Leaderboard Design Principles Influencing User Engagement in an Online Discussion

Brian S. Bovee

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LEADERBOARD DESIGN PRINCIPLES INFLUENCING USER ENGAGEMENT IN AN ONLINE DISCUSSION

A doctoral dissertation submitted to Dakota State University in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

in

Information Systems

April, 2022

By

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DISSERTATION APPROVAL FORM

This dissertation is approved as a credible and independent investigation by a candidate for the Doctor of Philosophy degree and is acceptable for meeting the dissertation requirements for this degree. Acceptance of this dissertation does not imply that the conclusions reached by the candidate are necessarily the conclusions of the major department or university.

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ACKNOWLEDGMENT

I would like to thank, first and foremost, my heavenly Father Jesus Christ for placing in me the desire to use the gifts He gave me to glorify Him and, hopefully, help others grow closer to Him. I would like to thank my wife Sheila whose sacrifices are immeasurable not only for this project but for all the years we have been blessed to share together. I would like to thank my children Bryce, Reed, and Kristen for supporting me and the time that was forever lost in order to finish this project. I would like to thank my parents Steve and Shyrle and my wife’s parents Ron and Gena for their prayer support and continued concern and encouragement to push on when it got hard.

Outside of family, I would like to thank, first, my committee. Each individual on this committee played such a significant role in not only this project but my entire educational experience at DSU. First, to Dr. Noteboom, thank you for guiding me from the very start with direction on the program to the very end with the endless emails and invaluable wisdom you shared with me in terms of editing my paper to just getting through this program. Second, to Dr. Omar for the role model you became to me over the course of my time here at DSU. You inspired me in so many ways with your dedication to research and to your students like me with helping us get papers done, published and succeed in general. Finally, to Dr. Smith, for your invaluable advice from the perspective of one who shares my passion to develop information systems that can improve business efficiency as well as student engagement. I also thank you for your valuable edits and feedback in this work.

Finally, I would like to thank Dr. Davis and the provost office at CBU. First, to Dr. Davis, for seeing something in me long ago and encouraging me to pursue my dream of teaching at the university level. Second, I would like to thank CBU, in general, for helping offset the financial cost of my education and providing me with a lifestyle that allows me to live my purpose.
ABSTRACT

Along with the popularity of gamification, there has been increased interest in using leaderboards to promote engagement with online learning systems. The existing literature suggests that when leaderboards are designed well they have the potential to improve learning, but qualitative investigations are required in order to reveal design principles that will improve engagement. In order to address this gap, this qualitative study aims to explore students' overall perceptions of popular leaderboard designs in a gamified, online discussion. Using two leaderboards reflecting performance in an online discussion, this study evaluated multiple leaderboard designs from student interviews and other data sources regarding the potential of each leaderboard to improve user engagement.

Analysis of the leaderboard designs was conducted using a single case study. The data was collected from semi-structured interviews, transcripts from the discussion data, and surveys. Interview data was analyzed using Corbin & Strauss’ (2014) open coding method. The result of the data collection was 221 minutes of recorded conversation which converted to 135 pages of transcribed text. The transcribed data was tagged with open codes, sorted, and grouped into related conceptual clusters resulting in 68 individual codes. These codes were then grouped into 16 concepts as part of the axial coding phase. The next phase of coding was theoretical or selective coding. In this phase, concepts were abstracted to eight broader categories or, in this project’s case, design principles that formed the essence of the emergent theory.

The eight categories that emerged from the data formed the essence of a theoretical model for system engagement using global, relative, and team leaderboards. The model communicates that factors which lead to positive system engagement include clear instructions, challenge/skill balance, and timely feedback. Within each of these areas are elements of the eight design principles that act as positive or negative system engagement factors.

Three significant findings were identified in the study in relation to factors influencing engagement in settings where leaderboards are used as the primary game element. First, clear instructions must include both clear goals but also a clear understanding of the system in which the leaderboard game element is employed. Second, team leaderboards must foster team accountability through the design of the leaderboard and through social influences. Data in this
study demonstrated that team leaderboards which employ rankings within teams creates power social comparison on two fronts: intra competition (evaluating scores within the team) and extra (evaluating the scores among teams). Team accountability is increased as each individual’s contribution to the overall team performance is clearly seen and is reinforced via social influences of other team members and game moderators.

Finally, and most significantly, this project demonstrated that global, relative, and team leaderboards each have specific design features that create differing levels of challenge-skill balance. Global leaderboards should be redesigned to use “sliced” leaderboards to avoid negative engagement from lower ranking users. Level leaderboards should employ levels that are perceived as realistic and achievable. Team leaderboards should develop accountability with ranking of team members both between and within teams. The design decisions associated with each leaderboard are, thus, critical to ensuring optimal positive system engagement and avoiding significant negative system engagement outcomes.
DECLARATION

I hereby certify that this dissertation constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and that appropriate credit is given where I have used the language, ideas, expressions or writings of another.

I declare that the dissertation describes original work that has not previously been presented for the award of any other degree of any institution.

Signed,

_____________________________
Brian Steven Bovee
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CHAPTER 1

INTRODUCTION

Background of the Problem

Leaderboards have become commonplace in gaming systems and, more recently, in non-gaming systems to increase user engagement with electronic and other types of systems. Gamification involves the use of game design elements for non-game applications (Deterding et al, 2011). While “serious” games are designed for a purpose other than pure entertainment, gamification involves the application of game like elements such as leaderboards, digital badges, and point systems to increase engagement and tap the learner’s normal drive for achievement (Deterding et al, 2011; Cronk, 2012). Deriving from the discipline of psychology, gamification is said to induce a state of “flow” in the user via the design of the optimal user experience (Hoffman & Novak, 2009), Chen et al, 2018, Park & Kim, 2021; Swacha & Itterman, 2017). Flow is attained when the mind and body are in complete absorption in the task at hand. Regardless of the methodology used, the goal of all game elements is to have a positive effect on the user’s motivation to engage with the system (Deterding et. al., 2011).

However, the specific game design element used to increase motivation has not been conclusive. There remains a lack of awareness on the effectiveness of each particular type of game element as the majority of research in gamification has employed multiple gamification elements while using a single measurement of engagement (Broer, 2017; Looyestn et al, 2017). Thus, more studies are needed that offer specifics on the factors leading to engagement for each type of game element used in various settings.

Statement of the problem

Leaderboards are currently among the most popular elements of gamification (Mese & Durson, 2019; Andrade et al, 2020). By ranking players according to their relative success in achieving a task, leaderboards are said to increase engagement by providing a sense of
competition in which the user’s performance in completing the task is placed in relation to the performance of others (Butler, 2017; Garcia et al., 2013). However, the research has been mixed showing that leaderboards can actually result in decreased engagement (Hanus & Fox, 2015; Jia et al., 2017). A significant reason for the negative outcomes is related primarily to improper leaderboard design (Cwil et al, 2020; Jia et al., 2017; Ninaus, 2020).

In general, the research on the design of leaderboards has been classified into three main categories: global, relative, and team based (Zicherman & Cunningham, 2011; Cwil et al (2020). Global leaderboards represent the traditional type of leaderboard displaying all users and their scores. Leaderboards designed in this manner inherently reward players at the top with a sense of accomplishment as opposed to players at or near the bottom of the leaderboard who may perceive it is impossible to reach the top of the leaderboard (Ostlund et al. 2020). In contrast, relative leaderboards display users along with their rank and only the users that are immediately below and above them. This design has also been shown to minimize negative effects of being at the bottom of a leaderboard (Ninaus et al., 2020) as the user is grouped with a smaller number of users who share similar performance characteristics. In team-based leaderboards, a user is assigned to a team and the leaderboard provides a ranking of the team’s performance which sometimes may also include individual users scores on each team. In order to move the discipline of gamification forward, rigorous studies are needed that compare various leaderboard designs in terms of actual engagement with the information system.

Moreover, while there is considerable quantitative research supporting leaderboards and engagement (Ding et al. 2017; Ding et al. 2018; Hanus & Fox, 2015), studies examining qualitative aspects of leaderboards in online discussions are sparse. Quantitative metrics do not draw a complete picture of users’ subjective experiences and the quality of their user experience (Rapp, 2015). Accordingly, the aim of this study is to address this gap by exploring users overall perceptions of different leaderboards used in a gamified, online discussion board.

**Objectives of the dissertation**

The present study extends previous research regarding the gamification of an asynchronous online discussion board (Bovee et al., 2020b). In that study, a quantitative
approach demonstrated a leaderboard that is added to an online discussion board resulted in improvements to both behavioral and cognitive engagement (Bovee et al., 2020b). The method was evaluated in two sections of an online, graduate business information systems course which were identical with the exception that experimental course used a leaderboard in the online discussion. The present study will use the artifact in Bovee et al. 2020b to create the leaderboards which will then be evaluated in this study as a case study using interviews and reports on the discussion as data sources. Qualitative method are appropriate for accomplishing this study as these methods provide a means for accessing unquantifiable facts about the perceptions of leaderboards used in an online discussion.

Given the negative impact on engagement associated with global leaderboards for those appearing at or near the bottom of the leaderboards (Ostlund et al. 2020), relative and group leaderboard designs were selected as the focus for this study. Both leaderboard designs will undergo a qualitative descriptive account of participants’ perceptions of each game design element as it relates to engagement and learning. This study contributes to the extant literature by evaluating user perceptions of popular designs of leaderboards used in online discussions and providing novel insights into the design of leaderboards in information systems.

**Structure of the dissertation**

The remaining sections of this dissertation are as follows. In chapter 2, a “Literature Review” presents related studies on leaderboards and engagement in online discussions. This is followed by Chapter 3, “Theory and Methodology” which describes the theoretical foundation and methodology used for evaluation of the leaderboards. Chapter 4 presents the “case study, results, and discussion”. In this chapter, the design principles identified are compared with existing related literature. Finally, chapter 5 presents the “conclusions” and presents an overview of the of contributions of this project.
CHAPTER 2

LITERATURE REVIEW

First, this chapter discusses the related studies on leaderboards. In this regard, it begins with discussing the literature of global leaderboards, team leaderboards, and relative leaderboards. Second, it provides insight on the literature of users’ acceptance of each of these types of leaderboards. This is followed by studies on engagement in online discussions. Then, the chapter presents flow theory as the theoretical background of this research. The chapter discusses how three key elements of flow theory were used to develop initial design principles for leaderboards in the study. Finally, the chapter concludes with a summary of the literature review and presentation of the two research questions that guided the study.

Leaderboards

Leaderboards can be defined as a “visual display that ranks players according to their accomplishment” (Ortiz-Rojas et al, 2019). In general, leaderboards reflect the performance of users in comparison with other users promoting social-comparison as a means to improve the outcome of a particular task. While, overall, leaderboards have been shown to improve engagement with the system, negative outcomes can result in the form of less engagement (Hanus & Fox, 2015) based on the design decisions used in creating the leaderboard. In general, the research on the design of leaderboards has been classified into three main categories: global, group or team, and relative based as summarized in table 1 (Zicherman & Cunnigham, 2011; Cwil, 2020)

<table>
<thead>
<tr>
<th>Global Ranking</th>
<th>Group/Team Ranking</th>
<th>Relative Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>All users</td>
<td>A group of users</td>
<td>Users with similar scores</td>
</tr>
</tbody>
</table>
Global leaderboards

Global leaderboards represent the traditional type of leaderboard displaying all users and their scores. Leaderboards designed in this manner inherently reward players at the top with a sense of accomplishment as opposed to players at or near the bottom of the leaderboard (Ostlund et al. 2020). For example, Jia et al. (2018) investigated preferences of leaderboards where the user’s name was shown at the top, middle or near the bottom in different domains. Players at the top of social leaderboards reported positive perceptions of the leaderboards and players at or near the bottom reported negative perceptions. In another study, Sun et al (2015) identified associations between leaderboard positions and player’s satisfaction rankings in a digital game. These studies demonstrated that user preference of leaderboards was related to the user’s position on the leaderboard.

Cwil et al (2020) examined if global leaderboards were preferred over other forms of presenting the information as in a traditional table. Respondents were asked to compare two different methods of score presentation – a traditional one (table-based) and one in the form of a ranking. Results demonstrated that the majority of users preferred/found it more motivating when results are presented in a leaderboard rather than in a traditional table.

Relative leaderboards

Relative leaderboards allow users to see their rank as compared with similarly ranked users scoring below and above them. Consequently, users will feel less discouraged when ranked lower. However, this type of leaderboard provides no mechanism to provide ranking information for all users. Landers et al (2017) demonstrated relative leaderboards increase task performance as opposed to global leaderboards. Ninaus (2020) found similar results and prescribed redesigning global leaderboards in a way that the position in the leaderboard does not demotivate the weakest players. In this design, all users interact with “sliced” leaderboards that depict they are performing relatively well and reaching the next top level or grouping is not impossible.

Group/Team-based leaderboards

In team-based leaderboards, a user is assigned to a team and the leaderboard provides a ranking of the team’s performance. Generally, team leaderboards do not provide any
mechanism for determining individual scores on the team as the focus is on team performance. Consistent with the findings of global leaderboards, Ninaus et al (2020) found individuals on highly performing teams were more motivated by the leaderboards. Students in poorly performing teams did not contribute to leaderboard motivation. Höllig et al (2018) examined team-based leaderboards in relationship to personal competitiveness of the user finding highly competitive individuals regard team-based leaderboards with more value than less competitive users.

In summary, while leaderboards have the potential of stimulating greater engagement by rewarding users with the presentation of their results of an activity, careful design decisions must be made to reward participants effectively. For example, the type of ranking should be adjusted to maximize acceptance of the technology and intrinsic motivation. Global leaderboards have been shown to have the potential of actually discouraging user acceptance as people with a low ranking may find it impossible to reach the top of leaderboard (Jia et al, 2017; Priest et al, 2014; Werbach & Hunter, 2015). In contrast, relative and group leaderboards may offer positive outcomes as the smaller number of individuals appearing in the leaderboard make it more motivating for users to perceive it is possible to make it to the top (Jia et al, 2017; Kapp, 2017; Cwil, 2020). These instantiations of leaderboards often show the user how close he or she is to attaining the next best score among a smaller group of users.

Engagement in Online Discussions

Asynchronous online discussions represent a critical aspect of the online learning process. Low student engagement, in the form of low quantity and quality of discussion posts, has represented a significant challenge to overcome for instructors (Hara et al, 2000; Hewitt, 2005). While engagement has been defined in many ways, this project examines engagement using Fredericks et al (2004) widely accepted model of engagement which focuses on examining the three elements of how students behave, feel, and think. In terms of behavioral engagement, previous quantitative methods have shown leaderboards to be effective in improving behavioral engagement in improving total posts and replies in online discussions (Bovee et al, 2020). In terms of measuring engagement by how students think, the author could find no research examining what students think about different types of leaderboards within the context of online discussions. Finally, in terms of improving how students feel,
leaderboards provide external motivation to engage with discussions via constructive competition toward a goal (Lo & Hew, 2018; Ding, 2019). As the user engages with the game, the motivation to engage can shift from extrinsic to intrinsic (Ryan et al, 1991; Lepper, 1988; Deci & Ryan, 2008). Self Determination Theory (Deci & Ryan, 2008) and Flow Theory (Csikszentmihalyi, 1990) describe this as a process in which one identifies with an activity’s value and integrates it into their sense of self. In applying flow theory to gamification of asynchronous discussions, students are more likely to be motivated to engage with the discussion by clear goals (Locke & Latham, 2006), challenging content, and appropriate feedback. When expectations are not set or vague, students struggle with both the amount and type of content in posts (Dennen et al, 2007).

Theory

Flow Theory

The concept of flow theory has long been applied to designing the optimal user experience and, more recently, to the design of game elements such as leaderboards (Hoffman & Novak, 2009, Chen et al, 2018, Park & Kim, 2021; Swacha & Itterman, 2017). Deriving from its roots in psychology (Csikszentmihalyi, 1990), flow is considered as an optimal experience of mind and body with complete absorption in the task at hand. Gamification and, indeed, many of life domains have been successfully applied to flow (Kowal and Fortier, 1999). Csikszentmihalyi (1990) offers nine dimensions that, together, represent the optimal psychological state of flow. These conceptual elements are 1) challenge-skill balance; 2) action-awareness merging; 3) clear goals; 4) timely feedback; 5) concentration on task; 6) sense of control; 7) loss of self-consciousness; 8) time transformation; and 9) autotelic experience. The three elements, challenge-skill balance, clear goals, and timely feedback are pre-conditions of flow (Csikszentmihalyi, 1990) and, thus, represent critical elements for the design of the leaderboard. First, challenge-skill balance represents the perception of both high levels of both the challenge of the situation and the skills needed to meet the challenge. The flow channel (see figure 1) depicts the negative results that occur when one is above the flow channel (anxiety results) or below the flow channel (boredom ensues). Second, clear goals
represent unambiguous direction on performing the task at hand. Finally, timely feedback on performance of the task is needed to maintain flow.

Using flow theory (Csikszentmihalyi, 1990) as the theoretical foundation, Bovee et al. (2020b) developed a method for the gamification of an online discussion (Bovee et al., 2020b). The method contained three main components: a database to import discussion board data, a webpage displaying either a leaderboard, digital badges, or points to gamify the discussion board, and a series of reports to assist both researchers and instructors using the tool. In the present study, the same method will be used to create two leaderboards which will then be evaluated in a case study using interviews.

In Bovee et al., 2020b the artifact was designed according to three foundational elements of flow theory (Csikszentmihalyi, 1998; Nakamura and Csikszentmihalyi, 2014). In the present study, the same three elements of flow theory were used to design two leaderboards in a manner that should induce a state of flow resulting in improved engagement with the discussion as summarized in Table 2. First, in order to achieve a state of flow, the leaderboards must have clear goals to allow proper focus on the task at hand (Csikszentmihalyi, 1990; Cowley et al. 2008). The two leaderboard designs used in this study, relative and group, were each designed with clear goals. The goal of the relative leaderboard is to reach the next level. Students using this leaderboard were displayed along
with students performing at the same level and encouraged to reach the next level. The goal of the group leaderboard is to reach the top of the leaderboard.

Second, in order to achieve flow, the leaderboard must be presented frequently and made available at any time to ensure the individual will not end the state of flow by losing concentration (Cowley et al. 2008; Nakamura & Csikszentmihalyi, 2014). Thus, in the present study, a web-based version of the two leaderboards will provide timely feedback to the students seeking information on their performance in the game. In addition, each participant will receive multiple emails throughout the 10 day game showing their position on the leaderboard and encouraging participants to either reach the next level (for relative leaderboards) or reach the top of the group (for group leaderboards).

Finally, a third element of flow theory is inducing an appropriate level of challenge to ensure there is confidence to complete the task but yet the task induces complete immersion in the task (Csikszentmihalyi, 1998; Cowley et al. 2008; Nakamura & Csikszentmihalyi, 2014). In order to achieve the appropriate level of challenge, multiple factors were considered. First, global leaderboards were rejected for design due to their inherent ability to create unrealistic challenges for participants appearing at or near the bottom of the leaderboard. Second, the group leaderboard was designed with a limited number of participants (less than ten) in each group to increase the possibility the challenge to reach the top of the leaderboard seemed feasible. Lastly, the relative leaderboard was designed with an appropriate challenge by ensuring the next level could be achieved with no more than 2 additional posts or replies to the discussion.

Table 2: Elements of flow theory and associated design decisions

<table>
<thead>
<tr>
<th>Elements of Flow</th>
<th>Design Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear goals</td>
<td>The goal of the relative leaderboard is to move to the next level.</td>
</tr>
<tr>
<td>(Csikszentmihalyi, 1998; Cowley et al. 2008)</td>
<td>The goal of the group leaderboard is to reach the top of the leaderboard in that group.</td>
</tr>
</tbody>
</table>

| Timely Feedback  | Students informed at least 3-5 times per week via email of their current position on the leaderboard. Second, students will be able to, at any time, access the online leaderboard to receive feedback |
| (Cowley et al. 2008; Nakamura & Csikszentmihalyi, 2014) | |

Challenge-skill balance (Csikszentmihalyi, 1998; Cowley et al. 2008; Nakamura & Csikszentmihalyi, 2014)

Group leaderboards limited to a small number of participants (less than ten) and relative leaderboards allowed for reaching the next level with a maximum of 2 additional posts/replies.

Based on the aforementioned detailed literature review, there remains a lack of awareness on the effectiveness of various design elements of leaderboards due to the fact the majority of research in gamification has employed multiple gamification elements while using a single measurement of engagement (Bovee et al., 2020a; Looyestn et al., 2017; Lopez et al., 2019; Schöbel et al., 2020). Moreover, while the leaderboard represents one of the most popular game elements in the research, there is limited research showing the effectiveness of various design elements of leaderboards. The amount of research is even less when evaluating different design elements of leaderboards from a qualitative perspective.

Accordingly, the purpose of this project is to answer the following research questions:

*What are the leaderboard design principles that will maximize user engagement?*

*What are student perceptions of leaderboards used in an online discussion board?*
CHAPTER 3

RESEARCH METHODOLOGY

This chapter, first, argues the qualitative research methodology adopted in this dissertation. Second, this chapter reviews the artifact adapted from a previous study which is designed to produce the two leaderboards in this study. Third, this chapter details the study design and how the principles of flow theory were instantiated using clear goals in instructions for the game, appropriate challenge skill balance for leaderboards, and timely feedback during the game via regular notifications.

Qualitative Research Methodology

The study employs qualitative research methods to investigate the relationship between leaderboard design elements and user engagement. This study uses a qualitative inductive research method to examine perceptions of leaderboards used in an online discussion. Qualitative procedures are used to provide a means for accessing unquantifiable facts about the perceptions of leaderboards used in an online discussion. As a result, the qualitative techniques enable the researcher to share in the understanding and perceptions of this popular game element from the perspective of the end user. The qualitative method developed for this research is appropriate for discovering reasons that describe user interactions with a leaderboard.

There are several factors that underlie the importance of using qualitative methods in order to enable an examination of the factors that impact user engagement with an online leaderboard. First, there is a need to identify context-specific measures of user engagement rather than relying on context agnostic instruments. User engagement in contexts such as health, education, marketing, and computer science is defined uniquely and, thus, should be measured differently. Second, gamification research needs to collect perceptions of game elements to improve engagement, not just measurements of the outcomes derived from using a game element. Finally, it is important to avoid assuming a single cause of relationships
between dependent and independent variables because rich insights can be obtained by looking at the interrelationships of the independent and dependent variables (Kaplan, 1988). The qualitative method used in this study provides information that reveals what students think about the quality, meaning, perception and context of leaderboards.

The artifact

A representative artifact (Bovee et al., 2020b) that encompasses the various design elements of concern is used. The focus for the present study is to use the artifact in Bovee et al., 2020b to a) deploy two different leaderboards (group and relative) and b) use qualitative semi-structured interviews to evaluate each leaderboard for their efficacy in improving user engagement in online discussions.

In Bovee et al. 2020b, an artifact was developed which imports online discussion data into a database where it can then be exported to a leaderboard for the purpose of improving user engagement in the online discussion. In that study a single leaderboard was used in an online discussion to demonstrate improved cognitive and behavioral engagement over online discussions which did not employ a leaderboard. The present study uses the same artifact to create two popular leaderboards (group and relative) which were evaluated by participants through semi-structured interviews for design principles that improve engagement.

Figure 2 depicts the process for creating the relative and group leaderboards from data exported from the discussion group.

![Figure 2: Gamification of online discussion board](image-url)
First, data was imported into the database using the export a CSV file from the online discussion area. Second, two versions of a leaderboard were created: a relative leaderboard and group leaderboard. Finally, reports regarding discussion data were used in this case study to analyze the discussion data for information related to improving leaderboard design principles.

**Study Design**

The following sub-sections describe the design of the study. The first section describes the subjects and setting for the study within an online discussion board. Next, the section on leaderboards designs presents the design of the two leaderboards evaluated in the project. Finally, the section on feedback describes the communication used to keep subjects engaged in the game.

**Subjects**

Subjects for this study included undergraduate and graduate students enrolled in online courses at a private university. After providing electronic consent to participate in the study, students were presented with instructions on how to login to Flipgrid; a free, online video-based discussion forum. Once logged into the discussion area, the subjects were presented with instructions and a short video describing how to participate in the game and submit discussion posts and replies. See figure 3 for the instruction page. Both the video and leaderboards described the goal of the game: to lead the discussion in total/posts and replies. For the relative leaderboard, the goal was to move to the next level of posts and replies. For the group leaderboard, the goal was to reach the top of the leaderboard in one’s assigned group. Subjects were informed at the start of the study that periodic updates will be sent via email showing the user’s performance in the game based on total posts and replies.
Figure 3: Instructions for online game with links to leaderboards

In order to engage in the discussion, subjects used their webcam or cell phone (via the mobile app) to submit, view, and reply to other video posts by answering questions presented in the discussion. See Figure 4 below for an example of the online discussion from the Flipgrid website illustrating the interface used for discussions in this study.

Figure 4: Example of Flipgrid Interface for Video Discussions

In addition to the directions provided within Flipgrid, participants were automatically sent a welcome email with detailed instructions on participating in the game, goals of the game to lead the discussion in total posts/replies, and links to the two leaderboards to monitor their progress on both the team and level leaderboards.
Leaderboards

Two types of leaderboards, relative and group, were developed in order to compare the challenge skill balance of each type of leaderboard. In order to ensure an appropriate challenge skill balance for each leaderboard, group leaderboards were limited to a small number of participants (less than ten) and relative leaderboards allowed for reaching the next level with a maximum of 2 additional posts/replies. The next sub-sections describe the two leaderboards (relative and group) used in this study.

Relative (Level) Leaderboard

The relative leaderboard was used for subjects to view their assigned level based on their individual total posts and replies. In addition to reporting which level each student has attained, the relative leaderboard displayed a message encouraging students to keep posting by indicating how many posts/replies are needed to attain the next level. There was a maximum of two additional posts/replies for students to reach the next level ensuring the challenge is both realistic and appropriate (Csikszentmihalyi, 1998). See figure 5 for a screenshot of the relative leaderboard depicting students reaching level 4; the highest level possible in the game. Subject names on the Y axis have been removed. The X axis depicts the total posts and replies.

Figure 5: Relative Leaderboard Depicting Students Reaching Level 4
Group leaderboard

For the group leaderboard (see figure 6), each subject was displayed within a small group (5-10) of other subjects based on the first letter of last name. See figure 6 for a screenshot of the team leaderboard depicting the leaderboard for the three teams. This design ensured a random assignment of students that did not relate to performance in terms of number of total posts and replies.

![Team Leaderboard: Total Posts/Replies](image)

*Figure 6: Group/Team Leaderboard*

Feedback

The feedback provided in the study was provided, primarily, through emails that were sent throughout the experimental timeframe. Subjects were informed at least 3-5 times per
week via email of their current position on the leaderboard. Subjects were also able to, at any time, access the online leaderboards to receive feedback on game performance. See figure 7 for a screenshot of the final email announcing both the winning team and students reaching the highest level.

**Figure 7: Final email announcing winners in team and level (relative) leaderboards**

To sum, this chapter, first, defended the qualitative research methodology adopted in this project with the need to discover user perceptions of different types of leaderboards. Second, this chapter reviewed the artifact adapted from a previous study which was used to produce the two leaderboards in this study. Third, this chapter reviewed the study design including information on subjects, the Flipgrid online discussion board, the two types of leaderboards analyzed, and the feedback provided to subjects during the game.
CHAPTER 4

DATA ANALYSIS

This chapter discusses the technique adopted in this project for discovering design principles of leaderboards from online discussions that used two popular types of leaderboards. First, it describes the data collection and analysis. Secondly, the chapter discusses the process for developing the design principles and theoretical model. Figure 8 below shows the methodology adopted in this study for the creation of design principles and a theoretical model for maximizing engagement using leaderboards.
Data Collection & Analysis

Analysis of the leaderboard designs was conducted using a single case study. The Eisenhardt case study approach (Eisenhardt, 1989) was used along with data collected from semi-structured interviews and reports about the discussion data.

Data Collection

Data collection was interpreted using the theoretical background of flow to inform the interview questions and analysis of the data. Using Eisenhardt’s case study approach (Eisenhardt, 1989), interviews and discussion reports were the primary data collection method and open coding for data analysis. The Eisenhardt research method is designed to produce in-depth descriptions of perceptions of leaderboards as related to engagement in the online discussion. Using a seven-step approach (see figure 9), the research strategy focuses on understanding the dynamics present in a setting.

![Figure 9: Research Methodology](image)

This approach is in line with generally accepted approaches to develop relationships or theory from cases (Walsh, 2015; Yin, 2009; Eisenhardt, 1989; Baskerville & Myers, 2004). The Eisenhardt method was selected for three reasons: 1) using constant comparison with literature it can generate new relationships or theory, 2) emergent theories will be likely testable using constructs that are measurable, and 3) relationships, models, or theories can be generated because the theory building process is linked to data and other evidence (Eisenhardt, 1989).
As suggested by Morse (2002) multiple techniques were used in data collection for the purpose of triangulation: transcripts from asynchronous video interviews, transcripts from synchronous interviews, and descriptive reports on the discussions. Semi-structured interviews were used to obtain first-hand information on participants’ perceptions of the design of each leaderboard game element used in the online discussion as related to improving engagement. The questions were developed using flow theory (Csikszentmihalyi, 1990) as the theoretical foundation. The three conditions used to design the leaderboard; clear goals (CG), appropriate challenge-skill balance (ASB), and timely feedback (TF) were converted into a series of questions designed to collect important data on the students’ perceptions of each leaderboard game element as related to inducing a state of flow: clear goals, an appropriate skill balance, and clear feedback. See Appendix A for the interview guide. In order to develop the questions, the researcher operationalized each of the three elements of flow and converted the element into resulting questions. Table 3 below depicts the mapping of questions to the appropriate elements of flow theory.

<table>
<thead>
<tr>
<th>Elements of Flow</th>
<th>Interview Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear goals</td>
<td>What were your general impressions of the emails containing the leaderboard displaying your position in the game ‘Lead the Discussion!’?</td>
</tr>
<tr>
<td>(Csikszentmihalyi, 1990; Cowley et al. 2008)</td>
<td>How did the presence of a leaderboard in the online discussion factor into your decision to complete additional discussion posts and/or discussion replies?</td>
</tr>
<tr>
<td></td>
<td>What were your general impressions regarding the goals or instructions expressed in the game?</td>
</tr>
<tr>
<td></td>
<td>What about the leaderboard promoted your motivation and engagement in the online discussion?</td>
</tr>
<tr>
<td>Challenge skill balance</td>
<td>What about the leaderboard undermined your motivation and engagement?</td>
</tr>
<tr>
<td>(Csikszentmihalyi, 1998; Cowley et al. 2008)</td>
<td></td>
</tr>
</tbody>
</table>
2008; Nakamura & Csikszentmihalyi, 2014) Did your placement on the leaderboard have any impact on your decision to complete additional posts/replies? Can you explain?
If you had a choice, would you choose a gamified discussion board or a traditional assignment? Can you explain?

Timely feedback Were the emails displaying your position on the leaderboard sent in a timely manner?
(Cowley et al. 2008; Nakamura & Csikszentmihalyi, 2014) Did the presence of an online version of your leaderboard promote your engagement or learning in the online discussion?

Following the experimental timeframe, subjects involved with the discussions were scheduled and participated in online interviews with the researcher. Participants included individuals who decided to participate in the game as well as those who did not. This was designed to capture the various opinions on the use of each leaderboard game element as well as reasons why the presence of a leaderboard may have resulted in not engaging with the game. Since the interviews were semi-structured, questions were modified occasionally, and sometimes new questions emerged based on the conversation with the students. Unexpected answers lead to further discussion adding more depth to the data collected through this source. Participants were interviewed once at the end of the experimental period (ten days) to determine whether, and to what extent, the leaderboard they experienced motivated and engaged them. The interview highlighted those aspects of the leaderboard that were most/least engaging and also indicated which elements motivated them the most/least. Researchers were careful to incorporate member checking (Guba & Lincoln, 1994) throughout the discussions by repeating answers, using a reflective listening strategy, and asking them to verify answers for accuracy. All interviews were transcribed to allow for further analysis and review.

Data Analysis

Each interview was recorded via Zoom and an iPhone using a voice memo application. Both recording methods resulted in digitally recorded files of the conversations. The transcripts derived were cleaned using Microsoft Excel in order to improve formatting
before importing into AtlasTi. These transcriptions were reviewed against the recordings and corrections were made to the transcriptions based on the comparisons. Data analysis consisted of the analysis of transcripts created from interviews, transcripts from video discussions, and a survey.

The result of the data collection is 221 minutes of recorded conversation which converted to 135 pages of transcribed text. The basic outline of questions prescribed in the protocol was adapted as appropriate for each individual participant. As interesting topics surfaced spontaneous questions were posed and additional relevant data was collected. When ambiguity arose follow-up questions were issued to clarify the intended meaning.

Open Coding

Interview data was analyzed using Corbin & Strauss’ (2014) open coding method. Within the transcripts, various “Labels of meaning” were identified and placed next to each relevant occurrence. Each relevant piece of information in the written text is analyzed and tagged with a descriptive verbal code. These codes represent the meaning and can often use a particularly specific word from the actual dialog. The tool ATLAS.ti served as the tool for both for the transcribed content from the interviews and for the coding. Use of a database for qualitative research artifacts establishes a chain of evidence which strengthens construct validity (Yin, 2008). The ATLAS.ti tool was used to manage the association of codes with sections of text from the interviews. This tool allowed for systematic organization and the ability to visually represent the relationship of open codes to later steps involving axial and selective codes.

Axial coding

Second, once the granular data was tagged with succinct and descriptive codes (open/initial coding) it was sorted and grouped into related conceptual clusters in a process called axial coding. The data representing events, behaviors, actions, emotions, perspectives, and interactions that are found to be conceptually similar in nature or related in meaning was grouped under abstract concepts that best represent the design features and perceptions of leaderboards. According to Corbin and Strauss (2014), although events or happenings might be discrete elements, the fact that they share common characteristics or related meanings enables them to be grouped.

Selective/Theoretical Coding
The next phase of coding was theoretical or selective coding. In this phase, the researcher abstracts from the concepts to broader categories that form the essence of the emergent theory. Corbin and Strauss (2014) suggest that a core unifying category should emerge during selective coding. Categories, according to Corbin and Strauss (2014), represent these higher order concepts that can be grouped. Given the purpose of this study, categories served to explain how students perceived the leaderboard and/or game and the effects it has on engagement with the online discussion.

Theoretical sampling

Reliability of these groupings was achieved through theoretical sensitivity, iterative coding and theoretical sampling. Theoretical sensitivity is required to enable the researcher to interpret and define data and thus develop relationships, models or theories that are grounded, conceptually dense and well-integrated (Corbin & Strauss, 2014). Sources of theoretical sensitivity are the literature, professional and personal experiences. Additional reliability was achieved through the iterative use of open and axial coding to bring out the concepts and discover any causal relationships or patterns in the data. Along with the groupings of abstract concepts (open coding) and identification of causal conditions (axial coding), that lead to the development of the design principles, additional coding was carried out iteratively using theoretical sampling. Theoretical sampling adds further reliability of data through identifying concepts that have proven theoretical relevance to evolving relationships, models or theories. Glaser et al. (1968) state that the researcher does not approach reality as a tabula rasa but, rather, assumes a posture that will help him or her abstract significant categories from the data based on the constructs identified in the literature.

Theoretical model

The goal of this research is to generate theory grounded in the data. The analysis of the data results in a number of concepts which are grouped into themes or categories. These concepts result in a theoretical model depicting the relationship of the associated concepts on the research questions.
CHAPTER 5

FINDINGS

This chapter will, first, provide information about the results of the study in relationship to participants and data sources. Second, it will elaborate on the detailed codes and their relationships that emerge from the data resulting in a diagram to this effect. Finally, a table overview of the findings is presented followed by a detailed discussion of each principle.

Results

Participant Information

The research involved the use of participants and data from three sources: interviews, online discussion data, and survey data. A total of 36 participants participated in the online discussion generating 15 pages of transcripts. A total of 16 participants participated in the interviews and included undergraduate to graduate students with an age range of 18 to 64. Transcripts from the interviews and other data sources resulted in a total of 135 pages and 221 total minutes of audio recording. Only eight participants submitted a survey. These were primarily individuals who were unable to complete the interview but still wanted to provide feedback related to the research questions in the study. Participant information is summarized in the table below.

Table 4 – Participant Information

<table>
<thead>
<tr>
<th>Demographic Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of participants from interviews:</td>
</tr>
<tr>
<td>Number of participants from online discussion:</td>
</tr>
<tr>
<td>Number of participants from surveys:</td>
</tr>
</tbody>
</table>
Analysis of the 135 pages of transcripts resulted in 109 individual codes (see Appendix A: Initial Codes). The codes that were created were a result of the open coding phase of analysis. Some codes were ultimately deemed insignificant resulting in a total of 63 codes that reflected the perceptions of participants toward the leaderboards and towards engagement as a result of the leaderboards. These codes were then grouped into 16 concepts as part of the axial coding phase (see Appendix B: Focused Codes). Finally, a total of eight categories emerged from the data from the 16 concepts.

Table 5 shows the progression from open coding to concepts. Open codes are short summaries of participant narrative from the interviews and other data sources. Through a line by line analysis of the transcripts, the researcher flags the meanings of each conversation. Concepts are also known as axial codes in the Corbin and Strauss taxonomy (2014). Concepts provide a grouping of the meaning from related codes into a word or phrase. These concepts can then become the constructs of resulting categories. Categories provide the highest level of abstraction providing labels that capture the theoretical significance of a set of related concepts. Corbin and Strauss (2014) refer to categories as selective codes in their taxonomy.

### Data Collection Information

<table>
<thead>
<tr>
<th>Interview Participants</th>
<th>16</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minutes of recording</td>
<td>221</td>
</tr>
</tbody>
</table>

**Table 5 – Findings Summary**

<table>
<thead>
<tr>
<th>Categories – abstractions based on concepts</th>
<th>Concepts – abstractions from the open codes</th>
<th>Open Codes – created by the researcher based on interview transcription narratives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear leaderboard instructions are needed for positive engagement.</td>
<td>Context-Expectations</td>
<td>Thorough, understood, a lot of information, user friendly, never used a leaderboard, time requirement, user-friendliness, prior experience</td>
</tr>
<tr>
<td>Clear system instructions are needed for positive engagement.</td>
<td>System instruction inhibitors</td>
<td>Trouble viewing the leaderboard, not clear enough, not safari supported, not used before, application new to me, hard time figuring system out</td>
</tr>
<tr>
<td>Context-Implementation</td>
<td>Excited to use, thought it was easy, tried at first, took some time,</td>
<td></td>
</tr>
<tr>
<td>System instruction promoters</td>
<td>Excited to use, like the format, motivate me more, enjoy seeing people, feels more like conversation, can see the emotion in comments</td>
<td></td>
</tr>
<tr>
<td>-------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Global leaderboards should be re-designed to sliced leaderboards to minimize negative engagement for lower ranking users.</td>
<td>Competitive</td>
<td>Competitive, control my destiny, not team oriented</td>
</tr>
<tr>
<td>Discouraging</td>
<td>Have to work hard, discouraged with my position, give up, step it up, see myself failing</td>
<td></td>
</tr>
<tr>
<td>Relative leaderboards can result in positive engagement when the effort to reach next level is perceived as achievable</td>
<td>Achievable</td>
<td>Attainable, feasible to attain level, each level was viable</td>
</tr>
<tr>
<td>Independent</td>
<td>my own actions, less unknowns, don’t need to depend on others</td>
<td></td>
</tr>
<tr>
<td>Team leaderboards can improve positive engagement when rankings are present both between and within teams</td>
<td>Team loyalty</td>
<td>Didn’t want to let team down, forward movement of team, other team rankings motivated</td>
</tr>
<tr>
<td>Team uncertainty</td>
<td>Ranking linked to team, unknowns of teams, poor team connection</td>
<td></td>
</tr>
<tr>
<td>Collaborative</td>
<td>Collaborate, working together, not competitive, multiple perspectives, part of a team</td>
<td></td>
</tr>
<tr>
<td>Social feedback regarding performance from leaders and peers can result in positive engagement.</td>
<td>Social peers</td>
<td>Social influence, help my peers, not let team down</td>
</tr>
<tr>
<td>Social leaders</td>
<td>Leader, help researchers, study, project, science,</td>
<td></td>
</tr>
<tr>
<td>For level leaderboards, timely feedback on levels achieved can result in positive engagement.</td>
<td>Level trends</td>
<td>Liked ability to monitor performance, emails acted as reminder, viable to reach next level, levels achieved, reports of levels changing</td>
</tr>
<tr>
<td>For team leaderboards, timely feedback on team rankings and individual rankings within teams can result in improved performance.</td>
<td>Team rankings</td>
<td>Trends in team leads, team accountability communication, score reported within teams, scores reported among teams</td>
</tr>
</tbody>
</table>

The findings can be summarized into three main themes: clear instructions, challenge skill-balance, and feedback. First, in terms of clear instructions, participants indicated clear
goals for the game were critical to improving engagement. They contrasted this with a second component of clear instructions: providing clear instructions on the system itself. We will look at this more as we analyze the concepts and codes that emerged from the data.

The second category which emerged from the data is challenge-skill balance techniques for each type of leaderboard. Participants expressed each type of leaderboard (global, relative and team) have distinct advantages and disadvantages which can be used in facilitating user engagement. In the following sections, we will look explore the findings which emerged in each of these types of leaderboards as they relate to user perceptions of improving engagement.

Finally, participants expressed the importance of providing timely feedback for each type of leaderboard. Given the unique aspects of each type of leaderboard, participants expressed the need for specific feedback principles that we will explore that relate to each type of leaderboard.

In the next section, we will review each of these three categories in more detail describing the process used to analyze the data resulting in a theoretical model describing system engagement factors associated with global, relative, and team leaderboards.

**Clear instructions**

Two design principles emerged from discussions with participants related to providing clear instructions:

*CI-P1: Clear leaderboard instructions are needed for positive engagement.*

*CI-P2: Clear system instructions are needed for positive engagement.*

Based on these principles, the following definition of clear instructions is offered: clear instructions can be defined as providing the needed information for users to succeed in the use of each type of leaderboard and the system for which the leaderboard game element(s) has been assigned.

*CI-P1: Clear leaderboard instructions are needed for positive engagement.*

Categories “Context-Expectations” and “Context-Implementation” were elucidated from codes in this area which reflected both the initial expectations of the users and the impact of the instructions on the implementation of the game. Expectations of users reflected concerns over time requirements along with the user-friendliness of the leaderboard. Prior
experience using leaderboards was also a factor in expectations of the use of the leaderboard. The category “context-implementation” reflected sentiments of users related to the users experience after reviewing instructions provided for the game and leaderboard. Participants felt that instructions regarding the use of a leaderboard should not be considered “self-explanatory”. Relative leaderboards, for example, should provide detailed instructions related to the types and numbers of levels as well as level thresholds (i.e. “only need one to two posts to reach the next level”). Team leaderboards, in contrast, should offer the needed information to monitor all teams, assess which teams are performing well, and possibly provide information on monitoring individual performance within the team.

CI-P2: Clear system instructions are needed for positive engagement.

Another principle that surfaced was providing detailed instructions on the use of the system for which the leaderboard game element has been assigned. Game elements such as leaderboards are added to non-game systems in order to improve engagement with the system. While some users felt the leaderboards increased a desire for engagement with the system (in this case a video discussion), the process by which to create video discussions within the Flipgrid interface was, for some users, unclear as reflected in the concept “system instruction inhibitors”. For example, participant #9 stated:

“I thought the instructions were pretty clear, though the experience of using Flipgrid was very new to me.”

However, the concept “system instruction engagement” emerged reflecting that, for many other participants, the instructions associated with the use of the video discussion board resulted in positive engagement.

Table 6 provides, the two design principles within the theme of clear instructions, a practical example of each design principle, and an example from user feedback.

Table 6. Design principles: Clear instructions

<table>
<thead>
<tr>
<th>Design Principle</th>
<th>Practical example</th>
<th>Examples from user feedback</th>
</tr>
</thead>
<tbody>
<tr>
<td>CI-P1: Clear leaderboard</td>
<td>Instructions provided using various media (ie text and video) regarding the purpose of each leaderboard. For example, “To reach the next level” or “To lead against other teams”.</td>
<td>“I thought the instructions for reviewing the level leaderboard were thorough and to the point”</td>
</tr>
</tbody>
</table>
**CI-P2: Clear system instructions are needed for positive engagement.**

Instructions on systems supported by the game. For example, “Here are the directions for completing a video discussion post”. “I thought the instructions were pretty clear, though the experience of using Flipgrid was very new to me”

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**Challenge-skill balance for global, relative, and team leaderboards**

Three design principles surfaced from discussions with participants related to providing adequate challenge-skill balance for the three main types of leaderboards: global, relative, and team.

**CSB-P1:** Global leaderboards should be re-designed to sliced leaderboards to minimize negative engagement for lower ranking users.

**CSB-P2:** Relative leaderboards can result in positive engagement when the effort to reach next level is perceived as achievable.

**CSB-P3:** Team leaderboards result in positive engagement when rankings are present both between and within teams.

Taken together, participants viewed challenge-skill balance as evaluating both the challenge and skill required for each unique type of leaderboard in order to maximize user engagement. Following is a more detailed explanation of each of the three principles within this category.

**CSB-P1:** Global leaderboards should be re-designed to sliced leaderboards to minimize negative engagement for lower ranking users.

Global leaderboards, or sometimes called infinite leaderboards, make all users and rankings visible. While this project did not employ a global leaderboard, many participants expressed perceptions of this leaderboard type resulting in valuable findings. Three concepts emerged related to this principle: “motivating”, “discouraging” and “competitive”. First, global leaderboards emerged as motivating. Statements along the lines of “would be excited to use” and “would like to see my ranking go up” and “motivates me to engage” all reflected the well-established and powerful potential of this type of game element to develop engagement. However, for many users the opposite was true in saying an infinite leaderboard
results in negative engagement or even abandoning the game completely as a result of “seeing myself fall behind” and feeling “discouraged with my ranking”. Finally, the “competitive” category was created as a result of an emerging theme of users who stated they identified as competitive or non-competitive in discussions with their relationship with an infinite leaderboard. Generally, users identifying as competitive aligned with positive perceptions with this type of leaderboard and non-competitive users aligned with negative perceptions. Taken together, it is clear that the traditional, infinite leaderboard should be re-designed to “sliced” leaderboards to avoid alienating lower performing and non-competitive users. By displaying a user’s score within a “slice” of other users at a similar score, the perception of reaching the top of the leaderboard will be the same; regardless of ranking.

CSB-P2: Relative leaderboards can result in positive engagement when the effort to reach next level is perceived as achievable.

Relative leaderboards generally employ levels that allow users to view their performance within a particular level; relative to other users performing at or about the same ranking. Two concepts emerged within the development of this category: “independent” and “achievable”. Regarding “independent”, the perceptions of participants reflected that these instantiations of leaderboards provide a measure of control in comparison to the global or team leaderboards. Participant #5 reflects this sentiment saying:

“The level leaderboard motivates me more to engage in the discussion. The reason why is, in a level leaderboard my own actions is what drives me up the leaderboard. The more I engage in the discussion, the more points I generate and the more points I generate, the more I move up the leaderboard. In the team leaderboard, the overall points are driven off of you and your teammates. My team member could potentially impact the team’s overalls or due to a lack of engagement.”

Participants also viewed this type of leaderboard as “achievable”. In this project, the next level could be achieved with 1-2 posts. Level 4 was the highest level and could be achieved in 10 posts and/or replies. Concepts derived from participants including “viable” and easy to “attain”, reflect the level leaderboard design needs to ensure that the perceived effort to reach each new level is both realistic and achievable. See figure 10 below for an example of the level leaderboard for level 4.
CSB-P3: Team leaderboards can improve positive engagement when rankings are present both between and within teams.

The team leaderboard used in this project used rankings reflecting the performance of each team as well as the individuals within each team. Three concepts emerged within the development of this category: “team loyalty”, “team uncertainty”, and “collaborative”. In regards to “team loyalty” participants expressed that this leaderboard fostered loyalty to the team in two areas: a) the performance of the user’s team against other teams in the game, and b) the performance of the user’s performance within the team. The group leaderboards in this study displayed both the performance of each of the three teams as well as individual user scores within each team. See figure 11 for examples of both the overall team performance and the performance of individuals on one team.
The competition developed, thus, seemed to work on two levels: the desire to outperform the other teams, and the desire to “support my team” by contributing more total posts and replies. For example, many users expressed the sentiment “the team leaderboard had the best engagement for me as it showcased all the members, where they rank, and how they are doing against other teams”. The concept “collaborative” reflected a personality type for users identifying with this type of leaderboard and the need to support those within their team. For example, participant 11 says: “I put more effort into the team leaderboard because I was concerned about letting the team down”. Despite these positive sentiments related to the team leaderboard improving engagement, the category “team uncertainty” was created as a result of the perception from many participants surrounding the unknowns associated with performance when a team leaderboard is used.

For example, participant 10 says:

“I have never been in a group where people equally pulled their weight and I don't like to have my grade tied to the work of others. There's just too many unknowns and unexpected things that happen when you're working with a random group of people that you may or may not know and whose work may compromise your own.”

Table 7 shows the design principles related to the three types of leaderboards from the user’s context. The three types of leaderboards included global leaderboards, relative leaderboards, and group leaderboards.
Table 7. Challenge skill balance for global, relative, and team leaderboards

<table>
<thead>
<tr>
<th>Design Principle</th>
<th>Practical example</th>
<th>Examples from user feedback</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CSB-P1: Global</strong></td>
<td>Leaderboard reflects subset of users with similar scores to increase perception all users are performing relatively well</td>
<td>“If I saw myself falling to a certain place, I would give up”</td>
</tr>
<tr>
<td><strong>Leaderboards should be re-designed to sliced leaderboards to minimize negative engagement for lower ranking users.</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CSB-P2: Relative</strong></td>
<td>Leaderboard displays user among a small group of other users performing at the same level</td>
<td>“Level leaderboard motivates me more to engage in the discussion. The reason why is, in a level leaderboard my own actions are what drives me up the leaderboard. The more I engage in the discussion, the more points I generate and the more points I generate, the more I move up the leaderboard.”</td>
</tr>
<tr>
<td><strong>Leaderboards can result in positive engagement when the perceived effort to reach next level is perceived as achievable.</strong></td>
<td>Next level is identified as realistic and likely to attain</td>
<td></td>
</tr>
<tr>
<td><strong>CSB-P3: Team</strong></td>
<td>Each team leaderboard displays individual scores of users</td>
<td>“I think the team leaderboards are better because you hold each other accountable”</td>
</tr>
<tr>
<td><strong>Leaderboards can improve positive engagement when rankings are present both between and within teams.</strong></td>
<td>Develop in-team performance measures</td>
<td></td>
</tr>
</tbody>
</table>
Timely feedback

The following design principles emerged from discussions with participants related to providing timely feedback:

TF-P1: For level leaderboards, timely feedback on levels achieved can result in positive engagement.

TF-P2: For team leaderboards, timely feedback on team rankings and individual rankings within teams can result in improved performance.

TF-P3: Social feedback regarding performance from leaders and peers can result in positive engagement.

TF-P1: For level leaderboards, timely feedback on levels achieved can result in positive engagement.

First, for level leaderboards, the concept “level trends” emerged from open codes. Level leaderboards are distinct from other leaderboards in that that goal is to reach the next highest level as opposed to reaching the top of the leaderboard for global leaderboards. In this study, the goal associated with the level leaderboard was to reach the next level by posting at least 1-2 additional posts. Timely feedback, therefore, was viewed by participants as a critical component of this type of leaderboard in terms of reporting trends on levels (ie moving up or moving down) as well as levels achieved.

TF-P2: For team leaderboards, timely feedback on team rankings and individual rankings within teams can result in improved performance.

For team leaderboards, the concept “team rankings” emerged from the open codes. This concept was developed in relation to sentiments related to viewing updates on both the team’s overall performance and the participant’s score within each team. Participants indicated receiving timely communication on both the performance of the team as well as individual performance within a team was a powerful motivator. “Team Accountability” was often referenced in what participants described was social comparison on two fronts: intra competition (evaluating scores within the team) and extra competition (evaluating the scores among teams).

TF-P3: Social influence from leaders and peers can result in positive engagement.
Finally, the concepts “social peers” and “social leaders” emerged from the open codes communicating that social influence was shown to be a powerful tool in improving system engagement. As revealed by the concepts, participants appeared to be influenced by two sources that provided feedback on performance: leaders of the game and peers. Regarding the social influence of leaders, participants described the desire to engage with the game simply because of the need to satisfy the needs of the research project. Regarding the social influence of peers, participants described the need to connect with peers and meet the needs of the team.

Table 8 shows the design principles, a practical example, and example from user feedback related to providing timely feedback from the user’s context.

Table 8. Design principles for providing timely feedback

<table>
<thead>
<tr>
<th>Design Principle</th>
<th>Practical example</th>
<th>Examples from user feedback</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TF-P1: For level leaderboards, timely feedback on levels achieved can result in positive engagement.</strong></td>
<td>Regular emails/notifications for users reaching higher levels</td>
<td>“I liked the emails and viewing the changes in levels for myself”.</td>
</tr>
<tr>
<td><strong>TF-P2: For team leaderboards, timely feedback on team rankings and individual rankings within teams can improve engagement.</strong></td>
<td>Regular emails/notifications on team leaders as well as individual scores within teams.</td>
<td>“The emails served as a powerful reminder that I was accountable to my team’s performance.”</td>
</tr>
<tr>
<td><strong>TF-P3: Social influence from leaders and peers can result in positive engagement.</strong></td>
<td>Provide multiple opportunities for leaders and peers to influence each other on performance via email or other communication</td>
<td>“I did not want to disappoint my peers on my team”.</td>
</tr>
</tbody>
</table>
In this chapter we have explained information about the study participants and data sources. This was followed by a discussion of the detailed codes and their relationships that emerged from the data. An overview of the findings was provided in table format and was followed by a detailed discussion of each construct along with a demonstration of how the constructs emerged from the data.
CHAPTER 6

DISCUSSION

In this chapter we will provide a discussion of an emergent theoretical model, the process used to create each construct in the model, and a discussion of the relationship of each construct in the model to system engagement. The chapter will then provide a discussion on new contributions to the literature including a table summarizing design principles for three types of leaderboards.

Discussion

Our two primary purposes in this project related to understanding leaderboard design principles that will maximize user engagement and student perceptions of leaderboards used in an online discussion. First, we wished to develop leaderboard design principles that provide a better understanding of how to develop system engagement using two popular types of leaderboards. Second, using a case study of students using a leaderboard in an online discussion, we sought to better understand the perceptions of students towards different types of leaderboards as it relates to improving engagement with the system. As a result of conclusions from the data in these two areas, a theoretical model was created that can be used to better understand factors that impact system engagement when different types of leaderboards are employed.

Design principles

To summarize the results relevant to developing design principles that maximize user engagement, first, we developed two popular leaderboard designs (team leaderboard and level leaderboard). Second, the two leaderboards were then added to an online discussion in which each of the leaderboards reflected each user’s performance in a game called “Lead the Discussion”. The object of the game was to lead the discussion in terms of total posts and replies. Participants were able to improve and monitor their performance both as a team through the team leaderboard and individually through the level leaderboard. The team
leaderboard included both the score of each team as well as individual scores within each team. The level leaderboard displayed the user’s performance along with other users who had had similar scores.

Finally, following the conclusion of the game, participants were interviewed regarding the design of each leaderboard as it related to user engagement with the online discussion. Using data from interviews, online discussion transcripts, and data from a survey a total of eight design principles were created. Each of these design principles will be summarized in the next section.

**Perceptions of Leaderboards**

As mentioned previously the second goal of this research is to generate theory grounded in the data on user perceptions of leaderboards. The analysis of the data resulted in a number of concepts which were grouped into themes or categories. The three main categories are clear instructions, challenge-skill balance techniques, and timely feedback. The emergent theoretical diagram with associated constructs is depicted below in figure 12.

![Figure 12: Theoretical Model](image-url)
The model represents many features. The primary categories that lead to positive system engagement include clear instructions (CI P1-2), challenge/skill balance (CSB P1-P3), and timely feedback (TF P1-P3). Within each primary category are the design principles for that category. In order to develop the categories, the researcher developed the construct by systematically coding the data from participant quotes in transcripts to a category theme. To illustrate the process of creating each construct, three figures have been created for each of the three constructs in the model.

Figure 13, figure 14, and figure 15 show examples of how the theoretical constructs emerged from an example participant quote through the open, axial, and selective coding phases resulting in the three main constructs. ATLAS.ti served as the tool for both for the transcribed content from the interviews and for the coding. ATLAS.ti allowed for systematic organization and the ability to visually represent the relationship of open codes to subsequent steps involving axial and selective codes as shown in Appendix D.

The process to create the three main themes in the model can be explained in five phases of data analysis. First, the “illustrative participant source” represents a quote from transcript data in interviews, transcript data from discussions, or the survey. For example, for figure 14, “I think the team leaderboards are better because you hold each other accountable”.

Second, using Corbin & Strauss’ (2014) open coding method various labels of meaning were identified and placed next to each relevant occurrence such as “Didn’t want to let team down” as shown in figure 14.

Third, axial coding was performed. Data representing events, behaviors, actions, emotions, perspectives, and interactions that were found to be conceptually similar in nature or related in meaning were grouped under abstract concepts that best represent the design features and perceptions of leaderboards such as “positive engagement teams” as shown in figure 14.

Fourth, concepts were elucidated to form the selective codes or categories (Corbin & Strauss, 2014) such as the one in Figure 14: “Team leaderboards can improve positive engagement when rankings are present both between and within teams”. Categories, according to Corbin & Strauss (2014), represent these higher order concepts that can be grouped. Given the purpose of this study, categories served to explain how students
perceived the leaderboard and/or game and the effects it has on engagement with the online discussion.

Finally, related categories were grouped into theoretical constructs. Theoretical constructs were developed from finding relationships in the categories. For example, the three categories associated with leaderboards were grouped into the theme “challenge-skill balance of leaderboards” as shown in figure 14.

Figures 13 and 15 depict the same process for the other two constructs in the model: clear instructions and timely feedback.
“I thought the instructions were pretty clear, though the experience of using Flipgrid was very new to me”

Open Code

Hard time figuring system out

Axial Code

System instruction inhibitors

Selective Code

Clear system instructions are needed for positive engagement

Theoretical Construct

Clear instructions

Figure 13 – Emergence of “Clear instructions” construct
I think the team leaderboards are better because you hold each other accountable

Didn’t want to let team down

Positive engagement teams

Develop team loyalty via rankings both between and within teams

Challenge skill balance of global, relative, and team leaderboards

Figure 14 – Emergence of “challenge skill balance of leaderboards” construct
Illustrative Participant Source

“I felt achieving the levels was viable”

Open Code

Each level was viable

Axial Code

Achievable

Selective Code

Provide timely feedback on users reaching new levels

Theoretical Construct

Timely feedback

Figure 15 – Emergence of “Timely feedback” Construct
System Engagement Factors

After creation of the three main constructs, the positive and negative factors of each construct were identified in relationship to user perceptions of system engagement as shown in the theoretical model. Following is a summary of each of the three main constructs and the resulting positive and negative outcomes toward engagement.

Clear instructions

Participants expressed the need to provide detailed instructions, first, on the use of each type of leaderboard and, second, on the system the leaderboard is designed to improve. Negative system engagement can result by assuming the use of a leaderboard is “self-explanatory”. Consistent with the findings of Matalloui et al. (2017) on providing clear goals, we found positive system engagement results when clear instructions are provided for each type of leaderboard. Relative leaderboards should provide detailed instructions related to the types and numbers of levels as well as level thresholds (i.e. “only need one to two posts to reach the next level”). Team leaderboards, in contrast, should offer the needed information to monitor all teams, assess which teams are performing well, and possibly provide information on monitoring individual performance within the team.

Secondly, in addition to detailed instructions on the leaderboard, positive or negative system engagement can result to the degree of instructions provided for the system in which the leaderboard game element is designed to improve. This is an area that appears to be overlooked in the literature and a potentially new finding for the literature. Game elements such as leaderboards are added to non-game systems in order to improve engagement with the system. While some users felt the leaderboards increased a desire for engagement with the system (in this case a video discussion), the process by which to create video discussions within the Flipgrid interface was, for some users, unclear. Thus, negative system engagement ensues as a result of ambiguity in completing tasks associated with the system. While gamification literature has previously focused on the importance of clear goals for the game (Bovee et al., 2020; Matallaoui et al., 2017), the authors could find little to no support to discuss the importance of ensuring the instructions for systems supported by the game are adequately understood. In this case, video discussion boards proved to be a challenge for some individuals and, thus, impacted the engagement.
Leaderboard Challenge-Skill Balance

Participants viewed challenge-skill balance as evaluating both the challenge and skill required for each unique type of leaderboard in order to maximize user engagement. Positive and negative system can result from the design of each type of leaderboard.

Global leaderboards, or sometimes called infinite leaderboards, are the most common type of leaderboard and make all users and rankings visible. Our findings support those of Werbach and Hunter (2015) and Park and Kim (2021) demonstrating that positive system engagement can be attained for users identifying as competitive. Negative system engagement can result for individuals appearing at or near the bottom of the global leaderboard. Thus, extreme caution should be used when employing this type of leaderboard. This conclusion is supported by other researchers such as Haque (2010) who found non-competitive personalities using a global leaderboard resulted in negative system engagement. In addition, Werbach and Hunter (2015) had the same conclusion. A solution to this problem is to invest extra effort to design the type of leaderboard in relationship to the audience, type of task, and collaboration needs of the system.

Relative leaderboards generally employ levels that allow users to view their performance within a particular level; relative to other users performing at or about the same ranking. In this project, the next level could be achieved with 1-2 posts. Level 4 was the highest level and could be achieved in 10 posts and/or replies. Participants communicated that system engagement results with this type of leaderboard when the levels are viewed as “viable”. Thus, our findings support those of Park and Kim (2020) in concluding designers should ensure that the perceived effort to reach each a new level is both realistic and achievable. In contrast, negative system engagement results when the perceived effort is perceived as exceedingly difficult.

Team leaderboards result in positive engagement when rankings are used to reflect the performance each team as well as the individuals within each team. This finding is significant as previous research on team leaderboards has, thus far, not examined the impact of adding individual scores within each team. Participants expressed that this type of leaderboard fostered loyalty to the team in two areas: a) the performance of the user’s team against other teams in the game, and b) the performance of the user’s performance within the team. This finding is consistent with recent research by Ninaus et al (2020) who found that team rank,
team commitment, and enjoyment of the game predicted motivation. Conversely, team leaderboards which provide no mechanism for ranking individual scores within the team can lead to negative system engagement as a result of the lack of accountability to the team.

**Timely feedback**

Level leaderboards are distinct from other leaderboards in that that goal is to reach the next highest level as opposed to reaching the top of the leaderboard for global leaderboards. In this study, the goal associated with the level leaderboard was to reach the next level by posting at least 1-2 additional posts. Positive system engagement can result when timely feedback is provided in terms of reporting trends on levels (ie moving up or moving down) as well as levels achieved. Negative system engagement can ensue as a result of failure to provide updates on levels attained and/or ambiguity regarding the levels attained.

Regarding team leaderboards, positive system engagement results when providing timely feedback on both the team’s overall performance and the participant’s score within each team. This finding is consistent with those of Ninaus et al (2020) who examined factors leading to team commitment. Accountability to the team was often referenced in what participants described was social comparison on two fronts: intra competition (evaluating scores within the team) and extra competition (evaluating the scores among teams). Negative system engagement ensues when timely feedback is missing or delayed on rankings within and between teams.

Finally, feedback in the form of social influence from leaders as well as peers plays a significant role in contributing to positive system engagement. This finding is consistent with many established models of technology acceptance such as the Unified Theory of Acceptance and Use of Technology (UTAUT) by Venkatesh et al (2003). This model, which consolidated eight previous acceptance models into one, lists social influence as one of four main constructs that have been found to influence behavioral intention to use a technology. Within this study, the social influences were the organizers of the study and other peers. Positive system engagement ensued when participants were provided with timely feedback from both the organizers and from other team members.
Comparison with existing literature

Table 9 below summarizes the comparison results of our data-grounded design principles extracted from our data analysis with the design principles developed by others in studies relating to improving engagement through gamification.

Table 9. Findings comparison with existing literature

<table>
<thead>
<tr>
<th>Design Principles</th>
<th>Clear instructions</th>
<th>Challenge Skill Balance</th>
<th>Timely Feedback</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Game instructions</td>
<td>Global leaderboards</td>
<td>Team leaderboards</td>
</tr>
<tr>
<td>Matallaoui et al (2017)</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Park and Kim (2021)</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Ninaus et al (2020)</td>
<td></td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>

First, with regard to the comparison of design principles developed by Matallaoui et al (2017), our findings provide empirical support for five of their six design principles. Regarding their “provision of long-term as well as short-term goals”, we provide evidence of two principles in this category: “clear goals for the game” and “clear goals/instructions for the system”. In their category “continuous and prompt feedback”, we provide “timely feedback for teams” and “timely feedback for users reaching new levels” related to the specific design of leaderboards and this category. Regarding their “status” as an aspect of game dynamics, we provide “social influence”.

Second, with regard to the comparison of design principles developed by Park & Kim (2021), our findings provide empirical support for two of their three design principles. Regarding their ”macro and micro leaderboards should be used together”, we provide “global leaderboards”.

Third, with regard to the comparison of design principles developed by Ninaus et al (2020), our findings provide empirical support for four of their design principles. Regarding their “personalized feedback”, we offer “providing feedback for teams” and “providing feedback for levels”. Regarding their “team commitment”, we offer “team leaderboard”. Regarding their “sliced leaderboards”, we offer “level leaderboards”.

New contributions to the literature

In terms of new contributions to the literature, three areas were identified which have not been adequately supported or researched.

1) Clear instructions – While gamification literature focuses on the importance of clear goals for the game, the authors could find little to no support to discuss the importance of ensuring the instructions for systems supported by the game are adequately understood. In this case, video discussion boards proved to be a challenge for some individuals and, thus, impacted the engagement.

2) Team challenge/skill balance - This study used team leaderboards that also included individual rankings within teams. As evidenced by many participants discussion of “accountability”, this design brought out two forms of competition that proved to be powerful. The authors could not find any research in this area that addresses the use of individual scores within teams. This design decision created social comparison on two fronts: intra competition (evaluating scores within the team) and extra (evaluating the scores among teams).

3) Collectively, this study is unique in offering three challenge-skill balance design principles specific to the type of leaderboard. The current body of work seems to focus on the efficacy of leaderboards in general. There is, thus, a significant need to better understand the positive and negative outcomes associated with varying types of leaderboards including level based, team based, and global (or infinite). Discussions with participants in this study identified the granular nature of three different types of leaderboards and, therefore, the differing levels of challenge-skill balance based on the type of leaderboard employed. Table 10 summarizes these findings based on the design principles which emerged from the data for the three types of leaderboards: global, relative and team. Design principles identified with a * in the table represent
new findings which were identified in this study and represent a significant contribution to gamification research.

Table 10: Design principles for three leaderboards

<table>
<thead>
<tr>
<th>Clear Instructions</th>
<th>Global (Infinite)</th>
<th>Relative (Level)</th>
<th>Team</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Clear Instructions</strong></td>
<td>- CI-P1: Clear goals for game</td>
<td>- CI-P1: Clear goals for game</td>
<td>- CI-P1: Clear goals for game</td>
</tr>
<tr>
<td></td>
<td>*CI-P2: Clear instructions for system</td>
<td>*CI-P2: Clear instructions for system</td>
<td>*CI-P2: Clear instructions for system</td>
</tr>
<tr>
<td><strong>Challenge Skill Balance</strong></td>
<td>-CSB-P1: Redesign to use “sliced” leaderboards showing subset of users at similar score</td>
<td>*CSB-P2: Levels are perceived as realistic and attainable</td>
<td>*CSB-P3: Use rankings both within and between teams to foster accountability</td>
</tr>
<tr>
<td><strong>Timely Feedback</strong></td>
<td>-TF-P1: Timely feedback on performance</td>
<td>*TF-P1: Timely feedback on levels attained</td>
<td>*TF-P2: Timely feedback on rankings between and within teams</td>
</tr>
<tr>
<td></td>
<td>-TF-P3: Social influence from leaders and peers</td>
<td>-TF-P3: Social influence from leaders and peers</td>
<td>-TF-P3: Social influence from leaders and peers</td>
</tr>
</tbody>
</table>

In this chapter we have provided a discussion of the emergent theoretical model, the process used to create each construct in the model, and a discussion of the relationship of each construct in the model to system engagement. The chapter concluded with a discussion on new contributions to the literature including a table summarizing design principles for three types of leaderboards.
In this chapter, the findings from the previous chapter are summarized as well as their application for future research in gamification. In terms of new contributions to the literature, three significant findings have been identified in relation to factors influencing engagement in settings where leaderboards are used as the primary game element:

1) Clear instructions – While gamification and flow theory literature focus on the importance of clear goals, this study broadens this construct to “clear instructions”. Clear instructions includes both clear goals but also a clear understanding of the system in which the leaderboard game element is employed. If either of these elements are missing, the goal of system engagement will be limited.

2) Team accountability – This study demonstrated that team accountability can be developed in two ways: through specific design methods of the leaderboard and through the social influences of others. First, team accountability can be developed through the design decisions of the leaderboard. This study used team leaderboards that also included individual rankings within teams. Traditional team leaderboards offer a level of anonymity that can reduce engagement. Leaderboards rely on social comparison and traditional team leaderboards will yield minimal gains in engagement due to the user’s ability to remain unaccountable to the team. The data in this study demonstrated that team leaderboards that employ rankings within teams creates power social comparison on two fronts: intra competition (evaluating scores within the team) and extra (evaluating the scores among teams). Moreover, team accountability is increased as the each individual’s contribution to the overall team performance is clearly seen.

Second, social influences of other team members and moderators of the game further contribute to the team accountability. Social influences in the acceptance of technology is well established in the literature (Venkatesh et al., 2003). In this study,
feedback from both the game moderator and from other team members acted as powerful social influences to engage with the system.

3) **Challenge skill balance of leaderboards** – Perhaps the most significant finding in this study is in the identification of three design principles specific to the type of leaderboard. The data in this study demonstrated that global, relative, and team leaderboards each have specific design features that create differing levels challenge-skill balance. Leaderboards using levels, for example, require levels that are perceived as realistic. In contrast, team leaderboards should be designed with rankings both within and between teams. Selecting the correct design features for each leaderboard is, thus, critical to ensuring optimal positive system engagement and avoiding significant negative system engagement outcomes.

**Limitations**

Limitations of this research are threefold. The generalizability of our design principles in other contexts of gamification using leaderboards, the role of a video discussion board in this project, and the focus of engagement in this study on total posts and replies. First, the design principles identified in this project were derived from a single case study using an online discussion and, thus, generalizability on leaderboards may be limited to these types of contexts. Second, a video discussion board was used in this study and could have resulted in different outcomes than a traditional text-based discussion board. Future research is needed using different forms of discussion boards (i.e. discussion versus text based) to validate the claims made in this study. Finally, measurements of engagement in this study were focused primarily on behavioral aspects of engagement in terms of total posts and replies to the discussion board. Future research should focus on examining the efficacy of different leaderboards on other forms of engagement such as improvement learning.

**Future Research**

Future research should, first, consider the use of quantitative methodologies to evaluate the efficacy of the model and the design principles which make up the model. Within each of the three themes identified in this study, there are opportunities for quantitative
research endeavors. Within clear instructions, “CI-P2: Clear system instructions”, should be more closely examined in the use of the leaderboard game element in settings where the system understanding is clear and those in which it is not. Secondly, within the theme of leaderboard challenge skill balance, “CSB-P2: Relative leaderboards are realistic and attainable” could be more closely examined by reviewing statistical differences between leaderboards with levels set at varying intervals. Alternatively, “CSB-P3: Team leaderboards rankings are present both between and within teams” could be examined using an experimental approach which focuses on examining statistical differences in teams that use individual rankings with teams that not. Finally, within the feedback theme, “TF-P2 Team leaderboard: timely feedback on rankings between and within teams” could examine the result of differing levels of feedback frequency for team leaderboards on system engagement.

Secondly, more qualitative studies are needed to better understand the influence of personality on types of leaderboards. While there is considerable work in the area of gamification and personalities, there are little to no studies involving the more specific relationship between personality and differing types of leaderboards. Qualitative examinations of this topic are needed to offer a starting point on user perceptions of each type of leaderboard based on personality type.

Summary

In conclusion, this research has set out to better understand the perceptions of users toward different types of leaderboards and the potential of these leaderboards for improving system engagement in an online discussion. The Eisenhardt case study method of research was employed to examine these questions using 60 total participants and 321 total minutes of recordings leading to a theoretical model that conceptualizes three main categories that influence system engagement: clear instructions; challenge/skill balance of global, team, and relative leaderboards; and timely feedback. These themes are made up of sixteen different design principles which establish the basis of the model.
REFERENCES


https://doi.org/10.1016/j.compedu.2018.02.007


https://doi.org/10.1016/j.compedu.2017.06.016


https://doi.org/10.1177/1745691613504114


https://doi.org/10.1016/j.compedu.2014.08.019


Park, S., & Kim, S. (2021). Leaderboard Design Principles to Enhance Learning and Motivation in a Gamified Educational Environment: Development Study. *JMIR Serious Games, 9*(2), e14746. [https://doi.org/10.2196/14746](https://doi.org/10.2196/14746)


APPENDICES

APPENDIX A: INTERVIEW QUESTIONS

1. What is your age (18-24, 25-34, 35-44, 45-54, 55-64, 65+)
2. (CG) What were your general impressions of the emails containing the leaderboard displaying your position in the game ‘Lead the Discussion!’?
3. (CG) How did the presence of a leaderboard in the online discussion factor into your decision to complete additional discussion posts and/or discussion replies?
4. (CG) What were your general impressions regarding the goals or instructions expressed in the game?
5. (CSB) What about the leaderboard promoted your motivation and engagement in the online discussion?
6. (CSB) What about the leaderboard undermined your motivation and engagement?
7. (CSB) Did your placement on the leaderboard have any impact on your decision to complete additional posts/replies? Can you explain?
8. (CSB) If you had a choice, would you choose a gamified discussion board or a traditional assignment? Can you explain?
9. (TF) Were the emails displaying your position on the leaderboard sent in a timely manner?
10. (TF) Did the presence of an online version of your leaderboard promote your engagement or learning in the online discussion?
11. Is there anything related to the use of leaderboards in improving user engagement that I haven't asked that you think might be important for me to know?
APPENDIX B: INITIAL CODES

Code
○ a lot of information
○ a motivator
○ age
○ age range
○ ahead of me
○ anonymous
○ application new to me
○ apprehensive
○ at the bottom
○ attainable
○ badge
○ bottom of the leaderboard
○ browser
○ bullied
○ can see emotion in comments
○ check back
○ cohesive
○ collaborate
○ competitive
○ confident
○ control my destiny
○ didnt want to let team down
○ discouraged with my position
○ discussion board
○ dissapoint your
○ dont need to depend on others
○ each level was viable
○ elite
○ emails
○ emails acted as a reminder
○ enjoy seeing people
○ excited to see rank go up
○ excited to use
○ extra point
○ feasible to attain level
○ feels more like conversation
○ flip grid
○ forward movement of team
○ gain progress
○ game
○ general impression
○ give up
○ grad
○ group leader board
○ hard time figuring system out
○ have to work hard
○ higher in placement
○ instructions
○ instructions were clear
○ internal emotions
○ introduction video
○ lack of time
○ less pressure
○ less unknowns
○ level leader board
○ levels achieved
○ liked ability to monitor performance
○ liked the format
○ makes me want to participate
○ monitoring engagement
○ more engagement
○ motivate me more
○ moving up
○ multiple perspectives
○ my own actions
○ never used a leaderboard
○ not clear enough
○ not competitive
○ not team oriented
○ not used before
○ other team rankings motivated
○ part of a team
○ personality
○ pointless
○ poor team connection
○ prefer the
○ prize
○ promote engage
○ ranking linked to team
○ real time
○ reports of levels changing
○ reward
○ safari
○ score reported among teams
○ score reported within teams
○ see myself failing
○ social comparison motivated me
○ social emotions
○ step it up
- team accountability
- team leaderboard
- thorough
- thought it was easy
- threshold
- took some time
- top three
- trends in team leads
- tried at first
- trouble viewing the leaderboard
- undergrad
- understood
- unknowns of teams
- unmotivated
- user friendly
- viable to reach next level
- video
- video based
- visual
- want to engage
- working in groups
- working together
APPENDIX C: FOCUSED CODES

- Engagement
- GL-Motivating
- GL-Competitive
- GL-Discouraging
- GL-Motivating
- RL-Achievable
- RL-Independent
- System Instruction Inhibitors
- System Instruction Promoters
- TF-Level trends
- TF-Team rankings
- TL-Collaborative
- TL-Team loyalty
- TL-Team Uncertainty
APPENDIX D: CODES IN ATLAS.TI