Digital Games to Develop Empathy in Students: A Scoping Review

Radhika Amashi, Preethi Baligar, and Vijayalakshmi M
KLE Technological University
radhika.amashi@kletech.ac.in

Abstract

Context

Empathy is developed in learning contexts where the learner is familiar, similar, and proximal to the protagonist, which often poses a challenge in designing learning environments. Although technology can bridge the gap between learner and the context, research in this area is still in its infancy. Games and virtual reality, is frequently used to develop empathy and empathetic behaviors in medical, nursing, and allied health students. In line with this, Researchers suggest that digital games can aid educational institutions in fostering empathy among students.

Purpose or Goal

This study aims to identify the games, the crucial elements that influence game design for empathy development, and how the elements map to the three dimensions of empathy: cognitive, affective and behavioral.
Also, we present simple scenarios where the game can be redesigned to develop competency for engineering problem-solving by situating participants in different case studies, past, present, and futuristic.

Methods

This proposed study is a scoping review of the Scopus database for articles between 2013 and 2023. Based on the five-step methodological framework, 17 articles were included in the review.

Outcomes

It is observed that narration, immersion, and interactivity play important roles in empathy development while supporting other game elements like role play, decision making, character identification, rules/tasks and challenges to develop empathy at different dimensions (cognitive, affective and behavior).

Conclusion

Combined with others, game elements like narration, immersion, and interaction contribute to different dimensions of empathy development. Further research is needed to establish a precise correlation between these elements and empathy dimensions, but the framework offers valuable guidance for game designers and researchers in this area.

Keywords— Empathy, digital, virtual, simulation, video games, technology-enhanced learning, gamification.

I. INTRODUCTION

Empathy is a social phenomenon defined as "the ability to sense other people's emotions, coupled with the ability to imagine what someone else might be thinking or feeling and compassionately take appropriate action" (Knezek et al., 2022), (Wulansari et al., 2020). Irrespective of the domain, empathy manifests itself in three dimensions: cognitive, affective, and behavioral. Cognitive empathy, also known as perspective-taking, involves consciously trying to understand another person's emotional state or point of view. Emotional empathy is the unconscious emotional response to someone else's emotions. The third dimension called behavioral or motivational or compassionate empathy, refers to the action in response to someone else's feeling (Boltz et al., 2015) (López-Faican & Jaen, 2023). Empathy has recently been promoted as the desirable outcome (Knezek et al., 2022), leading researchers and instructors to develop curricular interventions for fostering empathy in engineering education (Preethi B et al., in press).

The relationship between empathy and the use of technology has been researched since 1980. This association is complex as the development or decline of empathy due to the use of Technology depends on how much and in what way the Technology is used (Knezek et al., 2022). Among other technological tools, online chat, video chat, simulations, and video games (Wulansari et al., 2020) have demonstrated the potential to promote empathy as they let players become immersed in the situation and participate.

Digital games, once primarily seen as sources of entertainment, are now recognized as powerful tools that can engage players on emotional, cognitive, and social dimensions (Yusoff et al., 2018) (Wulansari et al., 2020). By immersing players in diverse and complex virtual worlds, digital games offer unique opportunities to experience different perspectives, confront challenging scenarios, and practice empathetic decision-making in a safe environment (López-Faican & Jaen, 2023). Empathy is developed in learning contexts where the learner is familiar, similar, and proximal to the protagonist, which often poses a challenge in designing learning environments.

In today's increasingly interconnected and diverse world, engineers are tasked with solving technical challenges and understanding and addressing the needs, perspectives, and emotions of a wide range of stakeholders. While researchers are designing frameworks, courses, and interventions to develop empathy (Walther et al., 2017), integrating digital games to foster empathy in engineering education holds great promise and is at its infancy.
By immersing engineering students in virtual scenarios, they must navigate complex ethical dilemmas, consider the impacts of their designs on various communities, and make empathetic decisions. This helps engineers contribute positively to society

by creating solutions that align with the diverse needs and emotions of the people they serve.

As technology advances and game designers harness the potential of immersive storytelling and dynamic character interactions, researchers highlight that digital games can support educational institutions to develop empathy in students(Chan et al., 2023) (Yusoff et al., 2018). Therefore, this study aims to explore different games and how digital games are used to develop empathy in undergraduate students through a scoping review. Section II discusses the scoping review process followed for this study. Section III discusses the synthesis and discussion of the study followed by the conclusion and future scope.

II. METHODOLOGY

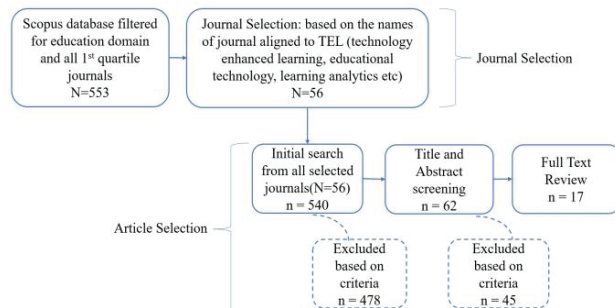(Arksey & O'Malley, 2005) five step methodological framework is used for the scoping review.

Fig. 1. Selection Process

1) Identifying the research question: This study aims to answer the following research questions:
   - *RQ1: What games are designed to develop empathy?*
   - *RQ2: What elements of game design are important to promote the development of empathy in students?*
   - *RQ3: How do the elements of game design map to the three dimensions of empathy: cognitive, affective, and behavioral?*
2) Identifying relevant studies: The authors followed the steps below to identify the suitable studies. Fig.1 shows the Flow chart for searching and filtering process.
   a. Top 25% of journals on technology-enhanced learning and its related journals indexed in the Scopus database were selected, resulting in 56 journals.
   b. Search String: All these selected journals were searched with the string empath* AND (digit* OR simulat* OR video* OR virtual*) AND game* for 2013 to 2023, resulting in a total of 540 articles.
3) Study selection: The selection of articles was done in two stages. The first stage selection was done by reading the paper titles and the abstract. The article was selected or rejected based on inclusion-exclusion criteria. The second stage selection was done by reading the full paper and charting the data.

Inclusion: The criteria for inclusion in this study encompass a range of factors crucial as listed below:
1. The studies must describe the design of games for empathy development by focusing on either of the mechanisms for empathy development: perspective-taking, responsible decision-making, empathetic concern, socio-cognitive skills, and socio-emotional skills
2. The games described in the studies must be grounded in existing game design theories.
3. The games must include elements like immersion and narration.
4. Furthermore, studies related to the development of empathy within pre-service teachers and teachers, and within the contexts of fields/courses related to literacy, history, drawing, and addressing contemporary issues like cyberbullying are considered.
5. The game must be technology-based.

Exclusion:
1. Papers situated within the domain of medicine or relevant fields are excluded, as the primary focus is on empathy using games within an engineering educational context.
2. Constructs such as curiosity, interests, intercultural competence, and gender equality, fall outside the defined parameters and are thus not considered.
3. Research involving participants classified as specially challenged students is excluded.
4. Studies centered on gamification without technological integration are excluded, given the emphasis on game elements like immersion and narrative.
5. Finally, the utilization of robots or Artificial Intelligence (AI) for Social Emotional Learning (SEL) competencies is excluded, as this study specifically explores the efficacy of Augmented Reality (AR) and Virtual Reality (VR) games.

Collectively, these exclusion criteria ensure that the selected research aligns closely with this study's intended focus and objectives.
4) Charting the data: The data from the articles is charted into an Excel sheet to identify different contexts, scope of studies, research questions, game design elements, a technology used for game design, definitions of empathy and its components, and so on.
5) Collating, summarizing, and reporting the results: The collated data is analyzed and reported in the paper's results section.

III. RESULTS AND DISCUSSION

This section presents and discusses the results of the study. Figure 2 shows the increasing trend of articles on technology-
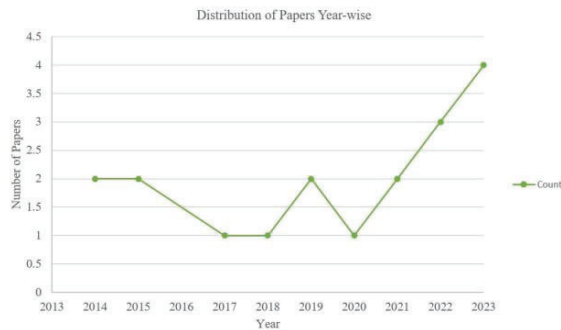
Fig. 2. Year-wise count of paper

Fig. 3. Country-wise count of paper

based empathy development from the year 2020. This coincides with the Covid-19 pandemic, during which all educational institutions were forced to leverage technology for teaching and learning. Figure 3 shows the distribution of papers across different countries. The USA, Spain, and Singapore have used gaming for empathy development.

A. What games are designed to develop empathy and their suitability for engineering problem-solving?

This research question is answered through Table I, which shows names and descriptions of different games that have the potential to develop empathy in students. A total of 13 games were identified, where one of them (Rector-Aranda & Raider-Roth, 2015) did not mention the level of empathy being catered through the games.

The diverse selection of games discussed in this study offers a nuanced perspective on using digital platforms to cultivate empathy across various age groups and contexts. Synthesis of this study shown in Table I also highlight that empathy development through games has been focused on participants aged 6 to 22.

The game "Com@Viver" is an example of how games can intentionally evoke empathy (Ferreira et al., 2021) by immersing players in a school context and presenting them with cyberbullying scenarios and bystander responses. The game aims to stimulate emotional engagement and empathetic concern among adolescents. This game presents pointers for developing scenarios of real-world problem for engineering problem solving. These scenarios are interdisciplinary, complex and ill-structured problems that can be situated in different countries and cultures to highlight that engineering is not the context-free application of technical knowledge (Hoeborn & Bredtmann, 2012).

Similarly, "Conectado" (Calvo-Morata et al., 2020) takes an educational approach, simulating a high school student's experience with bullying and harassment (Calvo-Morata et al., 2020). It fosters empathy in adolescents by emphasizing seeking help, making choices to change outcomes, and teaching strategies to prevent victimization and bystander involvement. Additionally, this game is valuable for engineering ethics and sustainability development, as it encourages students to address
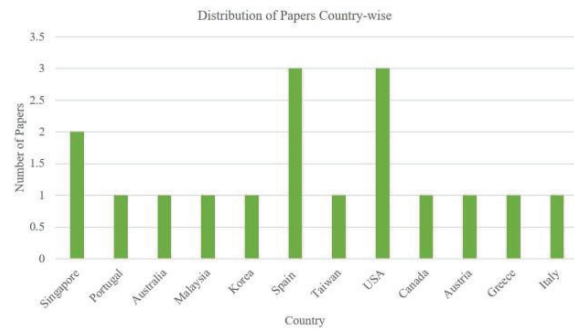
dilemmas in practice (Voss, 2013). It presents scenarios from different stakeholder perspectives and environments, prompting students to assess how solutions impact people, the planet, and profit.

The results also highlight that empathy-building extends beyond contemporary contexts. Games like "The Battle of Yiwei" (Chan et al., 2023) and "Kokoda VR" (Calvert & Abadia, 2020) take players into historical narratives, offering opportunities to empathize with characters' challenges and struggles, effectively fostering historical empathy, which is to understand the ideas, feelings, experiences, decisions, and acts of people in the past within certain historical circumstances (Karn, 2023). As these games focus on historical empathy, the players can be placed in several historical case studies related to the engineering profession, like the first bridge/dam construction, computers, to driverless cars, along with the constraints of that time, to enable players to appreciate the growth and progress of engineering and the technological, social and economical affordances that they need today to make rapid advances (Young et al., 2021).

Games such as "Why Did Baba Yaga Take My Brother?" (Muravevskaia & Gardner-McCune, 2023) demonstrate how virtual reality can provide an interactive and imaginative platform for instilling empathy and problem-solving skills in children.

Furthermore, the game "EmpathyAR" creatively utilizes augmented reality to provide tasks that involve helping virtual characters in distress (López-Faican & Jaen, 2023). By encouraging players to seek solutions and aid these characters, the game prompts individuals to step into others' shoes and experience empathy through action, offering a unique approach to empathy development. This game appears apt for courses that focus on disaster management in engineering as they focus on

The "Mysterious Museum" game adeptly tackles both cognitive and affective empathy, with a primary emphasis on nurturing cognitive empathy by fostering an understanding and acceptance of differing perspectives. This concept, referred to as self-other differentiation, plays a pivotal role in enhancing empathy development and positively impacting one's ability to

TABLE I
SUMMARY OF GAMES FOR EMPATHY AND TECHNOLOGY USED

S.No	Name of the Game	Description	Technology/Platform	Age Group
1	Unknown (Tan et al., 2022)	Game depicts an incidence of bullying in school in which the protagonist experienced being physically harassed and victimized online.	Immersive Virtual Environments	15
2	Com@Viver (Ferreira et al., 2021)	The game immerses players in a school context, interacting with profiled social agents to organize a field trip, including cyberbullying scenarios with bystander responses, aiming to evoke empathy and empathic concern based on theoretical models.	Web based interface	12 to 14
3	The Walking Dead (PC game) and The Last of Us (PS3 game) (Toh & Lim, 2022)	The Walking Dead (PC game) and The Last of Us (PS3 game) both feature protagonists navigating post-apocalyptic worlds alongside young companions (Clementine in TWD and Ellie in TLOU), one set in a zombie-infested universe and the other in a world transformed by a mutated fungal infection.	PC game	15 to 24 (youths)
4	Kokoda VR and the Kokoda 360◦ video. (Calvert & Abadia, 2020)	Kokoda VR offers students a immersive narrative experience, placing them at the heart of the historic Kokoda Track campaign during World War Two, condensing key events while maintaining historical accuracy and alignment with the Australian curriculum.	Virtual Reality	12 to 18 (high school)
5	Mysterious Museum game(Jeon et al., 2023)	Player solves various puzzles based on ambiguous images and three-dimensional models.	Virtual Reality/Unity and XR Interaction Toolkit	22 to 32
6	Conectado(Calvo-Morata et al., 2020)	The video game simulates a high school student's experience facing bullying and harassment over five days, emphasizing the importance of seeking help, altering dialogue choices to impact outcomes, while also teaching strategies to prevent victimization, bullying, and bystander complicity.	Unity 3D	12 to 17
7	The Battle of Yiwei (Chan et al., 2023)	This game situated in the context of the 1895 Yiwei War in Taiwan, where players assume the role of a militia leader fighting against the Japanese army alongside numerous Taiwanese people.	Online Role-Playing Game/Gather Town and Google Jam board	22 to 55
8	EmpathyAR (López-Faican & Jaen, 2023)	Game takes players through series of tasks where the player must locate and provide assistance to different individuals, each with unique needs and potential solutions, such as seeking support from friends, offering medical aid, or securing resources.	Augmented Reality/Unity Engine	12 to 15
9	''Why Did Baba Yaga Take My Brother?'' (Muravevskaia & Gardner-McCune, 2023)	Players must watch their younger brother, but a magical swan geese abduction sends them on a quest through an enchanted forest to rescue him.	Virtual Reality	6 to 9
10	JCAT and Place Out ofTime simulation (POOT) (Rector-Aranda & Raider-Roth, 2015)	This game is a web-mediated simulation designed for middle school classrooms where students take on roles of various characters throughout the world, history, and literature to address an imaginary court case.	Simulation	11 to 14
11	Nintendogs (Tsai & Kaufman, 2014)	Player pet a dog and use various items that can be found or purchased, such as balls, frisbees, toys, and grooming supplies, all designed to keep the dog happy.	Simulation Video Game	9 to 11
12	Path-Out(Wulansari et al., 2023)	This is an autobiographical adventure game where players follow the journey of Abdullah Karam, a Syrian artist who escaped the 2014 civil war. Disguised as a Japanese RPG, the game offers surprises, challenges, and humor,	Video Game/Unity 3D	18 to 22
13	Unknown (Di Tore, 2014)	In the first task, players must identify the man whose perspective is displayed while changing viewpoints. In the second task, they select the correct viewpoint window with one man present, and the third task involves choosing a park area based on a hidden man's perspective shown at the top.	Video Game/Unity 3D	Unknown

empathize with others (Jeon et al., 2023).

"Path-Out" is an autobiographical game that employs narrative elements to immerse players in the protagonist's life story. It utilizes gaming elements to provide players with a firsthand experience of the journey of a young Syrian artist who escaped the civil war in Syria (Wulansari et al., 2023). This game and "Mysterious Museum" game appears suitable and can be used to communicate the need for human-centred design.

Give a design say, a coffee mug or a cell phone, and the participant needs to redesign it for a person with upper limb disabilities. They can also be used to track the daily lives of people suffering from disabilities and develop products to ease their everyday challenges.

JCAT and its counterpart, Place Out of Time (POOT), are educational simulations for schools, fostering skills like critical thinking, empathy, and communication. One scenario presented

TABLE II
GAME ELEMENTS USED TO DEVELOP EMPATHY

S.No	Name of the Game	Level of Empathy	Game Elements
1	Unknown (Tan et al., 2022)	Cognitive, Affective and Behavior	Scenario, Role Play, Decision Making
2	Com@Viver (Ferreira et al., 2021)	Cognitive	Interaction, Feedback
3	Mysterious Museum game (Jeon et al., 2023)	Perspective taking	Scenario, Control, Interaction
4	Conectado (Calvo-Morata et al., 2020)	Behavioral and Affective	Immersion, Character Identification,, Player`s Choice, Decision Making, Scenario
5	The Battle of Yiwei (Chan et al., 2023)	Affective Connection, and Perspective Taking	Player`s choice, Character Identification, Planning, Feedback and Suggestion, Challenges, Immersive and Interactive
6	Empathy AR (López-Faican & Jaen, 2023)	Cognitive, Affective Behavior	Play, Rules, Scenario Interface, Tasks
7	''Why Did Baba Yaga Take My Brother?'' (Muravevskaia & Gardner-McCune, 2023)	Cognitive, Affective and Behavior	Story, Interaction, Challenge, Hints, Character Identification
8	JCAT and Place Out of Time simulation (POOT) (Rector-Aranda & Raider-Roth, 2015)	NA	Research their characters (Character Identification), Post biographies, Speeches and Comments as their character (Tasks/Rules), Role Play.
9	Nintendogs (Tsai & Kaufman, 2014)	Cognitive and affective	Player`s choice, Interaction, Rewards
10	Path-Out (Wulansari et al., 2023)	Cognitive and Affective	Story, Player`s Choice, Role Play, Character Identification), and Tasks.
11	Unknown (Di Tore, 2014)	Perspective taking	Interface, Tasks, Feedback

to player were simulated trial on reparations for SS. St. Louis passengers' descendants denied entry to the U.S. Another was on the debate over religious ornamentation in French schools, with Jewish and Muslim students advocating for their right to wear religious headwear (Rector-Aranda & Raider-Roth, 2015). This game can be used to integrate real engineering projects and case studies into the simulation which require the context of multiple perspectives (Murray et al., 2019), which has been presented here for the context of religious headwear.

"Nintendogs" is a real-time pet simulation video game by Nintendo, played on the DS (Dual Screen) console with a touchscreen and microphone. Players care for a virtual dog by petting it, using items, and teaching it commands. The game emphasizes grooming, feeding, and playing with the dog. Players can go on walks, to the park, and engage in activities like disc-catching and agility trials. Contests are the main way to earn in-game currency. This virtual pet game serves as a unique platform for children to develop empathy by experiencing and responding to the virtual pet's needs, fostering emotional connections, and understanding of caring behaviors (Tsai & Kaufman, 2014). For engineering, the context of virtual pets can be extended for virtual laboratories (Potkonjak et al., 2016) to develop competency in preventive maintenance of engineering artefacts like cars, equipment, solar panels, etc.

The diverse range of games examined in this discussion collectively demonstrates the potential of digital platforms to foster empathy among different age groups and contexts.

B. What elements of game design are important to promote the development of empathy in students

This research question is addressed by describing various elements used in game design. Table II shows the list of different elements used in the game design for empathy development.

1) Scenario/Story and Narration: A scenario in a game refers to a specific situation or context in which players must make decisions and take actions (Calvo-Morata et al., 2020; Ferreira et al., 2021). It sets the stage for the gameplay and often presents challenges that players need to overcome (Jeon et al., 2023). Story/Plot: The story or plot of a game encompasses the narrative, characters, and events that unfold as players progress (López-Faican & Jaen, 2023). A compelling story can enhance players' emotional engagement and empathy. Players immersion is based on how well the story/plot or scenario is narrated (Muravevskaia & Gardner-McCune, 2023; Tan et al., 2022; Wulansari et al., 2023).

2) Character Identification: is the emotional connection players establish with the characters in the game, particularly the protagonist or central figures. It's about players empathizing or feeling a strong bond with these characters. Character identification is when players mentally align themselves with the in-game characters' perspectives, emotions, and motivations. This can lead to a deeper understanding of different viewpoints. Role-play in games involves players taking on specific roles or characters within the game's narrative or setting (Rector-Aranda & Raider-Roth, 2015; Tan et al., 2022; Wulansari et al., 2023). They assume these roles' identity, characteristics, and behaviors during gameplay. The distinction between role-play and character identification lies in the active engagement of players. While role-play centers around assuming a character's role and making decisions, character identification focuses on establishing an emotional bond with the game's characters. (Calvo-Morata et al., 2020; Chan et al., 2023; Muravevskaia & Gardner-McCune, 2023; Wulansari et al., 2023).

3) Decision Making: Decision-making in games refers to players evaluating their options, weighing potential consequences, and ultimately choosing from those available to them. Decisions often significantly impact the game's progression or outcome (Calvo-Morata et al., 2020; Tan et al., 2022). Player's choice refers to the options or actions offered to players within a game. It encompasses a range of possibilities that players can select from, and these choices may or may not have immediate or long-term consequences (Calvo-Morata et al., 2020; Chan et al., 2023; Tsai & Kaufman, 2014; Wulansari et al., 2023). The player's choice encompasses all available options and actions in the game, including those with minimal consequences. Decision-making focuses specifically on evaluating options and selecting one with significant consequences.

4) Interaction: Interaction in games refers to the ways players engage with the game environment, characters, objects, and other players (Chan et al., 2023; Yusoff et al., 2018). It can include actions like movement, communication, and manipulation of in-game elements (Muravevskaia & Gardner-McCune, 2023). An intuitive and user-friendly interface can enhance the gaming experience and interaction (Di Tore, 2014; Tsai & Kaufman, 2014).

5) Feedback: Feedback in games informs players about their actions and progress. Positive feedback reinforces desired behaviors, while negative feedback helps players adjust their strategies(Chan et al., 2023; Di Tore, 2014; Ferreira et al., 2021).

6) Challenges: Challenges in games refer to obstacles or tasks that players must overcome to progress. They can include puzzles, enemies, and tasks that require problem-solving (Chan et al., 2023; Ferreira et al., 2021; Muravevskaia & Gardner-McCune, 2023).

7) Tasks/Rules: Tasks in games are specific actions or objectives that players need to complete. Tasks can vary in complexity and contribute to the overall gameplay (Di Tore, 2014; López-Faican & Jaen, 2023).

8) Immersion refers to how players feel fully engaged and absorbed in the game world. Elements such as graphics, sound, and narrative can contribute to creating an immersive experience (McMahan, 2004).

In each of these games, the incorporation of specific game elements aligns with different dimensions of empathy, creating a holistic and immersive experience that engages players on cognitive, affective, and behavioral front

While there are various game design frameworks like Mechanics Dynamics and Aesthetics (MDA) (Hunicke et al., 2004), and Learning Mechanics and Game Mechanics (LM-GM) (Arnab et al., 2015) which highlight on categorizing game elements for mechanics, dynamics, and aesthetics, however, in this study, the eight game elements are presented without any categorization due to the scope of the study being limited to understanding different game elements and their relationship with empathy dimensions. There is a scope for categorizing these eight elements into game world and the mechanics.

C. How do the elements of game design map to the three dimensions of empathy: cognitive, affective and behavioral?

Table II presents a comprehensive overview of different games, their associated dimensions of empathy, and the specific game elements they incorporate to foster empathy in players.
1. Cognitive Empathy:
Game Elements: Narration, Immersion, Decision making, Role Play, Interaction, Feedback

Cognitive empathy involves understanding another's perspective and feelings (Jeon et al., 2023). Game elements that enable players to make decisions, interact with character stories through hints and feedback (Muravevskaia & Gardner-McCune, 2023), and take on the role of characters can stimulate cognitive empathy(Jeon et al., 2023).

A well-constructed **narration** can help players understand and appreciate the perspectives, motivations, and thoughts of in-game characters. By immersing players in the characters' stories and dilemmas, narration can enhance their ability to cognitively empathize with these virtual individuals.

Narration combined with **decision-making** becomes a powerful tool for enhancing cognitive empathy. When players are presented with complex choices that involve ethical considerations and moral dilemmas, they are encouraged to think deeply about the consequences of their decisions.

Along with narration and decision-making, **interactive dialogues and conversations** allow players to engage directly with characters, enabling them to explore different perspectives and understand the cognitive aspects of empathy. Through interactions, players can ask questions, seek information, and engage in meaningful discussions, fostering a deeper understanding of the characters' thoughts and viewpoints. While narration and decision-making contribute to fostering cognitive empathy, interaction, feedback, and role play enhance the experience by adding a layer of direct engagement.

Role-play with narration, interaction, immersion, decision making, and interactive experience can promote cognitive empathy by encouraging players to think and act as their in-game counterparts, gaining insights into the characters' cognitive processes.
How cognitive empathy manifests in game design?

The game "Mysterious Museum" (Jeon et al., 2023) narrative focuses on the robot's journey to develop its empathetic ability. It highlights the theme of ambiguity and the significance of grasping diverse viewpoints to enhance cognitive empathy. Players assume the role of the robot, making choices that directly impact their understanding of others' perspectives. They decide which images and objects to explore, how to interpret them, and how to approach perspective-related challenges. Cognitive empathy is fostered through interactions with the virtual world. Players use a joystick and controller to navigate, interact with 2D images and 3D objects, and make decisions by selecting options and manipulating objects. These interactions encourage players to consider alternative viewpoints and broaden their cognitive empathy skills.

The game "The Battle of Yiwei,"(Chan et al., 2023) begins with a stage of familiarization where players are introduced to

historical characters and context through narration. Throughout the game, players are required to make decisions related to strategic planning and historical events. Players can select historical characters such as President Su, Vice-President Su, or Branch President Chen. This choice allows players to embody these characters and make decisions from their perspectives, enhancing their ability to empathize with the roles and responsibilities of these historical figures. Interactions with real-person NPCs, such as Battalion Officer Su, provide players with guidance, explanations, and feedback. These interactions facilitate the transfer of historical knowledge and support players in understanding the consequences of their decisions.

In the game "Nintendogs" (Tsai & Kaufman, 2014) the progression of the virtual dog's growth, behavior, and achievements becomes a narrative of the player's relationship with their pet. Players constantly make decisions that impact their virtual pet's well-being. They must decide when and what to feed the dog when to groom it, which activities to engage in, and how to participate in contests. These decisions require players to consider the dog's needs and preferences, encouraging them to think empathetically about what would be best for their virtual pet's happiness and health. Nintendogs encourage role-playing as players take on the role of a pet owner. They are responsible for the dog's care, training, and overall well-being. Through interactions, they can pet, feed, groom, train, and play with the dog, fostering cognitive empathy as players learn to understand their pet's cues and emotional states.

The game "Com@Viver" (Ferreira et al., 2021) strongly emphasizes cognitive empathy, encouraging players to interact with characters and provide feedback. By engaging players in interactions that necessitate understanding characters' thoughts and emotions, the game facilitates the development of cognitive empathy. Through these interactions, players are challenged to decipher emotional cues and respond appropriately, enhancing their ability to perceive and understand the feelings of others.

2. Affective Empathy:
Game Elements: Narration, Character Identification, Challenges and Immersion

Affective empathy is about sharing and feeling the emotions of others (Jeon et al., 2023). Game elements that encourage players to emotionally connect with characters through identification, immersion, and choices can evoke affective empathy. Emotional storytelling can be a potent tool for enhancing affective empathy.

In addition to narration, immersion and interaction, **character identification** facilitated by realistic and relatable characters is another driver of affective empathy. When players form strong emotional bonds with in-game characters, they are more likely to feel and share in the characters' emotions. This is the key difference between character identification and role play.

Immersive game worlds and environments contribute significantly to affective empathy when players are fully immersed in the game's setting. Players become more emotionally invested in the characters and their struggles.
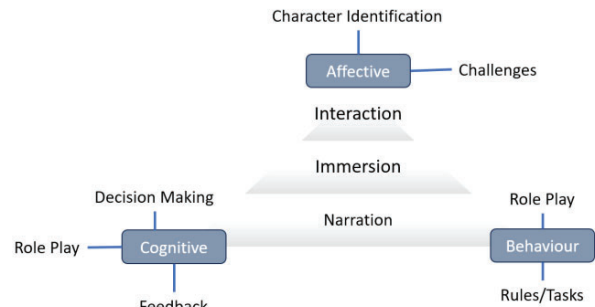

Fig. 4. Relationship between game elements and levels of empathy: Empathy Dimension and Game Elements (EDGE) framework

Challenges in games often evoke emotional responses from players. The frustration, excitement, and satisfaction that arise from overcoming challenges are primarily tied to emotions rather than cognitive processes. Therefore, the challenge element typically categorized within the affective dimension in mapping game elements to the empathy dimension framework. *How affective empathy manifests in game design?*

The player in "Conectado," (Calvo-Morata et al., 2020) assumes the role of a high school student who experiences bullying and harassment, allowing for deep character identification. Immersion in the game is achieved through the player's ability to make choices that impact the story's progression and outcome. As players witness the protagonist's experiences of bullying and frustration, they are likely to feel empathy for the character's emotional suffering. The game effectively utilizes character identification, challenges, and immersion to create an emotionally engaging experience.

In "The Battle of Yiwei," (Chan et al., 2023) the real-person NPC's(Non Player Character) appeared in period-appropriate attire and their interactions with learners in a historically accurate tone add an important dimension of affective empathy. This allows players to better relate to the characters and events of that era while engaging in cognitive and strategic tasks within the game.

The game mechanics in "Why Did Baba Yaga Take My Brother?"(Muravevskaia & Gardner-McCune, 2023) require players to perform empathy actions, such as hugging characters, to progress and complete the game. This direct involvement in demonstrating empathy reinforces the emotional connection between the player and the characters. The game imposes a challenge to the player to rescue her little brother who is being kidnapped.

Nintendogs (Tsai & Kaufman, 2014) game allows players to name their dog and use the built-in microphone to interact with it by calling it and teaching it commands. The process of naming and personalizing the virtual pet fosters character identification. The challenge game elements, is demonstrated in the form of contests to earn money and conduct training to earn trainer points.

3. Behavioral Empathy:
Game Elements: Narration, Immersions, Interaction, with Tasks/Rules, Role Playing

Behavioral empathy involves demonstrating understanding through actions (Boltz et al., 2015). **Interactions** that require players to respond empathetically, **follow rules** that mirror empathetic behaviors, and **perform tasks** to engage in prosocial tasks for learning can promote behavioral empathy (Muravevskaia & Gardner-McCune, 2023). Interactions encompass players' choices and actions within the game world. When players are given the agency to make decisions that reflect empathy and compassion, they are more likely to exhibit behavioral empathy by taking actions that benefit others within the game. **Role-playing** situations where players adopt characters' roles encourage empathy-driven actions (Tan et al., 2022).

How behavioral empathy manifests in game design?
In the game (Tan et al., 2022), the goal was to engage participants in a thought-provoking and immersive experience. This experience would encourage them to consider the complexities of social issues (Social and Income Inequality in Singapore and Bullying Faced by Young Singaporeans). The overarching goal was to generate discussions, and potentially develop solutions to the dilemmas presented in the scenarios.

Conectado (Calvert & Abadia, 2020) encourages players to ask for help and offer help to address the bullying issue. It fosters behavioral empathy by emphasizing the need for players to take action, seek help, and offer support to combat bullying, mirroring the behaviors of empathetic individuals.

In the game (Muravevskaia & Gardner-McCune, 2023) players' actions and interactions with the virtual characters reflect behavioral empathy. Specifically, in the strategies used by children to find their VR brother, such as actively listening to characters, asking questions, and performing empathy-driven actions like hugging characters.

Relationship between game elements and dimensions of empathy

The relationship between dimensions of empathy and game elements is complex and multi-faceted as shown in Figure.4 which we refer to Empathy Dimension and Game Elements (EDGE) empathy dimensions framework. Game elements of narration, immersion, and interaction play a central role in any game environment to foster empathy. At the core, narration, immersion, and interaction combined with decision-making, role-play, and feedback enable players to develop cognitive empathy. Similarly, narration, immersion, and interaction combined with character identification, and challenges can collectively contribute to the development of affective empathy. Narration, immersion, and interaction combined with tasks/rules and role play develop behavioral empathy in players. The interplay between these elements creates a rich and immersive gaming experience that has the potential to foster empathy on multiple dimensions, from understanding different perspectives to sharing emotional connections and engaging in prosocial behaviors within the game world.

The relationship between game elements and dimensions of empathy varies based on how the researcher interprets it. This aspect remains open for further exploration and investigation to uncover concrete evidence supporting a direct and clear correspondence between game elements and dimensions of empathy. The framework proposed in this paper lays the foundation and provides directions for researchers, practitioners, and game designers interested in designing games for the development of empathy.

IV. CONCLUSION

This scoping review has examined the multifaceted relationship between digital games and the development of empathy in students. The exploration of this intricate connection has revealed that digital games, ranging from simulations to virtual reality experiences, hold significant potential as tools for nurturing empathy across diverse age groups and educational contexts. The study has presented a diverse array of games designed to cultivate students' empathy. These games span various educational contexts, from addressing contemporary issues like cyberbullying to immersing players in historical narratives. Games like "Com@Viver", "Conectado", "The Battle of Yiwei," and "Nintendogs" serve as illustrative examples of how different games target various dimensions of empathy development, catering to different age groups and learning objectives.

The empathy developed through these games can be valuable when working on engineering projects that affect communities and society as a whole. By incorporating these games into the engineering curriculum, students can not only develop technical skills but also become more empathetic and socially conscious engineers, better equipped to address the complex challenges of our interconnected world

The research has highlighted how game design elements develop empathy. Game elements such as narration, decision-making, role-play, character identification, interaction, feedback, challenges, tasks/rules, and immersion play crucial roles in fostering empathy. Through these elements, players can engage with virtual scenarios, empathize with in-game characters, and make decisions that reflect empathetic behaviors. Elements such as narratives, immersive environments, and meaningful interactions are fundamental to creating an educational game for developing emotional connection between players and the game world. While specific game elements within the game and these basic game elements help develop different dimensions of empathy.

Lastly, EDGE framework for mapping game design elements and dimensions of empathy is also presented which opens up opportunities for testing the game elements-empathy dimensions framework.

By analyzing the intricate interplay of game elements and their impact on different dimensions of empathy, this study provides valuable insights for educators, game designers, and researchers seeking innovative approaches to cultivate empathy skills in today's digitally-driven educational landscape.

The essence of engineering lies in solving problems (Passow & Passow, 2017). Engineers solve design problems, decision-making problems, troubleshooting, and systems analysis; each calls for different cognitive processes (D. Jonassen et al., 2006;

D. H. Jonassen, 2000). This opens up opportunities to create problem contexts using technology-enabled game-based learning environments to develop different levels of knowledge, as pointed out by (Anderson & Krathwohl, 2001) factual, conceptual, procedural, and metacognitive knowledge within the context of engineering problem-solving.

As technology advances and game designers harness the power of immersive storytelling, integrating digital games into educational institutions holds promise for nurturing empathy in students of all ages and backgrounds. This study presents further avenues for exploration:

1. What is the relationship between role play, decision making, feedback game elements and cognitive empathy?
2. What is the relationship between character identification, challenges game elements in game and affective empathy?
3. What is the relationship between role play, rules /tasks game elements and behavioral empathy?

Limitations: Due to lack of time and effort, the scope of this study was limited to selection of papers from 2013 to 2023 year and only the journals in the Scopus database. However, it could have been extended to other databases and extending the time span for 10 more years would have helped gain a broader perspective.

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