

An Active Learning Framework for Humanity-Centered Design Education: Designing Board Games to Explore Social Issues

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Abstract

As social and environmental challenges grow increasingly complex, design education is required to move beyond improving individual user experiences toward addressing systemic and long-term societal issues. While Human-Centered Design (HCD) has been widely adopted in engineering and user experience (UX) education to foster user-oriented problem solving, its conventional methods often remain insufficient for engaging with multi-stakeholder contexts and future-oriented concerns. In response, Humanity-Centered Design (HuCD) has been proposed as an expanded perspective that emphasizes sustainability, ethical responsibility, and the collective well-being of society and ecosystems. This paper reports on an educational practice that integrates HuCD into design education through an active learning course in which university students design board games addressing social issues. In the course, students first identify problems rooted in everyday life, conduct qualitative research through interviews and public data analysis, and then translate their insights into game systems that represent both the structure of the problem and possible approaches to addressing it. The designed games allow others to experience social issues through play, enabling an embodied understanding of problem dynamics and consequences. The learning process is conceptualized as an active learning cycle consisting of problem discovery, research, design, experience, and reflection. This cycle aligns with constructionist and experiential learning theories by positioning students as creators of experiential artifacts rather than passive recipients of knowledge. A case example focusing on food loss illustrates how gameplay can convey the impacts of everyday decisions and promote reflective discussion among players. The findings suggest that board game design offers a promising medium for cultivating HuCD competencies—such as systems thinking, perspective-taking, and reflective learning—through embodied and experiential learning processes.

Keywords: Humanity-Centered Design; Active Learning; Board Game Design for Education; Embodied Learning.

1 Introduction

Active learning approaches have steadily attracted attention in higher education, particularly in design and engineering education, over the past several decades. As technological systems increasingly intersect with complex social contexts, learners are required not only to apply technical knowledge but also to identify problems, understand stakeholders, and explore solution spaces autonomously. Consequently, educational practices have begun to incorporate perspectives from user experience design (UXD) and human-centered design (HCD), even within traditionally engineering-oriented curricula.

At the same time, many companies and organizations are increasingly engaging with social issues such as sustainability and community well-being. These challenges are characterized by ambiguity and contextual dependency, making them difficult to address through predefined problem statements. However, in educational settings, problems are often still provided by instructors in a well-defined manner, limiting opportunities for learners to engage in authentic problem discovery.

In response to these challenges, the concept of Humanity-Centered Design (HuCD) was proposed as an extension of HCD. HuCD expands the conventional HCD framework by incorporating a long-term temporal perspective that accounts for sustainability, as well as considerations for environmental conservation, including a more holistic approach to material selection and production processes. However, unlike HCD, which typically

focuses on clearly defined and tangible users and artifacts, HuCD addresses broader and less tangible targets, such as society, ecosystems, and future generations. This lack of clearly identifiable and tangible design objects has posed a significant challenge in structuring effective educational programs based on HuCD.

This paper reports on an active learning course in which university students design board games to address social issues as a way to integrate HuCD into design education. Students identify everyday social problems, conduct qualitative research, and translate their insights into board game systems that represent problem structures and possible responses. Through gameplay, social issues can be experienced in an embodied and interactive manner.

The learning process follows an active learning cycle of discovery, research, design, experience, and reflection, aligning with constructionist and experiential learning theories. The findings suggest that board game design effectively supports HuCD competencies such as systems thinking, perspective-taking, and reflective learning through embodied experience.

This study addresses the following research question: How can board game design as an active learning approach support the development of Humanity-Centered Design (HuCD)-related competencies in higher education?

2 Related Work

This section reviews prior studies related to our approach, focusing on three aspects of research fields: active learning and problem-based learning, human-centered approaches in design education, and game-based learning and serious games. These bodies of work provide the pedagogical and theoretical foundations for understanding how experiential, humanity-centered, and game-based approaches have been applied to support problem-finding, engagement, and learning in design and engineering education.

2.1 Active Learning and Problem-Based Learning

Active learning and problem-based learning (PBL) have long been recognized as effective educational approaches that promote deeper understanding and learner engagement (Prince, 2004). Prior studies have shown that engaging learners in open-ended problem solving enhances critical thinking, autonomy, and motivation (Kolmos, 2014). However, many implementations of PBL rely on instructor-defined problems, which can reduce learners' opportunities to engage in problem framing and contextual sense-making. Recent research has highlighted the importance of supporting learners in the earlier stages of problem discovery, particularly when dealing with ill-defined or socially embedded issues.

2.2 Human-Centered Approaches and Design Education

Human-centered design (HCD) has gained widespread recognition as a foundational approach for addressing complex problems by foregrounding human needs, experiences, and values (Norman, 2013). Building on this perspective, design thinking has been developed and disseminated as a practical and structured framework for implementing HCD in real-world contexts. Design thinking typically follows an iterative process that includes empathizing with stakeholders, defining problem frames, generating ideas, prototyping, and testing solutions (Brown, 2008). Through this cyclical process, designers and engineers are encouraged to continuously refine both problem understanding and solution concepts.

These approaches have been widely adopted not only in product development and service design but also increasingly in engineering and information science education. In such contexts, HCD and UX methodologies are introduced to complement technical problem-solving skills, emphasizing empathy, field research, and

iterative prototyping. This integration enables students to engage with complex and ambiguous problems that cannot be fully addressed through purely analytical or technical methods.

2.3 Game-Based Learning and Serious Games

Game-based learning and serious games have been widely studied as methods for enhancing engagement and experiential understanding. Existing research demonstrates that games can effectively simulate complex systems, allowing learners to explore consequences of actions in a safe environment (Connolly, 2012). However, most prior work focuses on games designed by experts or educators, positioning students primarily as players rather than creators. In contrast, design-oriented approaches to game creation emphasize learning through the act of designing, where learners externalize their understanding by constructing systems and rules. This perspective aligns with constructionist learning theory, which argues that learners develop deeper understanding through the active creation of meaningful artifacts (Papert, 1980).

2.4 Positioning of This Study

Building on these strands of research, this study positions board game design as a form of active learning that integrates problem discovery, research, and experiential representation. The learning process described in this study also resonates with experiential learning theory, which conceptualizes learning as a cyclical process of concrete experience, reflective observation, abstract conceptualization, and active experimentation (Kolb, 1984). Unlike prior game-based learning approaches that focus primarily on gameplay outcomes, the emphasis here is on the process of designing games grounded in lived experiences of students, and on enabling others to engage with social issues through embodied interaction.

3 Humanity-Centered Design: An Expanded Perspective on Design for Societal and Environmental Challenges

HCD has been widely adopted as a design framework emphasizing users' needs, behaviors, and contexts (Norman, 2013). In UX practice, it is typically implemented through iterative processes such as user research and prototyping. This approach has proven effective in improving user experience and aligning solutions with individual needs.

However, as design increasingly addresses complex social and environmental challenges, limitations of conventional HCD have become apparent. However, many contemporary challenges involve multiple stakeholders, long-term consequences, and systemic interdependencies that extend beyond individual users. Optimizing solutions at the level of individual users' alone risks producing short-term or localized benefits while overlooking broader systemic effects.

To address these limitations, Norman proposed Humanity-Centered Design (HuCD) as an extension of HCD (Norman, 2023). While HuCD builds upon the core principles of HCD, it expands the scope of concern from individual users to humanity as a whole, including social systems, communities, and ecological environments. HuCD emphasizes long-term sustainability, ethical responsibility, and the anticipation of unintended consequences. In this perspective, designers are not positioned as problem solvers who deliver optimal solutions, but rather as supporters and facilitators who work collaboratively with diverse stakeholders.

Table 1 conceptually contrasts HCD and HuCD. HCD primarily targets usability and user satisfaction within relatively bounded contexts, whereas HuCD foregrounds systemic relationships, collective well-being, and future-oriented impacts. This shift requires designers to adopt broader perspectives, engage with ambiguity, and consider values that may conflict across stakeholders.

From an educational standpoint, this distinction is critical. Teaching HCD methods alone may cultivate skills for improving products and services, but it does not necessarily foster the ability to frame problems at the societal level or to reflect on long-term consequences. HuCD-oriented education therefore demands learning experiences that support perspective-taking, contextual understanding, and reflection beyond immediate needs of multiple stakeholders.

The board game design practice described in this study responds to this requirement by enabling students to explore social issues as interconnected systems and to translate their understanding into experiential forms. Through the process of designing games, students are encouraged to move from user-centered thinking toward a more humanity-centered perspective that considers relationships, constraints, and consequences over time.

Table 1. Basic Principles of HCD and HuCD (Norman, 2023)

HCD	HuCD
1. Solve the core, root issues, not just the problem as presented (which is often the symptom, not the cause).	1. Solve the core, root issues, not just the problem as presented (which is often the symptom, not the cause).
2. Focus on the people.	2. Focus on the entire ecosystem of people, all living things, and the physical environment.
3. Take a systems point of view, realizing that most complications result from the interdependencies of the multiple parts.	3. Take a long-term, systems point of view, realizing that most complications result from the interdependencies of the multiple parts and that many of the most damaging impacts on society and the ecosystem reveal themselves only years or even decades later.
4. Continually test and refine the proposed designs to ensure they truly meet the concerns of the people for whom they are intended.	4. Continually test and refine the proposed designs to ensure they truly meet the concerns of the people and ecosystem for whom they are intended.
	5. Design with the community and as much as possible support designs by the community. Professional designers should serve as enablers, facilitators, and resources, aiding community members to meet their concerns.

4 Externalizing Societal Complexity through Board Game Design

Board games are composed of several core elements, including *components* such as dice and cards, *rules* that define the nature of the game and conditions for winning, and *gameplay*, which describes how players interact with the game through these components and rules. These elements are integrated through *mechanics*, which organize interactions and govern the dynamics of the game system (Daniels, 2022).

Society similarly consists of diverse natural entities, people, and artifacts, along with institutional and cultural arrangements that define and constrain their relationships. Within these interdependencies, actions may lead to desirable or undesirable outcomes, often through complex and non-linear processes. From the perspective of HuCD, engaging with such social realities requires not only identifying individual user needs but also understanding broader systems of interaction, constraints, and feedback that shape human experience.

In this context, board games provide a pedagogically effective medium for representing and experiencing aspects of complex social systems. By abstracting social phenomena into tangible components, explicit rules,

and interactive mechanics, board games enable learners to externalize, explore, and reflect on social structures that are otherwise difficult to grasp. This aligns with educational engineering approaches that emphasize experiential learning, systems thinking, and learning through simulation.

Table 2 presents an analogy between the elements of board games and aspects of social issues. Various actors, resources, and objects in society can be mapped onto game components; institutions, laws, and customs correspond to rules that regulate behavior; people’s concrete actions and practices correspond to gameplay; and patterns of interaction and feedback loops correspond to mechanics. Through this mapping, learners can engage with social issues not as abstract problems, but as dynamic systems shaped by human behavior and structural constraints.

From a HuCD perspective, the process of designing a board game itself functions as a learning activity that embodies core design principles. Learners are required to identify relevant actors, articulate assumptions about behavior, and iteratively test how rules and mechanics influence outcomes. Thus, board game design serves as an effective educational framework for cultivating the competencies needed to address complex social issues, including perspective-taking, iterative problem framing, and reflective practice.

Table 2. Correspondence between board games and social issues

Elements of Board Games		Social Issues
Components	Physical items	Actors, resources, and objects
Rules	Regulations and constraints	Institutions, laws, customs, and cultural rules
Gameplay	Player actions	Actual human behavior, practices, and social processes
Mechanics	Systems that drive the game	Structures of interaction and feedback loops

Designing a board game can be broadly divided into rule design and artifact production (Takahashi, 2025). Rule design, in particular, involves selecting a theme, defining preliminary modes of play, and introducing mechanisms that generate engagement and meaning. Through repeated playtesting, designers iteratively adjust balance and refine the system.

When this design process intentionally incorporates social actors, their behaviors, and the constraints among them, it creates a learning environment that supports empathy and reflection toward social issues. From an educational engineering standpoint, such iterative design and evaluation cycles function as structured learning processes, enabling learners to construct understanding through action, feedback, and revision. In this way, board game design operates not only as a creative activity but also as a HuCD-oriented educational method for engaging with complex social challenges.

5 Educational Practice

5.1 Course Design and Learning Objectives

Based on the HuCD perspective, we implemented an active learning course in which students design board games that represent and communicate social issues. The course is positioned as an introductory course for second-year undergraduate students in design and engineering-related programs, and is offered as part of a curriculum focusing on user experience and social design.

The course aimed to achieve the following learning outcomes: (1) problem discovery, (2) contextual understanding of social systems, and (3) reflective thinking through iterative design. Rather than pursuing a single correct answer, the course emphasized students' ability to identify issues embedded in everyday practices and to translate their understanding into interactive experiences.

Students work in small groups and selected themes closely related to their daily lives. Through this process, they were encouraged to treat problems as situated and socially constructed phenomena, rather than as abstract tasks.

The course is structured into five phases across fifteen sessions. Students first develop a structural understanding of social issues through lectures, literature review, PEST analysis, and scenario planning. They then engage in user research and empathy building, followed by co-creative ideation and prototyping of board-game-based experiences. The course concludes with user testing, iterative refinement, and final presentations with reflection.

- Phase 1 - Understanding Social Issues: Students acquire basic knowledge of HCD and HuCD through lectures and learn to read and summarize academic literature. They then form teams, select a social issue, and conduct a PEST analysis to examine political, economic, social, and technological factors (Kotler, 1999). From the results, teams identify two key uncertainties and construct four future scenarios using a two-axis matrix. This enables teams to envision both the most desirable and the most adverse futures among the uncertain trajectories associated with the problems they have defined.
- Phase 2 - User Understanding and Empathy: Students then conduct user observations and interviews related to their social issue and analyze the qualitative data with empathy maps (Gray, 2010). Based on the findings, teams design personas (Cooper, 2014) and create persona stories in both optimistic and pessimistic future scenarios, treating the persona as the protagonist of an experiential narrative (Jones, 2021).
- Phase 3 - Ideation and Experience Design: Board games are used as an experiential medium to represent social systems and stakeholder perspectives. After experiencing existing games, students generate ideas and apply quick and dirty prototyping, rapidly building and testing paper-based game concepts (Figure 1). Designs are iteratively revised or replaced if they fail to convey the social issue or function as a game.
- Phase 4 - Evaluation and Iteration: Teams conduct cross-team user testing. Some members facilitate their own game while others test different teams' prototypes (Figure 2). Feedback is collected and interpreted to refine the designs.
- Phase 5 - Presentation and Reflection: Teams present their social issue, personas, scenarios, and board games in short pitches. Participants then play the games and reflect on how effectively the designs express the targeted social issues and foster empathy.

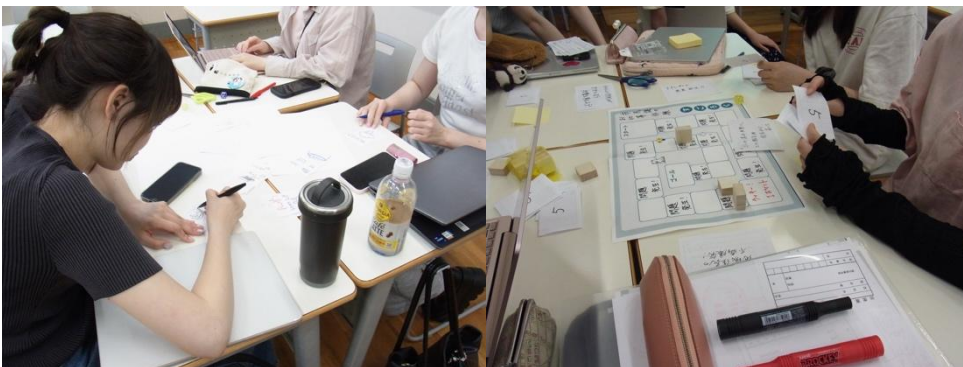


Figure 8. Quick-and-dirty prototyping.



Figure 2. Iteratively improve prototypes through user testing. Through this cycle, understanding of social issues and the complex need among stakeholders is deepened.

5.2 Example of a Student-Designed Game

The course was conducted with approximately 20 students and operated as a repeated active learning cycle of exploration, creation, feedback, and reflection. Each phase contributed to this cycle in distinctive ways. For example, board games have been created to address issues such as food security in Japan, gender inequality, urban sanitation, social media literacy, and fake news.

One representative outcome of the course was a board game addressing food loss called *Mogu Mogu* (Figure 3). In this game, players purchase ingredients during their turns. When the next turn arrives, points are awarded if players can cook dishes using available recipes that match their ingredients. Ingredients that remain unused are stored in a refrigerator, where time progresses day by day. Once an ingredient exceeds its expiration period, it must be discarded, resulting in a penalty.

By playing the game, participants experience the risks of over-purchasing, learn strategies to reduce waste, and observe effective practices employed by other players. Rather than receiving explicit explanations, players develop an implicit understanding of food loss through interaction and reflection. Students showed high engagement throughout the course, particularly during the prototyping and playtesting phases, where iterative failures and peer interactions stimulated sustained participation and discussion.



Figure 3. The prototype images of the *Mogu Mogu* game focused on food loss: Players buy food and recipe cards on their turn (Left). A stepwise refrigerator stores ingredients by stage on each level. Food ages step by step, gives points when used, and expired food is discarded for negative points (Middle). *Mogu Mogu* prototype in play (Right).

6 Key Impacts on the Active Learning Cycle

This section describes the learning outcomes from practice, with a particular focus on HuCD. This study adopts a qualitative case study approach based on a single course implementation. Data sources include students' artifacts (board games), observations of the learning process, and reflective reports. The analysis focuses on identifying recurring patterns related to learning outcomes. Four design elements had the strongest impact on activating and sustaining the learning cycle. These results are interpreted in terms of HuCD-related competencies, namely systems thinking, perspective-taking, and reflective learning.

1. Systems Thinking through PEST-Based Reframing: Introducing PEST analysis enabled students to move beyond personally defined or anecdotal problem framings and reinterpret social issues from broader political, economic, social, and technological perspectives. This shift transformed narrow, experience-based concerns into structural and systemic problem spaces, forming a stronger foundation for inquiry.
2. Perspective-Taking through Scenario-Based Temporal Exploration: By selecting two critical uncertainties from the PEST results and constructing four-quadrant future scenarios, students explored multiple plausible futures. By building each scenario around a persona as the central actor, students were able to frame these futures as speculative, while remaining grounded in realistic daily life. This approach enabled them to trace how the persona's experiences, decisions, and challenges might evolve over time, allowing students to perceive social issues not only as future possibilities but as continuations of present realities across a temporal axis.
3. Reflective Learning through Rapid Prototyping and Creative Friction: When students were required to quickly externalize ideas with simple paper prototypes, breakdowns became visible: the game failed to express the world of the persona or lacked playability; moreover, this revealed that essential aspects of the social issue had not been adequately embodied in the mechanics of play. These moments of failure generated creative friction (Stark, 2011), triggering deeper discussion, idea refinement, or radical change. Creative friction is the productive tension that arises when people with different values, skills, and perspectives work together. Prototyping thus acted as a catalyst for learning rather than merely a representation tool.
4. Reflective Learning through External User Testing: Cross-team playtesting exposed strengths and weaknesses that remained invisible during self-testing. What initially appeared as surface-level issues (such as pacing) often revealed more fundamental problems in the game logic, experience flow, or thematic clarity. This showed students that design knowledge is generated through real-world experimentation in how to communicate the meaning of social issues to people who have never considered them, and that this process, in turn, deepens their own understanding of those issues.

After completing the course, students were asked to write individual reflective reports. From the learners' perspective, the specific points discussed in this paper were not always mentioned explicitly. However, students did refer to several key learning outcomes, such as broadening their perspectives through PEST analysis, recognizing the importance of empathizing with personas, and understanding the value of iterative improvement through game testing. Overall, these reflections suggest that the present approach was able to demonstrate part of its potential learning effects.

Overall, the learning outcomes can be summarized as follows: students developed (1) systems thinking through structural analysis of social issues, (2) perspective-taking through personas and gameplay experiences, and (3) reflective learning through iterative prototyping and (4) user testing. These competencies correspond to the HuCD perspective outlined in the abstract and suggest that the proposed approach supports competence development through embodied and experiential learning.

7 Conclusion

This study shows that integrating board game design into active learning supports a shift from abstract understanding to embodied experience. By designing games grounded in real-world observations, students translate social issues into interactive systems that allow others to experience them firsthand. This approach promotes deep engagement with complex problems and highlights the potential of game-based design as a medium for experiential and reflective learning in design and engineering education. It further suggests that HuCD can be cultivated not only through conceptual instruction but through experiential system design.

This paper does not present empirical evaluations of specific interventions, and its discussion is limited to higher education contexts in UX and design. Future research should examine HuCD-informed curricula across diverse institutional and cultural settings and conduct empirical studies to assess learning outcomes from integrating HCD and HuCD into engineering education.

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