Climate Club: A Group-based Game to Support Sensemaking of Climate Actions

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Although information about addressing the challenge of climate change is widely available, many people struggle in making sense of the actions they can take in the context of their everyday lives. We present Climate Club, a group-based role-playing card game designed to help people make sense of the climate actions they can take in relation to the barriers they face. Gameplay involves helping relatable fictional characters in actualising climate actions, by providing alternative solutions that work within their constraints. We describe the game and how it was shaped through iterative playtesting using the tandem transformational game design process. By reflecting on this process and a qualitative study conducted with university students exploring the game's features, capabilities and limitations, we reveal design insights that can be useful for researchers, designers and educators to design and evaluate games, and other purposeful HCI artefacts, for climate action.

CCS CONCEPTS • Human-centered computing • Human computer interaction (HCI) • HCI design and evaluation methods

Additional Keywords and Phrases: Applied game design, Applied games research, Climate change games, Games for change

1 INTRODUCTION

Climate change is one of the major challenges being faced by the world [31, 62]. Addressing climate change depends on multiple stakeholders, their attitudes, values and beliefs [30]. It not only needs global organisations and governments to roll out efficient policies (top-down) but also calls for climate actions to be taken at an individual level (bottom-up) [38]. To enable top-down as well as bottom-up climate actions, various interventions ranging from guideline books [59], comics [61], documentaries [29], and workshops to AR and VR experiences [22, 50] are being used. Through their features such as experiential learning, simulation, visualisation of abstract information and social interactions [51] games have also been found effective for climate change engagement [19]. Climate change games cover a wide range of topics starting from global-level challenges to niche domains like coral bleaching [15, 66]. On one hand games such as The Climate Game [55], KEEP COOL [16] and Daybreak [14] task the player to achieve a net zero future by playing as global leaders while on the other hand, games like World Rescue [64] provide glimpses of contextual mitigation and adaptation actions. Group-based workshops like Carbon Conversations [8], Carbon Literacy Training [27] and Climate Fresk [9] use playful activities to effectively convey the complexities of climate change.

Through such interventions, information about climate change has become widely available, yet many people struggle to transform it into action due to several barriers that hinder pro-environmental behaviours [32]. These barriers include individual needs, desires, assumptions based on misinformation and constraints related to economic, social, cultural and other systemic factors. Taking one's constraints into consideration could help in customising climate actions such that it

becomes feasible and desirable. Climate change games have rarely dealt with climate actions in this manner. Gamified artefacts like GikiZero [25] and GREENIFY [35] encourage players to participate in real-world climate action challenges. A game called 2020 Energy [43] guides its players to choose climate-friendly actions in fictional scenarios. However, they do not account for the player's constraints. Therefore, we decided to explore how games can help people to 'think through' their decision-making in the context of their constraints and climate actions.

We present the design and evaluation of Climate Club, a role-playing game designed using the tandem transformational game design [57] with the central transformation goal of guiding players through a structured process to help understand various ways of taking pro-environmental within the complex constraints of everyday life. We refer to this process as 'sensemaking'. The game has been configured such that it scaffolds players to engage in activities that include reflection on current behaviour, brainstorming alternative actions and critiquing them to find the contextual solutions. By playing Climate Club, people will not only find solutions to the specific scenarios in the game but also experience its embodied thinking process that breaks down the complexities of climate actions without being overwhelmed or confused.

An explorative study comprising 5 play sessions with 18 university students was conducted to evaluate the potentials and limitations of Climate Club. University students undergoing life-course transitions are the key audience of this game as it may help them in transitioning towards sustainable lifestyles. Study sessions involved playing the game, answering a questionnaire and participating in a focus group. The inductive reflexive thematic analysis of the study generated findings informing how the game facilitates sensemaking through group-set up, relatable scenarios, problem-solving mechanics and explicit context of climate change. Our main contribution is in the form of design considerations derived from the study findings that could be useful to researchers, designers and educators working in HCI and climate action fields.

2 BACKGROUND AND RELATED WORK

Climate change has become a universal threat to ecological biodiversity as well as human civilization on Earth [38]. Addressing climate change requires a wide range of solutions to operate at distinct levels and with specific stakeholders. Our research intends to be a part of these solutions locating itself in the context of climate action and university students.

2.1 Climate actions and challenges

The Intergovernmental Panel on Climate Change (IPCC) has identified that to bring down and manage climate change, current economic, technical and sociopolitical systems need to undergo a massive transformation [58]. Citizens are an integral part of these systems and need to develop new skills to take actions that mitigate climate change by limiting greenhouse gas emissions and supporting adaptation to climate uncertainties [45]. Actions associated with climate change mitigation and adaptation are called 'Climate Actions' [60, 31].

Although the information about climate actions has been available, efforts taken at various levels to mitigate greenhouse gas emissions have not changed the situation [53]. One of the major reasons for the indifference, inaction and apathy observed among people related to climate change and climate action is the invisibility of climate change that makes it difficult to connect with the local context and to achieve salience as a problem to be addressed [37]. In addition to this, various systemic, contextual and personal barriers also obstruct people from behaving in pro-environmental ways [32]. Moreover, misinformation and unclarity about whether an individual's actions matter in addressing climate change make people feel demotivated and disengaged from taking climate action [42].

2.2 Climate change games and their potential

The IPCC says that people participate in climate actions only if they are cognitively, affectively and behaviourally engaged with climate change [31, 36]. Games are being effectively used for climate change engagement for the last 3 decades [66]. They enable learning through the shared experiences of active experimentation and exploration [21] which may lead to discovering innovative solutions [20]. Such a creative problem-solving approach is particularly valued in climate change education [39]. Games nurture empathy [1, 7] through their role-playing and perspective-taking activities [24]. Role-playing can elicit emotional responses among players associated with their attitudes, beliefs and motivation [54] and can lead to experiencing higher levels of reflection [28]. Research about player avatars in climate change games [18] reports that adopting distinct identities while playing the game aids in internalising their motivations for taking climate actions along with their values, beliefs, aspirations and capabilities.

Apart from studying the potential of climate change games, researchers have also found areas and attributes of games that are underexplored in climate change engagement. A scoping study [19] has informed that most games frame climate change topics at global levels contradicting the research from environmental psychology that recommend the use of local experiences. Another study has highlighted that climate change games rarely make use of social interactions which is one of the important attributes for climate change engagement [17, 44].

2.3 Games for sensemaking of climate action

We intend to address the challenges involved in taking climate action using the established as well as underexplored potential of games. Games like Solutions (a card game about ranking climate actions as per their carbon emissions) [23], WORLD CLIMATE (a simulation game that tasks its players to role-play as delegates to the UN climate negotiations) [48, 52] and 4Decade (a workshop-based interactive simulation wherein participants collaborate over climate actions as world leaders) [34] have attempted this in the past. While Solutions has not been formally studied for its efficacy, WORLD CLIMATE and 4Decade have been reported effective in enhancing knowledge, affective engagement and curiosity to learn and do more about climate change [48, 52] and engaging co-located groups to discuss and understand the complexity involved respectively [34].

While these games equip their players with a nuanced understanding of climate change and alternative climate actions, they do not account for the individual constraints and barriers that cause hinderance in taking climate actions in real life. Therefore, we set the goal of designing and evaluating a game that enable players to ‘think through’ everyday situations from the perspective of climate change, understanding the capabilities and constraints involved while imagining better alternatives. We were aiming for not only helping people find solutions to the specific problems featured in the game but also guiding them through a scaffolded process of reflection, brainstorming and critique. We framed our research question as “How to design games that can be used as tools for sensemaking in the context of climate actions?” and developed the Climate Club game by referring to environmental psychology, climate change education and communication.

3 CLIMATE CLUB GAME

3.1 Design process

Climate Club was designed using the Tandem Transformational Game Design Process [57] while referring to the Transformational Game Design Framework [12]. These methods were chosen as they support designing games “with the intention of changing players in a specific way that transfers and persists beyond the game” [12].

The design process started with the articulation of the central player transformation as 'players experience applying the skill of sensemaking of climate action in everyday contexts'. By sensemaking, we mean following a structured process involving reflection, brainstorming and critique of everyday situations to understand alternative ways of taking pro-environmental actions within various complex constraints. Our intention was that players of Climate Club will not only find solutions to the specific scenarios played in the game but also experience an effective thinking process that breaks down the complexities of climate actions without being overwhelmed or confused.

We then referred to the literature related to what might enable or hinder sensemaking of climate actions in environmental psychology, climate change education and game design domains to set the design goals that provided broad objectives for game conceptualisation. [Table 1] The game prototypes were playtested in 5 online and in-person sessions over the period of 3 months (Oct to Dec 2022) with the university staff and PhD researchers having expertise in climate change, sustainability, education and game design. We started with 4 distinct ideas and picked the 1 that achieved the transformational goals most comprehensively to develop further. Popular games such as Charades, Pictionary, Cards Against Humanity, Fiasco and 2 climate change games (GREENIFY and 2020 Energy) were referred to for inspiration while working out the gameplay. Another 3-month period (Jan - Mar 2023) was utilised to finetune the game concept through 5 iterative playtests into the final version of the game.

Table 1: Design goals

	Literature Review Findings	Design Goals (Players will …)
1	People need to engage with climate change cognitively, affectively and behaviourally to participate in climate actions [36, 38, 63]	Deal with climate action(s) presented as a challenges with cognitive, emotional and behavioural elements
2	Addressing climate change needs a simultaneous top-down and bottom-up approach of mitigation and adaptation [31, 63]	Work with a range of tasks / challenges that cover the expanse of individual, collective and system-level climate actions
3	Climate change does not receive salience because it is mostly invisible and hard to connect with the local context [19]	Establish connections between global and local causes and impacts of climate change
4	Various systemic, contextual and personal barriers make people question their exact role and responsibility in addressing climate change [32] Confusion about whether an individual's actions matter in addressing climate change leads to demotivation and disengagement [42]	Identify, express and work within the barriers / constraints faced while taking climate actions Investigate existing climate actions in the context of the barriers, imagine new / innovative solutions that follow the constraints
5	Adopting distinct identities while playing the game aids in internalising their motivations, values, beliefs, aspirations and capabilities [18] Role-playing as a relatable character results in higher levels of reflections [28]	Take / consider multiple identities with diverse points of views about the topics of climate action Perform role-play as a character dealing with a situation that is relatable to real life

3.2 Gameplay

Climate Club contains 5 role-play scenarios depicting everyday challenges faced by university students. It is played in groups of 3 to 5 players by taking turns for the number of rounds that equals the number of players. A typical game session with 5 players lasts for an hour. Every round follows 4 steps (Fig 1) wherein one player role-plays a character dealing with a scenario while other players act as helpers suggesting solutions to the role-player. At the end of a round, the role-player rewards tokens to the helpers for the feasibility and innovativeness of their suggestions. The player with the most tokens wins the game.

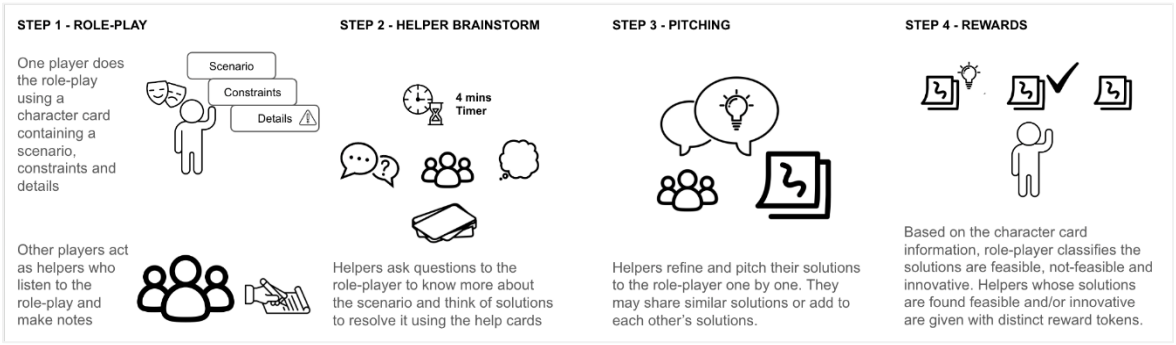

Figure 1: 4 steps of gameplay

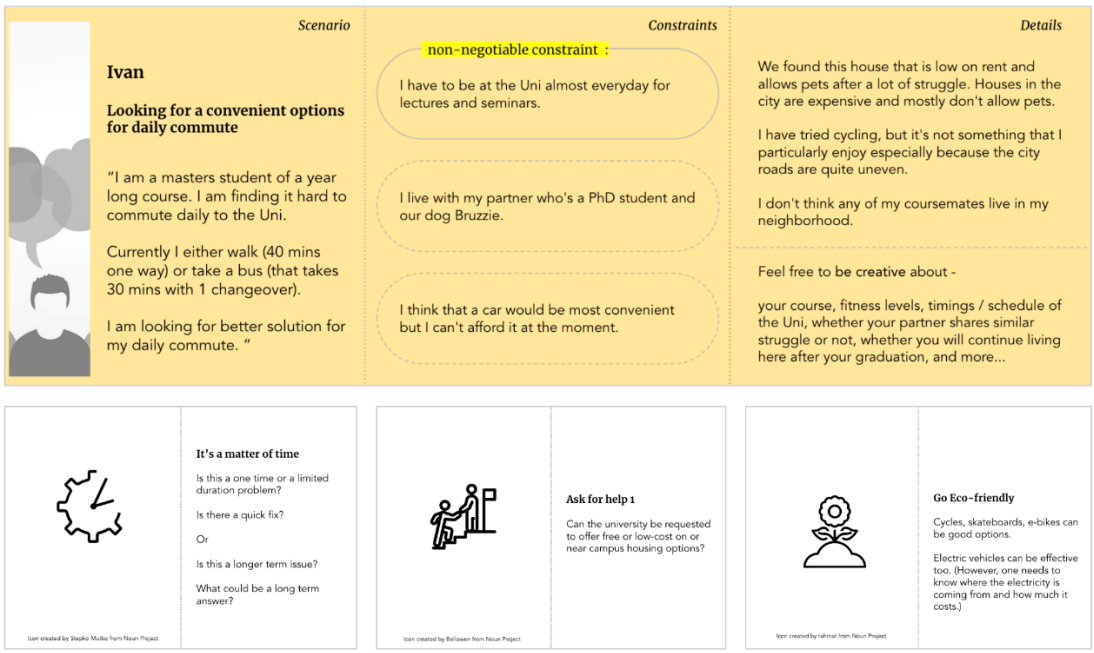

Figure 2: Game elements –character card with scenario, constraints and details along with 3 exemplar help cards

3.3 Game elements

Climate Club consists of 5 sets of Character Cards and associated Help Cards, a 4-minute timer, reward tokens of 2 colours, rulebooks, blank sheets of paper and pens.

3.3.1Character Cards.

The Character Card provides the challenge and constraints of the role-play. It has 3 sections: scenario, negotiable and non-negotiable constraints, and details.

The scenario sections of the character cards present everyday challenges such as finding convenient transportation (commute), planning an eco-friendly vacation (trip), reducing water bills (water bill), effective recycling in shared housing

(recycling), and deciding whether to vote for a vegan menu (vegan or not). These topics were chosen based on high-impact climate actions [47, 67], consumption and carbon emission patterns of university students [56], and sustainability plans of the City of York Council and the University of York [2]. The constraints section presents a list of preferences and/or limitations of the character classified as negotiable and non-negotiable. The negotiable constraints can be modified by the role-player in response to the solutions suggested by the helpers. The details section provides additional information about the character, their situation, likes, dislikes, etc to help the role-player perform well. It also comes handy while judging the solutions during the 'Rewards' step of the game.

While playing, role-players reveal only the scenario and constraints to helpers. The details section is kept secret. In early iterations, only scenario and constraint cards were used as prompts, however, playtesters reported that more information about the motivations of characters would be useful. Personality scales showing characters (indicating characters' value systems about environment, money and time) were tried in the next version and discarded due to their complexity. Finally, the details section was introduced that gave the background of role-playing.

3.3.2Help cards.

Each character card has a deck of help cards associated with it. They differ in number for different character cards. Players playing as helpers are tasked to come up with ideas to resolve the scenario during the 'Helper Brainstorm' step of the game. Although they are expected to do so by themselves, they can access and use the help cards if needed. Help cards contain hints in the form of broad ideas or questions, they do not contain direct solutions. A helper can take one help card at a time, when returned it can be taken by others.

Early prototypes used a shared set of prompt cards (such as 'involve others' or 'consider time factor'). However, they were found generic and unuseful. The prompts were converted into scenario-specific solution cards in the next iteration; however, it reduced the importance of helpers and restricted the number of ideas they could give. However, there was a need for some component that provided hints or rough ideas to ensure participation from the players who did not have experience with the scenario being played. Hence, prompts and solutions were merged in the form of help cards for the final version of the game.

3.3.3Timer.

The helper brainstorming step is restricted to 4 minutes that was decided through iterations. Time limit shortens round duration, increases seriousness of problem-solving, and creates competition between helpers.

3.3.4Reward System.

The game's reward system evolved throughout the design process. The final version uses 2 coloured tokens to reward feasible and innovative solutions. It prunes unrealistic suggestions and establishes smooth transitions between rounds.

Initially, a simple system of either accepting or rejecting a solution was used. It was rejected due to its simplistic nature. A 3-levelled system of good, bad and innovative ideas was tried and rejected as playtesters refrained from labelling ideas given by strangers as bad. The reward system was updated further to feature 4 categories: most innovative, most systemic, clearly unrealistic and solution trap. However, playtesters found four categories as too many and the 'most systemic' and the 'solution trap' badges confusing. Therefore, the reward system was revised to feature only 2 categories.

While testing the final version of the reward system, role-players faced difficulties in deciding the innovativeness of a solution. They often rewarded its badge for the idea that they liked the most. Yet, the system has not been changed because

based on the playtests conducted for finetuning, the rewards tend to become of lesser importance to the players in relation to the motivation and engagement produced by other elements of the game.

4 METHOD

We conducted an explorative study using Climate Club to evaluate how it supports sensemaking of climate action that involved participants playing the game, filling a questionnaire, and participating in a focus group.

4.1 Study design

After receiving an approval from the University's ethics committee, the study took place in the form of 5 sessions facilitated by the first author (researcher). Informed consents were obtained from all participants. Each session was 2 hour-long and comprised 4 parts: introduction, play session, questionnaire and focus group. The questionnaire asked participants to recall and describe key moments from the game, while the focus group gathered diverse views on the thinking process used while playing and potentials and limitations of the game to solve real-world problems.

4.2 Participants

University students were recruited as participants using digital posters circulated via newsletters and social media accounts of various departments. The posters mentioned that the study was about a game related to climate change and included a link to a sign-up form that allowed the participants to register as solo as or as a group of friends. All participants were offered a 10-pound Amazon voucher on completion of their participation.

18 Participants signed up for the study (Mean = 25.66, SD = 4.07) [Table 2]. They were grouped randomly unless they had registered as friends. 2 participants (A02 and C05) had played earlier versions of the game during the iterative playtesting process. Information about participants' degrees and major subjects of the study was used in identifying that 1 participant (E03) had specialised knowledge of climate change due to their degree in Green Chemistry. While recording their gaming experience, it was noted that 4 participants did not play any games while 3 played tabletop roleplaying games, a genre like Climate Club.

Table 2: Participants

Session	Participant	Age	What do they study	What do they play	Role-play
A (2 friends, 1 stranger)	A01	18	Mathematics (Bachelors)	CS: Global Offensive, Chess, Call of Duty	Trip
	A02	32	Education (PhD)	Cardgames, Monopoly, Arcade games	Vegan or not
	A03	24	Applied Human Rights (Masters)	Does not play any games	Commute
B (3 strangers)	B01	24	Film and Literature (Bachelors)	Cardgames, Chess	Vegan or not
	B02	24	Social Media (Masters)	Uno, Poker, Board games, Cardgames	Recycling
	B03	26	Law (Bachelors)	DND: homebrew, Mount and Blade	Trip
C (5 friends)	C01	25	Computer Science (PhD)	DND, Pathfinder, Starfinder, Fantasy TTRPG, Sci-Fi TTRPG	Commute
	C02	25	Computer Science (PhD)	Tabletop RPG	Trip
	C03	27	HCI and psycholinguistics Computer Science (PhD)	JRPGs rhythm, FPS esports	Recycling
	C04	34	Computer Science (PhD)	Strategy, RPG, narrative	Water bill

Session	Participant	Age	What do they study	What do they play	Role-play
	C05	31	Computer Science (PhD)	MMO and RPG	Vegan or not
D	D01	21	Social Media (Masters)	does not play any games	Commute
(4 friends)	D02	31	Social Media (Masters)	League of Legend	Recycling
	D03	23	Social Media (Masters)	League of Legend and similar games	Vegan or not
	D04	22	Social Work (Masters)	does not play any games	Trip
E	E01	25	Creative Technology (PhD)	League of Legends, PUBG	Water bill
(2 friends, 1 stranger)	E02	26	Creative Technology (PhD)	does not play any games	Vegan or not
	E03	24	Green Chemistry (Masters)	MOBAs, team tactic games, Card games, Board games - chess	Commute

4.3 Data collection and analysis

The study data was anonymized and transcribed using the transcription notation system for orthographic transcription [3]. Reflexive Thematic Analysis was chosen to analyse the data as it enables finding patterns in people's perspectives and understandings which is essential to address the research questions of this study [4]. The position of the first author as an applied game designer, freelance writer and an individual striving to pursue a sustainable lifestyle provided a valuable foundation to the analysis. Iterative coding was done using MaxQDA2022. The data items were parsed multiple times to move from low level codes (such as 'climate context is needed' or 'increased empathy with others') to candidate themes (like 'problem-solving using the climate framework', 'effects of relatable scenarios'). The candidate themes were discussed with the second author to develop the final themes that were reapplied to the data to refine and finalise the analysis.

5 FINDINGS

The analysis generated 4 themes that describe how the game facilitated sensemaking of climate actions among its players: 1) Group set-up formed a support system enabling peer learning and self-reflection through structured conversations, 2) Relatable contexts fostered empathy towards affected and created curiosity about alternative actions , 3) Problem-solving mechanic guided creative and critical thinking about climate actions, 4) Climate change context may get overlooked unless made explicit. The analysis also provided insights into functioning of the specific features of the game.

5.1 Group set-up formed a support system enabling peer learning and self-reflection through structured conversations

Group-based play was one of the key attributes of the game that afforded sensemaking of climate action by means of structured conversations, peer learning, and peer-support.

The gameplay facilitated meaningful conversations among the participants. To C05, the game felt *"very much like I was sat down with friends going I've got this problem like and I don't know what to do about it."* Moreover, the game provided dedicated time and space to discuss climate actions that was unlikely to happen otherwise. A02 shared, *"…maybe because it's a game you're more likely to spend some time talking about it (climate actions) if it wasn't, would we give it this kind of time and attention?"*

Being a social game that was *"all about conversations"* (B01), Climate Club functioned as an open platform for its players to share their experiences, thoughts and opinions about climate actions *("it was interesting to hear others open up about their views"* - C04). This often created a structure around the discussions that welcomed diverse points of views (*"sometimes we cannot think the ideas from like different perspectives. So it's good to hear (about) different ways"* - E01).

Through structured discussions and sharing of diverse perspectives, the group set-up enabled peer learning and self-reflection. While reflecting on the game session, A02 said, *"When I heard her pitch (I was) like, oh, that's a good idea. (I) never thought of (it)... some new things I learned from both of them so that was actually quite nice."* Peers helped in correcting erroneous understandings too. In session C, one player pitched a solution that was based on their wrong understanding related to the segregation of waste, however, *"others were able to educate them on it."* (C03) Some participants utilised the role-play scenarios as opportunities to share their attempts, questions, and confusions and sought feedback from others. A01 voiced it as the game helped to *"give (each other) feedback on which ones (climate actions) you already do and how well you are doing to be eco-friendly."* The game also became a reflexive exercise due to its group-based format as others' inputs prompted self-reflection. B01 reported *"I think hearing other people talk about these environmental concerns made me more self-conscious about my actions."*

Group-play made resolving the scenario a collective activity. It formed a support system around the task that would have been strenuous otherwise as D02 mentioned, *"... collective effort definitely feels easier rather than having to do it (deal with the role-play scenario) on your own."* In this manner, the game *"effectively use(d) group's wisdom to solve difficulties."* (E01) However, due to this, the gameplay was largely shaped by the prior knowledge of the players about climate change and climate actions. Therefore, the outcomes of the discussions facilitated by the game depended on the backgrounds and lived experiences of the group members. In session B, B02 was surprised to notice *"How actually a lot of the ideas were quite similar or going towards the same avenue"* due to the shared context of living in the university accommodation among the session's participants. Yet, they further added *"I probably think that with other people depending on what they've been exposed to, the solutions would occur."* Such dependency on the group's collective knowledge creates a risk of spreading wrong information unless the group members are equipped to notice and correct it.

5.1.1Adversities of group-based play

Group dynamics carried two more risks that could adversely affect the gameplay and its outcomes. The game could result in a group-think when the players accepted a certain viewpoint as the consensus of the group irrespective of their own opinions and beliefs. For instance, in session B focus group, referring to strong opinions shared by B01 about institutional climate actions being more impactful than their individual counterparts, B02 said *"I maybe got a bit more relaxed about thinking it's not just my fault … It's very much the bigger picture that will make the difference… while I'm still trying hard it may be not as necessary."*

It was observed that if the group playing the game is made of strangers then it may cause awkwardness and discomfort that may negatively impact the outcomes. Although the discomfort may get resolved as the game progresses, it may refrain participants from fully engaging with the game and hence impact the overall play experience. Similarly, realising that experiences and suggestions that one shares during the game expose their own lifestyle choices may cause a fear of judgement among the players. B03 expressed this concern, *"it's a very personal thing…you're judging people's suggestions on how to live a better life and like I can't really say… for you as an individual your suggestion is actually more suitable... it sort of creates very binary approach to people's existence."* Players feeling conscious in this manner may not play authentically affecting the game outcomes adversely.

5.2 Relatable contexts fostered empathy towards affected and created curiosity about alternative actions

Relatability of contexts encouraged the participants to feel empathetic towards others experiencing climate action challenges. It also generated curiosity about trying out alternative climate actions.

The empathy was felt towards their kins as well as with people exclusively involved in the climate movement such as the activists. For instance, D03 who role-played the 'commute' scenario shared *"One of my friends is living outside of campus … after this kind of role-play I could much more understand how he feels (about his) daily commute."* While thinking about the familiarity and inevitability of constraints A02 said *"I wonder if (this is the) climate activists' frustration half the time because people create these non-negotiable situations and then climate activists have to come up solutions while keeping these constraints in mind."* Feeling empathetic towards others who are directly involved in dealing with the challenges of climate change could create a feeling of solidarity leading to more conscious climate actions.

Dealing with an unfamiliar situation in a relatable set-up generated curiosity. It motivated the participants to imagine alternative futures. While reflecting on the 'vegan or not' scenario B02 said, *"if the university wants to enforce this … how would I feel? … I'll probably accept it I think to begin with I wouldn't be very happy."*

It was observed that the sense of relatability came from past experiences, observations and near-future plans of the participants. Scenarios that closely matched participants' lived experiences were found relatable by them. D04 found the 'recycling' scenario most relatable *"because segregating waste in my apartment is bad.*" Having observed the situations like the ones depicted in the scenarios also led to relatability as A01 mentioned, *"not particularly vegan but I have seen in bars have a vegan option on menus and the vegan like logo being put on products."* Lastly, future plans and dreams made the participants relate with the scenarios as well *("the end of term holiday (scenario was most relatable) because we're now currently considering going out because only dissertation (is) left."* - D02).

5.2.1Adversities of relatability

While participants shared that due to the relatable nature of role-play scenarios they were *"able to bring (their) own experiences into (the game)"* (C03), too much relatability was reported as uncomfortable and affected the gameplay adversely. In a rather special case, C01 shared that *"It feels weird when you're asked to roleplay as someone having the exact same name as you and is experiencing something you have personally gone through as well like a little confusing and disorientating until you make a decision to just play it as yourself rather than pretend to be someone else."*

Another adverse effect of role-players relating too closely with the characters was the confusions about how to play the game. Participants like E02 who were new to role-playing were unsure about how much to behave like oneself while playing the game and how much to improvise. E02 reported, *"When they asked me questions … should I answer like my personality or the personality I have on the card?"* On the contrary, E03 thought that during the reward step of the game one was required to be aware of the distinction between their own self and role-play character to ensure unbiased judgement *"It is important that the player remembers they are role-playing when they decide what constitutes a good suggestion because choosing from the perspective of the player's ideologies and not the role-playing character would introduce bias".*

5.3 Problem-solving mechanic guided creative and critical thinking about climate actions

The problem-solving format of the game guided the players to not only brainstorm alternative solutions but also look at them critically to arrive at the climate actions that suit the given context and constraints.

It was observed across all study sessions that the participants got excited to play the game to win it, however, they started focusing more on solving the problems as the game progressed *"I wasn't thinking about it in terms of a game and further along we got I was more just like how we can solve this problem."* B01. The distinct steps of the game (dealing with understanding the problem, ideating solutions and reviewing them for feasibility) guided the players to look at the multiple aspects of the issues at hand, as A01 shared, *"I was taking into consideration different parts of a scenario one by one and how they affect the environment."* Participants reported that such multi-dimensional thinking can contribute to

conceptualising numerous and novel solutions to the problem, however, it is a skill that needs to be honed. (*"(solutions didn't come) easily to me. (for) the first two, I was quite confident … trying to think of a third or fourth … it was hard. I should probably try to improve how I approach problems … I think the more you play it, the better you would be."* - E03).

Participants reported that ideating alternative solutions was a relatively simpler task for the scenarios that were similar to situations that they have dealt with in the past. E01 who has experienced an energy shortage situation found suggesting solutions for the 'water bill' scenario easy. Prior experience of thinking from climate-friendly perspectives also played an important role in deciding the difficulty level of brainstorming. Lack of experience in thinking from the climate-friendly perspective hindered some participants from suggesting better solutions. *("Even though I travel a lot, I had never thought about how to minimize environmental cost. So, it was quite tough to think about solutions we played on this theme."* - A03)

Although participants often started the brainstorming step by thinking how they would respond to the presented scenario, they would soon realise the need to think beyond the obvious solutions and be more creative in their approach. While talking about the 'commute' scenario, B02 quoted - *"I like to walk that's my first option or if I'm really lazy I'll get the bus from the free stop because I also want to save money. So having those constraints of I don't like walking and I don't want to take the bus I'll start to think what are other options, where it'll both be convenient but also better."*

Participants observed that the common knowledge about sustainability and climate action was also insufficient in properly resolving the scenarios. The game helped them in realising the need for personalising and customising their solutions to the context of the role-player. *("I think there's so much out there in terms of solutions … (you need to) work around things and figure out the route through it all that works best for you"* - B01)

While on one hand the game demanded outside the box thinking about climate actions, it also encouraged the participants to think critically to arrive at personalised alternative solutions that withhold the characters' constraints. (*"I wasn't really convinced necessarily about what I was saying because whenever I was coming up with solutions I could immediately see all the problems and solution and it made me hesitant."* - C03).

There was evidence that reward system based on the feasibility and novelty of the solutions promoted critical thinking among the players. As a result, role-player as well as helper players were observed to be thinking critically. Critical thinking encouraged helpers to ideate across time frames. C02 explained this with an example during the focus group session C, *"Stuff like collecting rainwater (requires) the initial cost. If you're not in space, where you can justify that you probably won't do it, but (in the) long term it would be worth it because you'd be saving more."* Role-players were being critical during the rewards step of the game. B03 who role-played for the 'commute' scenario and received 'skateboarding' as a suggestion recalled thinking from a critical standpoint as *"skateboarding was quite interesting (as a solution).. it felt reasonable but I then imagined … as you get older you don't learn new skills. … all these solutions are completely feasible on paper and until you add in human psychology and culture and it just becomes crashing down."*

5.4 Climate change context may get overlooked unless made explicit

The game empowered players to recognise the underlying climate change context in everyday situations. As A02 said, *"(it is a) practice for solving problems, keeping a climate framework in your mind."*

Participants were able to recognise and acknowledge the climate issues that they otherwise ignored while playing the game. As D02 explained, *"I find it very rewarding when I see scenarios and issues around me that I hadn't thought about. For example, we went on a trip at the end of term and we didn't consider climate change."* E03 who role-played for the 'trip' scenario reported a similar experience, however, with a negative connotation, *"I felt a little bit guilty when I realized that I didn't consider like the impact of like a few weeks ago, I went to (a city abroad) for a few days for like a quick holiday. Yeah. And I didn't consider like my carbon footprint doing that."*

Participants who played as helpers also shared reflections about realising the issues related to climate change in day-to-day settings. For instance, when D03 played the 'vegan or not' scenario, they realised, *"I never thought about the vegan issues before"* Contents on the help cards provided helper players further opportunities to notice climate change challenges in everyday situations like *"it allowed me to consider problems and suggestions that I hadn't considered in regard to the topic before like cutting your hair to reduce water usage"* (E03).

However, it should be noted that these realisations occurred only when the climate context was mentioned explicitly in the scenario. If the scenarios did not depict concerns about impacts on climate change, participants failed to recognise them. As C02 explained, *"I … just wanted to fix the problem rather than thinking of the overall climate impact. The only one that I'd say made me really think about it was the climate friendly holiday. It was basically in the title."* A01 shared similar concerns - *"If it wasn't in the context of eco-friendly, then people would just not consider that (as) an option."*

Along with the ability to recognise the climate issues, the game helped participants to realise that there are multiple ways to be climate-friendly whenever the climate change context was made explicit (*"I had merely linked everyday activities with environmental issues except for food waste, so it was good that I happened to think about it."* A03). It also emphasised that each climate action matters. (*"I think … it's like … small things like … managing your waste, segregating it properly, so that you can recycle it. So, even like the smallest steps matter."* D04) Some participants realised that they already were being climate-friendly in their everyday lifestyle. For example, C03 who shared *"the game reassured me that I do more for climate change than I had realised, so, I was happy."*

6 DISCUSSION

Our research question aimed to explore how games can be designed for the sensemaking of climate action (skill of finding contextually feasible climate actions by reflecting, ideating and critiquing available alternatives under various constraints). We developed and evaluated the Climate Club game to address it. Based on our findings, we present 3 design considerations that can be useful for design and research related to the sensemaking of climate actions.

6.1 Use relatable role-plays to cultivate interest, empathy and self-reflection about climate actions

Role-playing as relatable characters in day-to-day scenarios was one of the key aspects of Climate Club that facilitated sensemaking of climate actions through problem recognition, empathy and reflection. Everyday situations presented in the form of role-play challenges helped players to acknowledge the underlying context of climate change that they usually ignored. This finding reinforces the research reporting role-plays as useful tools for increasing interest in climate actions [39] and role-plays being effective in climate change education [49].

Applied games researchers have encouraged designing local context-based games that make use of real-world-like situations to create play experiences that are relatable to the players [46]. In Climate Club, all role-play characters had their own set of constraints depicting the capabilities and limitations of individuals derived from the real world. Players found them quite relatable. The sense of relatability enabled them to connect the role-plays with either themselves or the people they knew struggling with similar challenges and constraints. It has been established that empathy stimulated by games can encourage pro-social and pro-environmental actions in real life [5].

Players were also seen reflecting on their own lives in relation to the role-plays performed in the game. This observation supports the finding that by role-playing as a relatable character in a relatable and relevant context players can achieve higher levels of reflection in games [28]. However, since the game involved designing and choosing the character being role-played, it created confusion among some players about the boundary between their real personality and the role-play character. They were unsure about whether to respond to a solution (suggested) as themselves or as the character they were

role-playing. In groups where players know each other, players playing as helpers could make use of such confusion of the role-player by proposing solutions that align with their values to garner more points. However, this would negatively impact game outcomes and hinder individual reflection. One of the ways to mitigate this issue could be to avoid asymmetric role-play where only one player was enacting a persona while others played as themselves. Giving role-play personas to all players may construct a stronger game world eliminating the confusion about personalities. In addition to that, novice players can be first made comfortable with role-playing using simpler characters prior to the actual game session to introduce them to the concept of improvisation. It might also reduce the fear of judgement among the participants as reported in the focus groups as all participants will be involved in role-playing.

Based on this insight, a variation of the game could be designed that asks the players to create role-play challenges based on their own experiences and constraints anonymously and use them as the character cards for the game session. It would be valuable to explore how such a game will be played and the takeaways it will generate. To emphasise reflection, the gameplay can include specific instances for the players to recall the game played so far and reflect on it. Although such 'reflection points' may impact the flow of playing, they might work as debriefing moments enhancing the overall impact of the game. A dedicated player action related to listing and sharing individual learning can also be added in a moderated version of the game to increase the immediate utility of the game. Digital versions of the game can also be explored with AI-based chatbots performing role-plays and all players acting as helpers provided, they are designed and developed following ethical and sustainability guidelines. It might remove the role-play-related confusion altogether. However, it might also reduce the enjoyability of the game as it takes away the fun of role-playing.

6.2 Support players in applying design thinking to generate effective climate solutions and real-world takeaways

Through its problem-solving mechanic, the game focused on the helper players who were ideating and suggesting personalised climate actions to the role-player. Research in environmental psychology suggests that being able to imagine cognitive alternatives to the established patterns of actions can contribute to engaging in pro-environmental actions [65]. In the game, helper players first employed creative thinking to conceptualise multiple suggestions and later thought critically to tailor them to the character's constraints. We think that in this way the game followed a process akin to design thinking, enabling bottom-up ideation of solutions that complemented the limitations, values and desires of the characters instead of top-down impositions [6]. Design thinking provides a user-centred way of problem-solving through cycles of diverging by brainstorming multiple ideas and converging by refining a few of them [41]. This approach has already been found effective in fostering sustainability through climate actions among university staff and students [33]. We think that games like Climate Club can become more impactful by accommodating and supporting design thinking in a better manner.

One of the areas to support design thinking in the game could be players' connection with the context of the role-play scenarios. Participants reported that if they had experienced situations similar to the ones being dealt by the role-play characters, they were able to conceptualise and propose the solutions easily. On the other hand, a lack of real-life experiences or awareness about challenges associated with climate actions also restricted some participants from contributing holistically to the game. This highlights the need for situating games like Climate Club in the context of their intended audience to support impactful design thinking. Studying and understanding the audience demographics can help in crafting relatable scenarios. Players with little or no prior experience can benefit by introducing auxiliary information components or experience packs before and during the game session to refer to. Another way to address this issue could be to collect data about the collective climate action experience of the players through interviews or surveys to customise the game for them. Experts like environmental educators and climate activists can be involved in designing the scenarios

based on such data using dedicated tools or guidelines. However, this might be impractical for most contexts of playing the game as it will require forming groups and collecting data prior to the actual play session.

Looking through the lens of design thinking, the divergent thinking required to be done in the brainstorming step of the game was deemed difficult in various study sessions. If the participants had not thought about the role-play scenario from the perspective of climate change and its impacts, they would have been unable to frame the problem correctly and hence, ideate any useful solutions. Contrastingly, if the scenario resembled situations that the participants had failed to resolve in their real lives then too, they were seen getting stuck in the brainstorming step. To resolve these difficulties, the game may include sub-steps or rules that scaffold divergent thinking such that the players can iterate and develop their initial unuseful solutions into richer innovative concepts. It might also be beneficial to include prompts or directions to guide divergent creative thinking from multiple dimensions.

The convergent thinking aspect of design thinking being followed in the pitching and rewards steps of the game can also be improved to make the game outcomes objective and efficient. The current version of the game heavily relied on the role-players' knowledge of climate actions and understanding of the scenario for deciding the feasibility and efficacy of the solutions proposed by the helpers. Therefore, participants who lacked knowledge about the fundamentals of climate change and its impacts were not able to gauge the solutions proposed to their role-plays properly. It was also observed that the players gave points for feasibility and innovation based on their own interpretation of the same. These issues can be addressed by providing a 'decision framework' for each role-play character that will guide and reason the solution selection by the players. A digital tool based on carbon footprint calculators can also be added to the game to judge the solutions proposed with scientific accuracy. Games such as Solutions [23] can be referred for inspiration to turn the reward step into a mechanic that evaluates the climate actions based on carbon emissions they produce.

The solutions generated as an outcome of the design thinking process could be useful as real-world takeaways to the participants. However, it was observed that the participants had polarising opinions about such real-world utility of the solutions. Some participants found the solutions inspiring and useful to follow in their real lives while others questioned their practicality. Some of the solutions were found unuseful in hindsight during the focus group. The game outcomes can be improved in a dedicated focus group or a debriefing component that evaluates them as real-world takeaways. In education theory, such debriefing is considered essential for experiential learning [11]. It may include exercises like working with a scenario from players' real lives using the game-like method to explore whether any solutions can be found.

6.3 Enable peer learning and perspective sharing via structured conversations about climate actions by curating player groups

Although research [40, 10] has recommended using social interactions to foster support and trust among the audiences of artefacts intended for climate change communication and education, analysis of existing climate change games has shown that the social or multiplayer attributes of such games are underexplored [19]. When we evaluated the impacts of social attributes through Climate Club, we found that these attributes led to peer learning and perspective sharing.

We observed that group-based play facilitated peer learning. Players were seen analysing and evaluating the role-play scenarios with each other in the discussions prompted by the game. They shared their own experiences and observations about alternative solutions during the brainstorming and pitching steps. Players who were well-versed in climate change knowledge shared some information that they could recall about the scenario such as its causes and its solutions with the group. At times they also critiqued and corrected erroneous solutions suggested by others. There is evidence that sharing such experiences and knowledge can contribute to getting better at climate action. A study about stakeholders involved in

household energy advice underlines that personal experience and tacit (procedural) knowledge significantly improve the abilities needed for understanding and managing energy use [13].

Players reported that structured conversations that occurred while playing helped them to open-up about confusions and questions related to situations similar to the scenarios being played and even exchange feedback on climate actions they take in their real lives. Research in climate change education has established that such wholesome discussions help the group members move further in their climate awareness journeys [39]. The game was not specifically designed to enable these discussions, however, to enrich them further, explicit steps that ask players to share personal experiences, climate actions, doubts or confusions related to the scenarios being role-played could be added to the rules.

The discussions held during the game showcased different perspectives of the players. Diverse viewpoints led to the generation of a wide range of climate action ideas. However, some study participants debated whether the competitive nature of the gameplay made the ideation inefficient. There could be an alternative version of the game that focuses on and enhances the perspective-sharing element by asking helper players to first ideate the solutions individually and then build over each other's concepts to provide refined and efficient suggestions for the role-player.

It should be noted that peer learning, structured conversations and perspective sharing were not observed uniformly across all study sessions because of various challenges that the group setup created. Playing the game with a group of strangers carried the issues of feeling awkward and uncomfortable. Ideation of solutions was completely dependent on the group members' prior knowledge of climate actions. The groups that lacked such knowledge did not have any information, experiences or opinions to offer to each other. Such groups carried a risk of establishing incorrect understandings about climate actions which would be fully counterintuitive to the objective of this research. In groups that were dominant included members having strong opinions and personalities, the game leaned towards becoming a group-think that accepted the dominant point of view as their consensus. These findings were aligned with research stating that homogenous groups are more likely to settle on an agreement than debate over distinct perspectives [39].

To tackle these challenges, the player groups can be curated by the moderators or organisers. Players can be profiled using 'climate awareness scale' questionnaires such as the [26] and the groups can be formed based on players' backgrounds and awareness levels. A dedicated knowledge component might also be added to the game like a short video or a comic book that all players can go to before playing the game to ensure that all participants have at least some knowledge of climate actions. Although help cards were seen to be doing this job in the current version of the game, accessing them was bound by the rules.

To further explore the potentials of social interactions in climate change games, alternate versions can be designed and evaluated such as a game that is played online by a group of remote players or a game played asynchronously wherein the players can play in their own comfort of time and place to contribute to a virtual group. Longitudinal impacts of group-based play also can be explored by making the same group of players play for multiple scenarios over a period of time or by letting the players mingle between the groups while playing for multiple scenarios across multiple play sessions.

6.4 Limitations of the study

The study design involved 3 limitations that may have impacted the findings. 1) Knowing that the researcher is the designer of the game, participants' feedback and responses could have been biased. The researcher has attempted to mitigate this by emphasising the importance of honest feedback while moderating. 2) While the data from the groups containing participants who were strangers to each other may carry a social bias impact the overall gameplay, groups consisting of participants who were friends with each other may also carry a bias affecting the rewards stage of the game. However, since the analysis focused on the process of sensemaking that occurred during the game rather than the exact information

shared or the solutions rewarded, there is little risk of these biases affecting the analysis. Yet, we acknowledge them as potential challenges of a group-based game and would explore them in our future work. 3) We acknowledge that this study did not have a longitudinal component that might be beneficial, especially in exploring whether and how playing the game leads to transferable 'sensemaking skills' among players. We plan to work on in the future.

7 CONCLUSION

Our research intended to explore how to design games that can be used as sensemaking tools of climate action. We followed the tandem transformational design process to iteratively develop the Climate Club game and studied it exploratively. The study findings helped us understand how the game (through its group set-up, relatable scenarios, problem-solving mechanic and explicit climate change context) facilitated sensemaking. We have articulated our learning in the form of design considerations that recommend using role-plays to foster curiosity, empathy and reflection among players, crafting the gameplay around design thinking to generate effective alternative solutions, and curating player groups to enable peer learning and perspective-sharing. We believe that these would be useful not only for improving our game but also for designing and studying other games related to climate action and sensemaking. Future research can garner more insights by adding a post-study survey component and by studying the longitudinal effects of playing games like Climate Club repeatedly on players' sensemaking skills in real life.

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