
1. Perceived climate knowledge	33	2.24	0.56	-	-.005
2. Helplessness	33	1.85	0.62	-.005	-
Posttest					
1. Perceived climate knowledge	33	2.09	0.68	-	-.008
2. Helplessness	33	1.52	0.62	-.008	-

*p < .05

Hypothesis 4: Positive Relationship Between Self-Efficacy and Climate Concern

Climate Concern

During the pre-test, the majority of students expressed at least some level of concern about climate change, with considerable variation in the degree of worry (see Table 1 and 7). In the post-test, students' concerns about climate change remained moderate, with some reporting less worry (see Table 1 and 7).

The Wilcoxon signed-rank test indicated that the difference in climate concern between the pre-test and post-test was not statistically significant (W = 22.00, Z = -1.069, p = .285).

A Spearman's rank-order correlation was conducted to assess the relationship between concern about climate change during the pretest and posttest. The analysis revealed a significant positive correlation between pretest and posttest scores, $r_s(31) = 0.464$, p=0.007. The correlation is statistically significant at the 0.01 level (two-tailed), suggesting a moderate positive relationship between the scores at the two time points. This indicates that higher levels of worry about climate change in the pre-test are associated with higher levels of worry in the post-test.

Table 7

Frequencies and Percentages of Climate Concern Responses

Response	Pre-test		Post-test	
	N	%	N	%
No	14	42.4	14	42.4
A little	11	33.3	12	36.4
Yes	9	24.4	5	18.2
No response	0	0	1	3

Hypothesis Testing

The pretest data showed no statistically significant correlation between self-efficacy and climate concern, as seen in Table 8. Based on these findings, Hypothesis 4 is rejected for the pretest, as there was no significant relationship between self-efficacy and climate concern before the intervention.

However, in the posttest, a strong negative correlation between climate concern and self-efficacy was observed, which was statistically significant (see Table 8). This suggests that as students' sense of self-efficacy increased, their worry about climate change decreased, and vice

versa. Based on these findings, Hypothesis 4 is partially accepted for the posttest, as there is a significant negative relationship between self-efficacy and climate concern following the intervention.

Table 8

Correlations Between Self-Efficacy and Climate Concern in the Pretest and Posttest

Variable	N	M	SD	1	2
Pretest					
1. Self-efficacy	33	1.82	0.65	-	.014
2. Climate concern	33	2.12	0.65	.014	-
Posttest					
1. Self-efficacy	33	1.84	0.66	-	-.601*
2. Climate concern	33	1.97	0.65	-.601*	-

*p < .001

Hypothesis 5: Negative Relationship Between Climate Change Helplessness and Concern

The pretest data showed no statistically significant correlation between feelings of helplessness and climate concern, as seen in Table 9. Based on these findings, Hypothesis 5 is rejected for the pretest, as there was no significant relationship between feelings of helplessness and concern about climate change before the intervention.

In the posttest, there was also no statistically significant correlation between feelings of helplessness and climate concern (see Table 9). This suggests that, even after the intervention, there was no meaningful relationship between students' levels of concern about climate change and their feelings of helplessness. Based on these findings, Hypothesis 5 is rejected for both the pretest and posttest, indicating that feelings of helplessness did not significantly relate to climate concern at either time point.

Table 9

Correlations Between Helplessness and Climate Concern in the Pretest and Posttest

Variable	N	M	SD	2	3
Pretest					
2. Helplessness	33	1.85	0.62	-	.283
3. Climate concern	33	2.12	0.65	.283	-
Posttest					
2. Helplessness	33	1.52	0.62	-	.229
3. Climate concern	33	1.97	0.65	.229	-

*p < .001

Hypothesis 6: Increase in Perceived Urgency of Climate Change Post-Intervention

Perceived Urgency of Climate Change

The perceived urgency of climate change was measured by summing the scores of six questions from the ACSI. Thus, the possible scores ranged from 6 to 30. During the pre-test, the scores ranged from 12 to 28. The results seen in Table 10 indicate that, on average, students perceive climate change as moderately urgent, with a relatively wide range of urgency perceptions among the participants.

During the follow-up, the scores ranged from 14 to 28. The results shown in Table 9 indicate that, on average, students perceived a moderate to high urgency regarding climate change, with some variability in their responses.

Scores for perceived climate urgency (see Table 10) indicate a decrease in the perceived urgency of climate change from the pretest to the follow-up. The correlation between the pretest and follow-up is 0.740, which is statistically significant ($p < 0.001$).

A paired samples t-test revealed that this decrease was statistically significant, with a mean difference of 1.38 (SD = 2.96), $t(28) = 2.51$, $p = .018$ (two-sided), suggesting a moderate effect size.

Based on these results, hypothesis 4 is rejected. The paired samples t-test revealed a statistically significant decrease in the perceived urgency of climate change from the pretest to the follow-up test. The moderate effect size indicates a noticeable change in perceived urgency over the period between tests, but not in the expected direction.

Table 10

Descriptive Statistics for Perceived Urgency of Climate Change

Variable	N	M	SD
Perceived climate urgency (pre-test)	33	21.83	4.07
Perceived climate urgency (post-test)	33	20.45	4.13

Hypothesis 7: Perceived Urgency of Climate Change Correlates to More Pro-Environmental Behaviour

Pro-environmental Behaviour

Pro-environmental behaviour was measured by summing the scores of seven questions from the ACSI, resulting in possible scores ranging from 7 to 35. The scores shown in Table 1 suggest that students generally exhibit moderate to high levels of (self-reported) pro-environmental behaviour, with a considerable range of behaviours observed among the participants.

In the follow-up, scores ranged from 9 to 35. The results shown in Table 1 suggest that, on average, students engaged in a moderate level of pro-environmental behaviour, with a considerable range of variability among their responses.

There is a strong positive correlation between pretest perceived climate urgency and pretest pro-environmental behaviour, with a Pearson correlation coefficient of 0.613. This correlation is statistically significant ($p < 0.001$), indicating that higher scores on pretest perceived climate urgency are associated with higher scores on pretest pro-environmental behaviour. This suggests that students who had a higher perceived urgency of climate change at the pretest also tended to engage more in pro-environmental behaviours in the pretest. This strong positive relationship implies that students' attitudes towards climate change were strongly related to their reported behaviours even before the intervention.

The follow-up data also showed a strong positive correlation between perceived climate urgency and pro-environmental behaviour, indicating that higher scores on follow-up perceived climate urgency are associated with higher scores on follow-up pro-environmental behaviour. The significant correlation suggests that students who have higher perceived urgency of climate change also tend to engage more in pro-environmental behaviour.

Hypothesis 8: Increase in Pro-Environmental Behaviour Two to Three Weeks Post-Intervention

The mean scores for the pretest and follow-up sum of behaviour items indicate a decrease in pro-environmental behaviours from the pretest to the follow-up (see Table 1). The correlation between the pretest and follow-up sum of behaviour items is statistically significant, suggesting a strong positive relationship between students' behaviours measured at both time points.

A paired samples t-test confirmed that this decrease was statistically significant, with a mean difference of 2.10 (SD = 4.24), $t(30) = 2.75$, $p = .010$ (two-sided), suggesting a moderate effect size. This result indicates a significant decrease in pro-environmental behaviours from the pretest to the follow-up, contrary to the expected increase.

In conclusion, the results indicate a statistically significant decrease in pro-environmental behaviours from the pretest to the follow-up. The strong positive correlation between pretest and follow-up scores suggests consistency in students' behaviours over time, despite the overall decrease. The effect size measures suggest a moderate impact of the intervention or time period between tests on students' pro-environmental behaviour, although not in the expected direction.

Table 11

Descriptives for Pro-Environmental Behaviour (Pretest and Follow-Up)

Variable	M	N	SD	SEM
Pro-environmental behaviour (pretest)	26.45	31	6.46	1.16
Pro-environmental behaviour (follow-up)	24.35	31	6.02	1.08

Discussion

This study aimed to evaluate the impact of the 'Growing Greener' climate card game on various dimensions of elementary school students' climate change-related attitudes and behaviours: perceived climate knowledge, self-efficacy, feelings of helplessness, climate concern, perceived urgency of climate change, and pro-environmental behaviour.

While some hypotheses, such as the association between self-efficacy and lower climate concern, were supported, the data showed no significant increase in perceived climate knowledge, self-efficacy, or pro-environmental behaviours. Additionally, perceived urgency of climate change unexpectedly decreased after the intervention. These results suggest that the

'Growing Greener' game had a limited impact on the intended climate-related attitudes and behaviours, highlighting areas for improvement in the game's design to enhance educational and behavioural outcomes. However, feelings of climate helplessness did decrease after playing the game.

By investigating the effectiveness of an innovative educational card game, this research fills a gap in existing strategies and offers a foundation for future studies to build upon and improve climate education methods.

Hypothesis 1: Perceived Climate Change Knowledge Increases Post-Intervention

The hypothesis that the 'Growing Greener' game would increase students' perceived knowledge about climate change is rejected, as there was no statistically significant increase in perceived climate knowledge among the students due to the intervention. The lack of a significant increase in perceived knowledge suggests that the 'Growing Greener' game did not effectively enhance the students' sense of understanding of climate change. This could be due to several factors. For example, it could be that perceived knowledge does not accurately reflect their actual knowledge. For example, it is possible that students overestimated their own knowledge prior to playing the game and gave a more accurate estimation after learning more about climate change. This would align with the extensively studied Dunning-Kruger effect (Kruger & Dunning, 1999), which posits that individuals with lower abilities tend to overestimate their skills or knowledge. However, it should be noted that this theory has received criticism, suggesting the effect might be a statistical artifact (Gignac & Zajenkowski, 2023). For those with moderate or higher initial knowledge, the intervention might not have introduced enough new or challenging material to significantly shift their perceived understanding. This ceiling effect, where students already feel knowledgeable, can limit the apparent growth in self-assessed knowledge (Bandura, 1989).

Another possible explanation can be found in the related study conducted by Augustijn (2023), where results suggested a low level of game engagement, potentially caused by a lack of game-like elements. Lack of engagement or interest in the game may lead to diminished attention and retention of the educational content conveyed to the students (Ningsih et al., 2020). Additionally, the game focused mainly on practical tasks and activities, which can help develop skills and reproduce knowledge, but may not foster a deep understanding of core climate concepts, theories and principles (Czauderna & Guardiola, 2019). Lastly, the game lacks features for players to receive feedback or assess their progress, which may have hindered their ability to track their learning and understanding, affecting the effectiveness of knowledge acquisition (Hill & Nassrallah, 2018).

To enhance the 'Growing Greener' game and improve students' perceived knowledge about climate change, it might therefore be beneficial to increase engagement with game-like

elements, balance practical tasks with deeper theoretical knowledge or more explicit educational content and provide immediate feedback and progress tracking.

Hypothesis 2: Increased Perceived Climate Knowledge Correlates to Higher Scores on Self-Efficacy

The posttest data revealed a statistically significant negative relationship between perceived knowledge and self-efficacy. This suggests that as students gained more insight into the complexity and severity of climate change, their confidence in their ability to make a difference actually decreased. This result aligns with the idea that increased awareness of a problem's magnitude can sometimes lead to feelings of powerlessness, as noted in prior research (Dobkins et al., 2023). However, the pretest data did not show any significant relationship between perceived knowledge and self-efficacy. This could be due to the fact that the expected increase in perceived knowledge did not occur as anticipated, and therefore could not positively impact students' sense of efficacy.

Based on these findings, Hypothesis 2 is rejected. The unexpected negative correlation between perceived knowledge and self-efficacy in the posttest contradicts the hypothesis. This significant negative relationship, combined with the lack of increase in perceived knowledge (as indicated by the rejection of Hypothesis 1), suggests that the intervention did not improve students' confidence in their ability to address climate change as expected. It is possible that as students gained more knowledge, they began to realize the complexity of climate change, leading to a decrease in self-efficacy. For future interventions, focusing on practical and actionable steps that could bolster self-efficacy may help mitigate this effect.

Hypothesis 3: Increased Perceived Climate Knowledge Correlates to Lower Scores on Climate Change Helplessness

The analysis of the pretest and posttest data revealed no statistically significant relationship between perceived knowledge and feelings of helplessness. This suggests that, contrary to the hypothesis, students' perceived knowledge about climate change did not correlate with a reduction in feelings of helplessness. The lack of significant findings could be attributed to the minimal change in perceived knowledge throughout the intervention, meaning any potential effect on helplessness may not have materialized.

Based on these findings, Hypothesis 3 is rejected. Without a notable increase in perceived knowledge, there was limited opportunity for this variable to influence feelings of helplessness as anticipated. In future studies, targeted interventions that provide knowledge alongside clear, actionable steps could better support students in translating knowledge into reduced helplessness.

Hypothesis 4: Positive Relationship Between Self-Efficacy and Climate Concern

During the pretest, no statistically significant relationship was observed between self-efficacy and climate concern. However, in the posttest, a significant negative correlation emerged between these two variables. This finding contradicts the hypothesis, which predicted a positive relationship between self-efficacy and climate concern. Instead, the results suggest that higher levels of self-efficacy are associated with lower levels of concern about climate change among students. This implies that enhancing students' self-efficacy may help reduce worry related to climate issues. Reese et al. (2022) argue that self-efficacy often corresponds with a sense of control and effective coping strategies, which could lead to reduced climate anxiety. Additionally, Innocenti et al. (2023) propose that fostering coping strategies, such as pro-environmental behaviours, can strengthen self-efficacy and mitigate anxiety surrounding climate change.

Based on these findings, Hypothesis 4 is rejected. The observed negative correlation indicates that increasing self-efficacy might contribute to lower, rather than higher, climate concern.

Hypothesis 5: Negative Relationship Between Climate Change Helplessness and Climate Concern

In both the pretest and posttest, no statistically significant relationship was found between climate change helplessness and climate concern. This lack of correlation suggests that students' levels of helplessness did not influence their degree of concern about climate change. One possible explanation for this finding is that students reported relatively low levels of helplessness before the intervention. While these levels further decreased post-intervention, the initial low levels of helplessness might have limited variability, thereby reducing the potential for significant correlations with climate concern.

As a result, Hypothesis 5 is rejected. The low baseline of climate change helplessness in the sample likely limited its association with climate concern, indicating that feelings of helplessness may not play a substantial role in shaping climate concern in this context. Future interventions could explore the impact of moderate or higher initial levels of helplessness on climate concern, potentially providing more insight into this relationship.

Hypothesis 6: Increase in Perceived Urgency of Climate Change Post-Intervention

The data revealed a statistically significant decrease in perceived urgency of climate change from the pretest to the follow-up. This observed decrease suggests that the intervention may

have contributed to a reduced sense of urgency about climate change among the students. One possible explanation is that after playing the game, students felt that the presented actions and solutions were sufficient, leading them to perceive the issue as less urgent. This could suggest that students felt their actions were already sufficient, leading to a perception that no further efforts were needed, thereby decreasing their sense of urgency about climate change (Kolandai-Matchett & Armoudian, 2020). The hypothesis that perceived urgency of climate change would increase among elementary school students following the intervention is rejected, because although there was a statistically significant change in perceived urgency, it was in an unexpected direction.

Hypothesis 7: Perceived Urgency of Climate Change Correlates to More Pro-Environmental Behaviour

The strong positive correlations found between perceived urgency and pro-environmental behaviours in both the pretest and follow-up support the notion that students who perceive climate change as more urgent are more likely to engage in pro-environmental behaviours. This finding aligns with Langenbach et al. (2019) and Zeng et al. (2020), who emphasize that the perception of climate change as an immediate and pressing issue significantly influences individuals' motivation to take action. The observed relationship underscores the importance of perceived urgency in driving sustainable behaviours, as suggested by previous research (Langenbach et al., 2019). Consequently, educational interventions should aim to emphasize the immediacy of climate issues to foster a sense of urgency, which, in turn, can lead to more proactive environmental actions among students. This is consistent with the theoretical framework that highlights the role of urgency in motivating behaviours that contribute to environmental sustainability. In conclusion, the hypothesis that perceived urgency of climate change leads to more pro-environmental behaviour is accepted.

Hypothesis 8: Increase in Pro-Environmental Behaviour Two to Three Weeks Post-Intervention

Contrary to the hypothesis that pro-environmental behaviour would increase two to three weeks post-intervention, the results indicated a statistically significant decrease in pro-environmental behaviours from the pretest to the follow-up. The game did not effectively increase students' sense of efficacy, which is crucial for sustained pro-environmental behaviour (Abousoliman, 2024). If students do not feel confident that their actions matter, they may be less likely to engage in these behaviours consistently, since self-efficacy is a strong indicator for behaviour (Myers & Horswill, 2006; Norman & Hoyle, 2004). More importantly, students' sense of urgency decreased after the intervention. Since a sense of urgency has been

shown to increase the likelihood to show pro-environmental behaviour (Langenbach et al., 2019), a decrease in sense of urgency can be expected to have a negative effect on pro-environmental behaviour. This was further enforced by the results of the hypothesis that perceived urgency of climate change leads to more pro-environmental behaviour, which was confirmed by the data. Therefore, the decrease in pro-environmental behaviour may be due to limited or unintended effects on other variables like self-efficacy and perceived urgency of climate change.

Limitations of the Study

Despite the valuable insights gained from this study, several limitations should be acknowledged to provide context for the findings and guide future research.

One aspect to consider is the relatively small sample size of 33 participants. While this sample allowed for meaningful exploration within the scope of this study, future research with larger and more diverse samples could further enhance the generalizability and strength of the results. This limited sample may not be representative of the broader population of elementary school students in the Netherlands or other regions. As a result, the findings may not be generalizable beyond the specific group of students who participated in the study. Future research should aim to include larger and more diverse samples to provide a broader understanding of the intervention's impact across different groups.

The duration of the intervention was relatively short, with assessments conducted immediately after the game and at a follow-up two to three weeks later. This limited time frame was necessary due to the scope of the study and limited availability of schools and teachers. Although it provided valuable insights into the immediate effects of the intervention, it may not have been sufficient to observe long-term changes in attitudes and behaviours, since long-term intervention strategies are considered to be more effective in achieving sustained behaviour change (Carr et al., 1999). Longer-term studies are needed to assess the enduring effects of educational interventions on climate-related attitudes and behaviours. Extending the duration of the study and the frequency of playing the game could offer a more comprehensive view of how educational interventions influence climate-related attitudes and behaviours over time.

Some constructs in the study, such as self-efficacy and helplessness, were measured using single-item questions. Although these items came from pre-existing and evaluated questionnaires, single-item measures may not capture the full complexity of the constructs and could lead to less reliable assessments (Fisher et al., 2016; Spörrle & Bekk, 2013). Although outside the scope of this study, future studies should consider using multi-item scales to improve the reliability and validity of the assessments.

Implications

This study adds to the existing body of research on the Growing Greener card game by investigating its influence on students' attitudes and environmentally friendly behaviour, especially among young children. It also reveals essential findings on the effectiveness of climate change educational interventions and offers valuable perspectives for enhancing tools like the 'Growing Greener' game. One key insight is that a high perceived urgency of climate issues positively correlates with pro-environmental behaviour. This suggests that educational interventions may be more effective when they emphasize the immediacy and relevance of climate action, encouraging students to view environmental behaviour as urgent and necessary. This aligns with findings from Langenbach et al. (2019) and Zeng et al. (2020), underscoring that urgency can be a strong motivator for action. A practical implication of this result is that focusing on urgency in educational content is essential for fostering proactive environmental behaviour.

Although the intervention did not significantly increase self-efficacy, it did effectively reduce feelings of helplessness, suggesting that the game can empower students in meaningful ways. This reduction in feelings of helplessness aligns with the idea that well-designed interventions can still mitigate negative emotions even if they don't directly enhance self-efficacy (Berardelli et al., 2019). Therefore, Educational programs should continue to provide actionable steps to help students feel more capable of addressing climate challenges.

Recommendations

One of the key findings was the lack of statistically significant improvement in perceived knowledge, which may be attributed to low engagement levels during the game, as found by a related study by Augustijn (2023). To address this, it is recommended to incorporate more engaging, game-like elements into the "Growing Greener" game. Augustijn (2023) suggests that incorporating elements such as interactive challenges, rewards, and competitive features can enhance student engagement, leading to better retention of educational content. Additionally, Ningsih et al. (2020) highlight that increased engagement through interactive and enjoyable activities can improve attention and learning outcomes.

The game currently focuses on practical tasks, which are valuable for skill development but may not sufficiently convey core climate concepts and theories. To address this gap, it is recommended to integrate more explicit educational content that balances practical activities with deeper theoretical knowledge. Czauderna and Guardiola (2019) argue that combining practical experiences with theoretical understanding can foster a more comprehensive learning experience, helping students to better grasp complex climate change concepts. Providing clear explanations of underlying principles, alongside hands-on activities, could

enhance students' understanding and retention of climate-related knowledge. For instance, alongside hands-on activities like sorting recycling or conserving water, lessons could include discussions about the science of climate change. This combination of action-oriented tasks with foundational climate science concepts may help students understand why their actions matter, deepening their knowledge and reinforcing the purpose behind practical behaviour.

Feedback mechanisms and progress-tracking features could be integrated into the educational card game to enhance its effectiveness in promoting knowledge acquisition. Research underscores the importance of feedback in educational contexts, as it helps learners understand their performance, identify areas for improvement, and retain knowledge more effectively (Benton et al., 2018; Drogaris, 2023; Hill & Nassrallah, 2018). Progress-tracking systems also allow learners to see the impact of their actions over time, which supports motivation and reinforces learning objectives (Borji & Khaldi, 2018). Implementing these elements may make the game a more powerful tool for engagement and knowledge retention.

The short duration of the intervention may have limited its effectiveness in producing long-term changes in attitudes and behaviours. To improve outcomes, it is recommended to extend the duration and frequency of the game-based intervention. Carr et al. (1999) suggest that long-term interventions are more effective in achieving sustained behaviour change. By offering the game over a more extended period with repeated play sessions, students are more likely to internalize the lessons and apply them to their everyday actions.

Finally, the study used single-item measures for constructs like self-efficacy and helplessness, which may not fully capture the complexity of these concepts. Future iterations of the game could incorporate multi-item scales to assess these constructs more reliably. Fisher et al. (2016) and Spörrle & Bekk (2013) suggest that using multi-item scales can provide a more nuanced understanding of student attitudes and behaviours, leading to more accurate assessments of the game's impact.

Conclusion

The primary aim of this study was to determine the extent to which the Dutch elementary school adaptation of the 'Growing Greener' climate card game impacts children's climate change-related attitudes and behaviours. Despite the 'Growing Greener' card game not achieving all expected outcomes, this research underscores the complexity of fostering climate change-related attitudes and behaviour in children. The intervention did not significantly enhance perceived climate knowledge or self-efficacy, nor did it effectively sustain a sense of urgency. However, it significantly reduced feelings of helplessness. The findings highlight the importance of addressing multiple psychological dimensions and providing continuous engagement and feedback. The study revealed a strong positive correlation between perceived urgency and pro-environmental behaviours, suggesting that students who viewed climate

change as urgent were more likely to engage in such behaviours. Although pro-environmental behaviour did not increase overall, this finding points to the need for further refinement of the game.

The "Growing Greener" climate card game shows great potential as an educational tool, and several enhancements could further amplify its impact. By incorporating more interactive elements, the game can become even more engaging, leading to better knowledge retention. Balancing practical activities with enriched theoretical content will help students develop a deeper understanding of climate change concepts. Introducing features for immediate feedback and progress tracking will empower students to monitor their learning and stay motivated. Emphasizing the urgency of climate issues within the game will likely inspire more proactive environmental behaviours. Extending the duration and frequency of the intervention might ensure a more lasting influence on attitudes and actions. Finally, employing multi-item scales for key constructs such as self-efficacy and helplessness might offer more detailed and reliable insights into the game's effectiveness. These enhancements might strengthen the game's educational value and contribute to fostering a more climate-conscious generation.

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Appendices

Appendix A

This appendix shows all 26 translated cards of the Growing Greener card deck.

Table B1

Overview of the Translated Cards in the Card Game

Card Front	Card Back
1. Ga bij een klimaatveranderingsclub op school of in je buurt, of start er zelf één!	Vind vrienden die ook de aarde willen helpen. Bedenk een naam voor je club. Bedenk doelen voor je club. Deze kaartjes geven je al wat ideeën, maar wat kan je samen nog meer doen?
2. Let op lekkende kranen	Een lekkende kraan verspilt meer dan 1100 liter water per jaar. Daarmee kun je 180 keer douchen!
3. Recycle!	Wees een superrecycler door papier, blikjes, glazen flessen, karton, plastic zakjes en flesjes te recyclen!
4. Houd je huis warm in de winter en koel in de zomer door de deuren dicht te houden.	Als je 8 uur lang één schuifdeur een klein beetje openlaat, kan dat je energierekening tot wel 30% verhogen.
5. Schrijf een brief naar mensen die het klimaat kunnen helpen.	Jouw mening doet ertoe! Het schoolbestuur, burgemeesters, leden van de tweede kamer, en zelfs de koning willen weten wat kinderen denken!
6. Loop naar plekken toe in plaats van de auto te nemen.	Als de plek waar je heen wil dichtbij is, kun je lopen in plaats van met de auto gaan. Zo krijg je beweging en bespaar je energie. Dat is altijd goed voor de aarde.
7. Gebruik koud water als je helpt met de was.	Het opwarmen van het water kost energie. De kleren worden net zo schoon in kouder water.

8. Haal de stekker uit elektrische apparaten als je ze niet gebruikt.	Heb jij 'energievampieren'? Dat zijn apparaten en elektronica die kleine hoeveelheden elektriciteit slurpen, zelfs als ze uitstaan. Als je de stekker eruit trekt bespaar je elektriciteit en geld!
9. Doe de kraan uit terwijl je je tandenpoetst.	Als je twee minuten je tandenpoetst, spoel je meer dan 40 liter water per keer door de gootsteen. Door de kraan dicht te draaien, bespaar je enorme hoeveelheden water. Dat water kan onze planeet goed gebruiken!
10. Doe de lichten uit als je een kamer verlaat.	Door het licht uit te doen, bespaar je elektriciteit en de brandstof die nodig is om elektriciteit te maken. Minder brandstof gebruiken betekent dat er minder koolmonoxide en andere broeikasgassen ontstaan.
11. Praat met vrienden en familie over klimaatverandering en zorgen voor de planeet.	Kinderen hebben een superkracht: als je je ouders of opa en oma vraagt om over klimaatverandering te praten doen ze dat!
12. Deel wat je weet over klimaatveradering met familie en vrienden.	De meeste mensen praten nooit met hun familie of vrienden over klimaatverandering. Blijf niet stil. Deel wat je weet!
13. Ga met de fiets naar plekken die niet ver weg zijn.	Fietsen is een leuke manier om beweging te krijgen. Het is goed voor jou en de aarde!
14. Hergebruik. Maak dingen van gerecyclede materialen.	1. Weiger wat je niet nodig hebt. 2. Verminder wat je weggooit. 3. Hergebruik wat je kunt. 4. Recycle wanneer je klaar bent.
15. Lees over klimaatverandering.	Lezers zijn leiders. Kennis is macht. Hoe meer je leert over klimaatverandering, hoe meer je kunt doen om de aarde te helpen.
16. Maak gebruik van het openbaar vervoer.	Lezers zijn leiders. Kennis is macht. Hoe meer je leert over klimaatverandering, hoe meer je kunt doen om de aarde te helpen.

17. Zeg nee tegen wegwerpbekers. Gebruik een herbruikbare beker.	In Nederland kopen we gemiddeld 900 miljoen kleine plastic flesjes per jaar. Door een herbruikbare beker te gebruiken, houd je deze plastic flessen weg van de vuilnisbelt of de oceaan.
18. Maak een wandeling in de natuur of bezoek een natuurcentrum om te leren over klimaatverandering.	Er zijn verschillende natuurcentra in Nederland. Zoek eens naar een natuurcentrum bij jou in de buurt!
19. Eet minder vlees.	Het produceren van één hamburger kost evenveel energie als een kleine auto die 32 kilometer rijdt.
20. Gebruik LED lampjes.	LED-lampjes geven veel licht, maar gebruiken weinig elektriciteit. Omdat er geen kwik in zit zijn ze veel beter voor het milieu. En ze gaan ook nog eens heel lang mee!
21. Hang kleding binnen of buiten te drogen.	Als je je kleding binnen of buiten te drogen hangt, bespaar je de elektricteit van de droger. Ook zullen je kleren lekker ruiken en maakt de zon witte kleren nog witter!
22. Kweek je eigen groeten en fruit.	Het kost veel energie om eten te verpakken en naar winkels te brengen. Als je zelf groenten en fruit kweekt bespaar je die energie.
23. Eet vers voedsel.	Het kost veel energie om eten te verwerken, in te pakken en te vervoeren. Fruit met schil, zoals banenen, watermeloenen en sinaasappels heeft geen verpakking nodig en je kunt de schil composteren.
24. Doneer kleren en speelgoed dat je niet meer gebruikt.	Het maken van kleding en speelgoed kost veel water en stroom. Je kleding en speelgoed kunnen vaak nog lager mee, dus geef ze door aan iemand die het kan gebruiken.

25. Gebruik beide kanten van het papier en recycle oud schoolwerk.	Als je beide kanten van het papier gebruikt, heb je minder papier nodig, en hoeven er minder bomen omgekapt te worden. Bomen geven dieren een thuis, absorberen slecthe dingen uit de lucht en geven ons zuurstof. Eén grote boom zorgt voor genoeg zuurstof voor vier mensen, voor een hele dag!
26. Composteer restjes uit de keuken.	Door te composteren kun je goede mest maken, waardoor andere planten kunnen groeien! Ook zorg je zo niet voor meer afval op de vuilnisbelt.

Appendix B

Pretest Questionnaire

The following appendix shows the questionnaire that was used for the pretest.

Hoi,

Fijn dat je meedoet aan ons onderzoek! Wij zijn Rochelle en Else, studenten aan de Universiteit Twente. Wij doen onderzoek naar een klimaatkaartspel.

Je gaat binnenkort op school dit kaartspel spelen. Daarbij krijg je ook een les over klimaatverandering. We gaan het hebben over wat jij kunt doen voor het klimaat en een actieplan maken. Voordat je het spel gaat spelen, willen we graag weten wat jouw mening is over het klimaat, wat je doet, en hoe vaak je erover praat.

Dankjewel voor het invullen van de vragenlijst.

Je krijgt eerst een paar korte vragen over wie jij bent. We gebruiken dit alleen om te weten welke vragenlijst bij wie hoort.

Wat is je naam?

_____

Op welke school zit je?

_____

In welke klas zit je?

- ○ Groep 6
- ○ Groep 7
- ○ Groep 8

Ik ben een...

- ○ jongen
- ○ meisje
- ○ anders
- ○ zeg ik liever niet

Hoe oud ben je?

De volgende twee vragen gaan over wat je vindt van **natuur en techniek**-vakken.

Vind je vakken over natuur en techniek **moeilijk**?

	Makkelijk	Gemiddeld	Moeilijk
Ik vind vakken over natuur en techniek...	○	○	○

Vind je vakken over natuur en techniek **leuk**?

	Leuk	Gemiddeld	Stom
Ik vind vakken over natuur en techniek...	○	○	○

Hoe vaak doe jij een **experiment** in de klas?

- ○ Meer dan 1 keer per week
- ○ Meerdere keren per maand
- ○ Bijna nooit

De volgende zeven vragen gaan over je **interesse** in het klimaat.

Hoeveel weet je over het klimaat van de aarde?

- ○ Veel
- ○ Een beetje
- ○ Bijna niets

Voel je je hulpeloos als je denkt aan klimaatverandering?

- ○ Heel erg
- ○ Een beetje
- ○ Bijna niet

Maak je je veel zorgen over klimaatverandering?

- ○ Ja
- ○ Af en toe
- ○ Nee

Ben je geïnteresseerd in het onderwerp klimaatverandering?

- ○ Ja
- ○ Een beetje
- ○ Nee

Als je aan klimaatverandering denkt, heb je dan het gevoel dat je er **niks** aan kunt doen?

- ○ Ja
- ○ Een beetje
- ○ Nee

Als je aan klimaatverandering denkt, heb je dan het gevoel dat je er **iets** aan kunt doen?

- ○ Ja
- ○ Een beetje
- ○ Nee

Hieronder zie je een aantal stellingen. De stellingen gaan over jouw **mening**, wat je **doet** en of je over het klimaat **praat**.

Let op: er zijn geen goede of foute antwoorden!

Deze vragen gaan over jouw **mening** over het klimaat. Wat vind je van de volgende stellingen?

	Helemaal niet mee eens	Niet mee eens	Neutraal	Mee eens	Helemaal mee eens
Mensen zouden meer moeten geven om het klimaat.	○	○	○	○	○
Het klimaat is het allerbelangrijkste.	○	○	○	○	○
Ik vind het vervelend als mensen niets doen aan klimaatverandering.	○	○	○	○	○
Mensen maken zich teveel zorgen om klimaatverandering.	○	○	○	○	○
Hoe serieus we klimaatverandering nemen is overdreven.	○	○	○	○	○
Klimaatverandering is een bedreiging voor de wereld.	○	○	○	○	○

Deze vragen gaan over wat je **doet** voor het klimaat.

	Helemaal niet mee eens	Niet mee eens	Neutraal	Mee eens	Helemaal mee eens
Ik probeer geen water te verspillen.	○	○	○	○	○
Ik probeer geen eten te verspillen.	○	○	○	○	○
Ik scheid mijn afval.	○	○	○	○	○
Als het kan, gaat mijn gezin met de fiets of het OV in plaats van de auto.	○	○	○	○	○
Ik doe altijd de lichten uit als ik een kamer uit ga.	○	○	○	○	○
Ik doe mijn computer uit als ik hem niet gebruik.	○	○	○	○	○
Ik probeer energie te besparen.	○	○	○	○	○
Ik vind het belangrijk om goed voor het milieu te zorgen.	○	○	○	○	○

Deze vragen gaan over hoeveel en met wie je over het klimaat **praat**.

	Nooit	Bijna nooit	Af en toe	Vaak	Heel vaak
Ik praat thuis over het klimaat.	○	○	○	○	○
Ik praat op school over het klimaat.	○	○	○	○	○
Ik praat met vriend(innet)jes over het klimaat.	○	○	○	○	○

Dit waren de laatste vragen. Dankjewel!

Appendix C

Posttest Questionnaire

The following appendix shows the questionnaire that was used for the posttest.

Hoi,

Fijn dat je meedoet aan ons onderzoek! Je hebt net een les gekregen over het klimaat en het klimaatspel gespeeld. We willen graag weten wat je van het spel vindt. Daarom vragen we je om de volgende vragenlijst in te vullen.

Dankjewel voor het invullen!

Je krijgt eerst een paar korte vragen over **wie jij bent**. We gebruiken dit alleen om te weten welke vragenlijst bij wie hoort. Daarna krijg je vragen over jouw **gevoel bij het klimaat**. Dit zijn dezelfde vragen als de vragen die je al eerder hebt ingevuld. Als laatste vragen we je **hoe je het vond om het spel te spelen**.

Wat is je naam?

_____

Op welke school zit je?

_____

In welke klas zit je?

- ○ Groep 6
- ○ Groep 7
- ○ Groep 8

In welke groep was je ingedeeld tijdens het spel?

- ○ Groep A
- ○ Groep B

De volgende vragen gaan over jouw **gevoel bij het klimaat**.

Hoeveel weet je over het klimaat van de aarde?

- ○ Veel
- ○ Een beetje
- ○ Bijna niets

Voel je je hulpeloos als je denkt aan klimaatverandering?

- ○ Heel erg
- ○ Een beetje
- ○ Bijna niet

Maak je je veel zorgen over de klimaatverandering?

- ○ Ja
- ○ Af en toe
- ○ Nee

Ben je geïnteresseerd in het onderwerp klimaatverandering?

- ○ Ja
- ○ Een beetje
- ○ Nee

Als je aan klimaatverandering denkt, heb je dan het gevoel dat je er **niks** aan kunt doen?

- ○ Ja
- ○ Een beetje
- ○ Nee

Als je aan klimaatverandering denkt, heb je dan het gevoel dat je er **iets** aan kunt doen?

- ○ Ja
- ○ Een beetje
- ○ Nee

De vragen gaan op de volgende pagina gaan over hoe je het vond om het spel te spelen, en hoe jij je daarbij voelde.

Hoe voelde je je tijdens het spelen van het spel? Beantwoord de volgende vragen.

	Helemaal niet	Bijna niet	Af en toe	Vaak	De hele tijd
Ik voel me anders na het spelen van het spel.	○	○	○	○	○
De tijd leek stil te staan tijdens het spel.	○	○	○	○	○
Het voelde alsof ik niet meer in de echte wereld was.	○	○	○	○	○
Ik vergat waar ik was.	○	○	○	○	○
Het spel voelde echt.	○	○	○	○	○
Als er iemand tegen me praatte, hoorde ik hen niet.	○	○	○	○	○
Ik werd enthousiast van het spel.	○	○	○	○	○
Ik antwoordde niet als iemand iets tegen mij zei.	○	○	○	○	○

Ik voelde niet dat ik moe werd.	○	○	○	○	○
Het spelen van het spel ging automatisch.	○	○	○	○	○
Ik hoefde niet na te denken over hoe ik het spel moest spelen.	○	○	○	○	○
Het spel spelen maakte me rustig.	○	○	○	○	○
Ik had het gevoel alsof ik niet meer kon stoppen met spelen.	○	○	○	○	○
Ik vergat de tijd tijdens het spel.	○	○	○	○	○
Alles wat ik deed ging automatisch.	○	○	○	○	○
Mijn gedachten gingen snel tijdens het spel.	○	○	○	○	○
Ik had langer door willen spelen.	○	○	○	○	○
Ik zat helemaal in het spel.	○	○	○	○	○

Dit waren de laatste vragen. Dankjewel!

Appendix D

Follow-Up Questionnaire

The following appendix shows the questionnaire that was used for the follow-up.

Hoi,

Een tijdje geleden hebben wij, Rochelle en Else, bij jullie op school een les gegeven over het klimaat, en hebben jullie samen het klimaatspel gespeeld. Na het spel heb je twee kaartjes gekozen (klimaatacties) die je wel zou willen uitvoeren.

We willen graag weten of je je klimaatactie hebt uitgevoerd en wat je hier van vond. Ook willen we je vragen hoe je na het spel denkt over het klimaat, wat je voor het klimaat doet en hoeveel je erover praat. Daarom vragen we je om de volgende vragen in te vullen.

Dankjewel voor het invullen!

Je krijgt eerst een paar korte vragen over **wie jij bent**. We gebruiken dit alleen om te weten welke vragenlijst bij wie hoort.

Wat is je naam?

_____

Op welke school zit je?

_____

In welke klas zit je?

- ○ Groep 6
- ○ Groep 7
- ○ Groep 8

Je hebt tijdens het spel 2 kaartjes (klimaatacties) gekozen. Schrijf hieronder op wat er op je 1e kaartje stond:

_____

Heb je dit kaartje met de klimaatactie zelf gemaakt?

- ○ Ja
- ○ Nee

Vul de volgende vragen in voor de klimaatactie die je hierboven hebt opgeschreven.

Hoeveel dagen na het spel ben je begonnen met het uitvoeren van je 1e kaartje (klimaatactie)?

- ○ Dezelfde dag
- ○ 1 - 2 dagen
- ○ 3 - 4 dagen
- ○ 5 - 6 dagen
- ○ Langer dan een week

Hoe vaak heb je je klimaatactie gedaan?

	0 keer	1 - 5 keer	6 - 10 keer	11 - 15 keer	16 - 20 keer	Meer dan 21 keer
In de 1e week na het spel	○	○	○	○	○	○
In de 2e week na het spel	○	○	○	○	○	○
In de 3e week na het spel	○	○	○	○	○	○

Welke klimaatactie stond er op je 2e kaartje?

_____

Heb je dit kaartje zelf gemaakt?

- ○ Ja
- ○ Nee

Hoeveel dagen na het spel ben je begonnen met het uitvoeren van je 2e kaartje (klimaatactie)?

- ○ Dezelfde dag
- ○ 1 - 2 dagen
- ○ 3 - 4 dagen
- ○ 5 - 6 dagen
- ○ Langer dan een week

Hoe vaak heb je je klimaatactie gedaan?

	0 keer	1 - 5 keer	6 - 10 keer	11 - 15 keer	16 - 20 keer	Meer dan 21 keer
In de 1e week na het spel	○	○	○	○	○	○
In de 2e week na het spel	○	○	○	○	○	○
In de 3e week na het spel	○	○	○	○	○	○

Hoe leuk vond je het om je klimaatactie uit te voeren?

- ○ Niet leuk
- ○ Soms niet leuk
- ○ Soms leuk en soms niet leuk
- ○ Best leuk
- ○ Heel leuk

Hoe leuk vond je het om je klimaatactie uit te voeren in week 1, 2 en 3?
Een 10 is super leuk en een 0 is helemaal niet leuk.

	1	2	3	4	5	6	7	8	9	10
Week 1										
Week 2										
Week 3										

Hieronder vind je een aantal stellingen. De stellingen gaan over jouw **mening**, wat je **doet** en of je over het klimaat **praat**.

Let op: er zijn geen goede of foute antwoorden!

Deze vragen gaan over jouw **mening** over het klimaat. Wat vind je van de volgende stellingen?

	Helemaal niet mee eens	Niet mee eens	Neutraal	Mee eens	Helemaal mee eens
Mensen zouden meer moeten geven om het klimaat.	○	○	○	○	○
Het klimaat is het allerbelangrijkste.	○	○	○	○	○
Ik vind het vervelend als mensen	○	○	○	○	○

niets doen aan klimaatverandering.	○	○	○	○	○
Mensen maken zich teveel zorgen om klimaatverandering.	○	○	○	○	○
Hoe serieus we klimaatverandering nemen is overdreven.	○	○	○	○	○
Klimaatverandering is een bedreiging voor de wereld.	○	○	○	○	○

Deze vragen gaan over wat je **doet** voor het klimaat.

	Helemaal niet mee eens	Niet mee eens	Neutraal	Mee eens	Helemaal mee eens
Ik probeer geen water te verspillen.	○	○	○	○	○
Ik probeer geen eten te verspillen.	○	○	○	○	○
Ik scheid mijn afval.	○	○	○	○	○
Als het kan, gaat mijn gezin met de fiets of het OV in plaats van de auto.	○	○	○	○	○
Ik doe altijd de lichten uit als ik een kamer uit ga.	○	○	○	○	○
Ik probeer energie te besparen.	○	○	○	○	○
Ik vind het belangrijk om goed voor het milieu te zorgen.	○	○	○	○	○

Deze vragen gaan over hoeveel en met wie je over het klimaat **praat**.

	Nooit	Bijna nooit	Af en toe	Vaak	Heel vaak
Ik praat thuis over het klimaat.	○	○	○	○	○
Ik praat op school over het klimaat.	○	○	○	○	○
Ik praat met vriend(innet)jes over het klimaat.	○	○	○	○	○

Dit waren de laatste vragen. Dankjewel!

Appendix E

Powerpoint Presentation

The following appendix shows the Powerpoint presentation that was used to guide the intervention.

Figure D1

Slide 1

Figure D2

Slide 2

Figure D3

Slide 3

Note. The slide shows an embedded video about climate change.

Figure D4

Slide 4

Figure D5

Slide 5

Figure D6

Slide 6

Figure D7

Slide 7

Figure D8

Slide 8