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GAMIFYING INNOVATION: EFFECT OF COLLABORATIVE AND COMPETITIVE GAMIFICATION

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ABSTRACT

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An experimental study was conducted to further understand the effects competitive and collaborative game elements on an ideation task. Participants (N=80) were recruited via microwork platforms and were requested to brainstorm for ideas that could be applied in a real-life setting. Cross comparison between outputs and participants self-reports of their experience indicates that there were no significant differences between the control and treatment groups on idea quantity and idea quality. However, results from this study provides theoretical and practical implications as to how to do implement simple competitive and collaborative mechanics to set the foundation for more complex interactions between the two elements.

Keywords and terms: Gamification, Goal-setting theory, cognitive load theory, collaboration, co-operation, competition, design

Contents

1 Introduction

Gamification as a design method that is getting increasingly common in Human-Technology Interaction (HTI) design, mainly incorporated to fostering motivation to perform non-entertainment related tasks. The term is generally used to describe the practice of incorporating features of an interactive system, such as points, badges, and leaderboards to make tasks such as learning, chores, and work more engaging for the end-user through the use of game mechanics and elements (Deterding, Dixon, Khaled & Nacke, 2011). This interest is mostly driven by the success seen in the digital games industry, with record-breaking sales numbers and a huge normalization of gaming across ages and gender in the digital age (Deterding et al., 2011).

A common use case of gamification comes from the workplace, where organizations employ its use to create environments to fuel performance (Mekler, Brühlmann, Toch, & Opwis, 2017; Stanculescu, Bozzon, Sips, & Houben, 2016; Suh & Wagner, 2017) and facilitate ideation (Gears & Braun, 2013; de la Peña Esteban, Torralbo, Casas, Garcia, 2020). Friendly competitions in work environments in order to generate innovative products or solutions are not uncommon. Through employing gamification to facilitate this experience, the innovation process is opened to wider circles in an organization. The effectiveness of gamification to elicit such an environment has always been a subject of interest of academia, and numerous studies have investigated the behavioural and psychological outcomes of these endeavours.

These academic studies in this area report promising preliminary results, but should treated with caution. Some authors cited contradictory results from their quantitative and qualitative analysis (Viberg, Khalil, & Lioliopoulos, 2020), while some reported success in their studies but suggest further work to be done to validate their findings (Gears & Braun, 2013). Not to mention that most of these published works are case studies of elaborate gamified systems for specific use cases (see Koivisto & Hamari, 2019, Nicholson, 2015), thereby rendering the findings of their research not replicable beyond their niche. These statements echo the findings in Koivisto & Hamari (2019)'s literature review of gamification research, stating that most gamification research lack theoretical foundation, and had a dearth of agenda or guide for application. In essence, to close the gap of our understanding of gamification as a feasible tool for tool for motivating and engaging users, more empirical work done through the means of controlled experiments is required.

For that reason, this study tries to understand the effects of gamifying competition and collaboration in ideation with a controlled experiment. The experiment explores the individual effectiveness of gamifying competition and collaboration in producing ideas, as well as the interaction effects of the gamified competition and collaboration on the ideation. Besides the behavioral effects, we also attempt to have a better understanding of its psychological effect on the users, through the use of a post-task survey. The experiment's theoretical foundation is based on Goal-Setting Theory, a psychological theory of motivation that explains how people perform better in tasks through setting and monitoring goals.

This thesis proceeds as follows: First, the background of this study is provided examined. Specifically, the theoretical concepts that inform design decisions, such as Goal-Setting Theory and cognitive load are discussed. Gamification, as well as how it is applied to create competitive and collaborative environments are also further examined. The section concludes with how these elements are combined to formulate the thesis of this study. Secondly, the method section reviews how the experiment was designed and conducted. Then, the results section looks at the analysis of the data gathered from the study, and finally, the applications, limitations, and recommendations for future study that can be drawn from this study are laid out in the discussion.

2 Background

This section provides a theoretical background for the study. Goal-Setting theory and its key features will be firstly defined; then its relation to gamification design discussed. Studies on how competition and collaboration are induced in gamification design are also briefly elaborated, as well as the concept of cognitive load within the context of HTI. How this study creates a collaborative design is also further elaborated. Finally, these concepts are brought together in presenting the areas of focus for this research.

2.1 Goal-Setting Theory: An Overview

Goal-setting theory is a motivational theory that aims to understand the relations between people's performance and their goals. Its application is mostly found in work-related tasks, the has been validated and further developed in hundreds of laboratory and field settings across cultures (Locke & Latham, 2006). The theory posits that people are motivated to strive towards goals (Locke & Latham, 2002). As such, with the right goal, and with the given ability to attain it, people would naturally be motivated and perform actions towards achieving them (Locke & Latham, 2006). Goal-setting theory is an emergent theory applied in academia’s understanding of gamification, which, through this view,

the implementation of gamification structures non-entertainment tasks into a goal-oriented activity with the use of mechanics borrowed from games, affording better motivational experiences.

Core to goal-setting theory is its emphasis on defining a goal in such a way that would motivate people. A common pattern found in Goal-Setting studies was that specific, difficult goals lead to a higher level of task performance than easy or vague abstract goals (Locke & Latham, 2006). Taking individual abilities into account, the theory lists the common criteria of effective goals to be Specific, Measurable, Attainable, Realistic, and Time-bound - commonly known as SMART goals. According to Goal-setting theory, if one were to commit to these goals - with adequate feedback, high self-efficacy (and ability), combined with suitable task strategies - would result in a high-performance cycle.

The success of goal-setting is highly dependent on the creation of feedback loops, a negative or positive indicator of the output towards the goal. In a more complex environment, feedback loops also drive an individual's progress by signaling proximal goals - the smaller, and more achievable milestones - that would eventually lead to the individual's distal goals. Locke & Latham (1991) notes that goals and feedback together are most effective in motivating high performance, rather than either one separately. As such, feedback serves as a moderating factor for goals on performance, while goal-setting serves as a meditator (or cause) of its effects on performance. The relationship can be easily be illustrated if one imagines an environment when an individual receives multiple types of information, like those in games. Goals draw attention to a specific element(s), using them as an indicator if a feedback is good or bad. In a fighting game, the goal of a player is to take down the opponent (while making sure that they are not taken down themselves). Therefore, the deduction of points in the opponent’s health bar would provide feedback and serve as a point of reference as to how close a player is to defeating their opponent. Atmospheric animations, while present, are usually not given as much attention, because they do not relate to the goal at hand.

2.2 Goal-Setting Theory in the Context of Gamification

In the context of gamification, academics have noted that gamification, as games do, is essentially goal-oriented (Deterding et. al., 2011). Most gameful design methods themselves include some form of goal-setting at the organizational level and individual level (see Deterding et al., 2011; Mora, Riera, González & Arnedo-Moreno, 2017; Morschheuser, Hassan, Werder, & Hamari, 2018). While there are some slight discrepancies between the specifics of the goals - Deterding et al. (2011) having note "clear goals" as a design element of gamification; whereas Huotari and Hamari (2012) mention "conflicting

goals" - Tondello, Premsukh, & Nacke's (2018) observes that the community seems to have a consensus that gamification's best practices of optimal goal-setting directly correspond to that of SMART goals.

Summarizing this connection, Tondello et al.'s (2018) literature review notes that "gamification is often based on setting specific and difficult goals, encouraging users to pursue these goals, and providing constant feedback". Specifically, the use of gamification acts on moderating and mediating variables that influence the relationship between goals and performance. While the authors mentioned that nuances of motivations according to goal-setting theory has yet to be thoroughly explored in gamification studies, few elements of game design are deemed as common applications in commercial and academic settings, and deemed as potential mechanisms for goal-setting in Gamification. The list of these elements include badges, leaderboards, levels, progress bars, rules, goals, challenges, conflict, points, achievements, and rewards. In Landers, Bauer, Callan, & Armstrong (2015) paper, the authors map the use of these mechanisms through the view of Goal-Setting Theory, to create the feedback loop that is core to goal-setting as according to Locke & Latham (1991). Often, the feedback loop is done through the combined use of different game elements, where in their paper, the authors suggested that mechanisms such as badges and levels can be used for implementing goal-setting; while progress bars are mechanisms for feedback.

Of interest to this study is the use of leaderboards within the context of gamification. In itself, leaderboards fulfill the criteria for goal-setting – users can benchmark themselves against anyone else on the same leaderboard. Tondello et al. (2018) describe leaderboards as specific, difficulty-and-performance-oriented goal type, as 1) the points in a leaderboard provides the user a clear goal to beat, 2) the user can challenge themselves by aiming to beat the score of another user based on their assessment of their own skill, 3) to gain a certain amount of points, the user would need to be performing at a certain level. In regards to providing progress feedback, leaderboards are usually designed with counters where the user knows how much points they currently have, and are given feedback if their points surpass another user on the same leaderboard. As such, leaderboards also serve a type of progress feedback, allowing users to moderate performance - a view that is echoed by the results from other studies (see Landers et al., 2017; Eickhoff, Harris, Vries, & Srinivasan, 2012; Ortiz-Rojas, Chiluiza, & Valcke, 2019). Not to mention that in gamification practice, leaderboards are also a game design element that has been known to be effectively synonymous with competition, an element known to increase engagement.

2.3 Using Gamification to Create Competitive & Collaborative Environments

Competition has often been said to be one of the key components in successful video games (Sepehr & Head, 2013; Reeves & Read, 2009; Yee, 2006), and is one of the main ingredients when it comes to gamification practice. The nature of competition corresponds well with Goal-Setting Theory, as having competition creates goals that a user needs to achieve or overpass. The consensus of studies is that there is no one-size-fits-all competition design in gamification (Santhanam, Liu, & Shen, 2015). However, because the element of competition is known to increase engagement (Sepehr & Head, 2013), and drive performance (Wolf, Jahn, Hammerschimdt, & Weiger, 2020), understanding the psychological effects and methods of creating the optimal competitive environment has been a huge interest in the early days of gamification studies.

Efforts in producing a competitive environment in gamification very often take the form of a leaderboard (Riar, 2020), where an individual or group competes with another. Other methods of introducing competition sometimes take the form of self-competition, where one person competes with their own previously held record – that of a high score or fastest time (Riar, 2020), or with challenges / goals / missions / quests (Suh & Wagner, 2017). For instance, Landers et al.'s (2017) used only a leaderboard in their study, and noted that just the presence of a leaderboard and its complementing elements (eg. points, user identification, incentivized task, etc) is sufficient to create the conditions for goal-setting, and motivate participants to perform at similar to that of difficult and impossible goal-setting. In their study, participants in the leaderboard condition not only had the highest number of outputs, but also self-reported higher than average commitment to their goals than participants in other conditions. The results from this study also suggest that participants implicitly set goals at or near the top of the leaderboard without any explicit prompt to do so.

That said, Landers et al.'s (2017) are one of the few studies that were strictly studying the use of a leaderboard as a competitive element in a Goal-Setting context. In a broader view, other researchers have also pointed out that there are nuances that need to be taken into consideration when it comes to creating a competitive environment. For instance, Santhanam et al.'s (2015) study in the education context notes that the skill difference between the individuals in competition influences confidence levels, learning outcomes, and engagement with learning materials.

The concern for nuances also extends to incorporating collaborative game elements as well. Riar (2020), in his review of academic articles on using gamification to motivate

collaboration, remarks that while gamification shows great promise in motivating people in collaboration, we still cannot be certain as to how to approach designing for such circumstances. In his study, the author identified few elements that are unique to eliciting collaborative environments, such as user-to-user feedback through the means of voting, likes, commenting, team events, virtual goods, and the assignment of roles. The common feature for these elements is that they foster some level of social interaction through their application by requiring the platform users to work with one another.

Some studies have also investigated combining competition and collaboration, often seen in educational and crowdsourcing settings (Riar, 2020). Looking at a few of these research, collaborative elements show promise in being a form of a social lubricant in a competitive environment. For instance, Morschheuser, Hamari, & Maedche's (2018) study saw that group-based competition, that incorporates both collaboration and competition, not only resulted in high participant contribution, but also higher enjoyment and higher willingness to recommending a system. Similarly, Suh & Wagner's (2017) study also saw that adding competition in the context of a collaborative goal also increased participation as well as the perceived hedonic value of a system. As such, we could cautiously surmise that the interaction of competitive and collaborative elements provides strong goal-setting and increased experience of societal bond between individuals. However, a subject of interest that is not as thoroughly studied is – would individuals benefit from collaboration by providing a higher quality response while competing?.

2.4 The Potential of Offsetting the Negative Effects of Gamifying Competition Using Collaboration

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Latham & Locke (2007) in their paper highlighted the concern of rigorous goal-setting, stating that while competition usually correlates to an increased level of productivity, certain conditions must be met. Specifically, the task being performed should not require too much cognitive effort. An explanation of this is that the increased attention and production rate of competition is due to an increase in experienced task complexity, thereby heightening the effort one would make into performing in said task (Scott, 1966; Locke, 1968). Contrary to a task requiring a low cognitive effort, the addition of competition to a task already cognitively taxing is more likely to push the experienced complexity of the task outside the range that one feels is achievable, thereby lowering performance (Locke & Latham, 2006). While past research employing collaboration in gamification have focused on the social aspects of it, some researchers in the HTI domain (see Kirschner,

Sweller, Kirschner, & Zambarno, 2018) have pointed out the possibility of using collaboration as a means of reducing cognitive load, which this study is interested in exploring its use in reducing the experienced task complexity in a competitive context.

To provide context, cognitive load is often referred to the brain processing that is required to carry out a task (Sweller, 2010). In HTI, this is often facilitated or inhibited by the design of UI (User Interface) and UX (User Experience). If optimized effectively, both UIs and UXs could effectively allow the users' mental resources to be used on the task at hand, rather than being allocated to understanding how to use a designed product to perform a task (Oviatt, 2006). The result of poor optimization for cognitive load in design is known to directly affect performance (Oviatt, 2006), create conditions to technology-induced continuous partial attention (Kahn et al., 2007; Oviatt, Arthur, & Cohen, 2006), and in problem-solving - a selective decline in high-level meta-cognitive skills (Oviatt et al., 2006).

In the case of gamification, the introduction of a competitive element seems to introduce some amount of cognitive load to users, and would thereby overload the same user should they be performing a complex task. Janssen & Kirschner (2020) in their paper theorized the potential use of collaboration to reduce cognitive load, which, applied in this context, could be used to offset the experienced cognitive load by competition, thereby allowing the same user to use the resources to better perform in the complex task. The authors theory can be seen in practice in Chou & Chan's (2016) reciprocal tutoring system, where learners collaborating with another learner while learning a new programming language significantly outperformed our learners. Chou & Chan's (2016) paper also notes that while learners collaborating with a simulated partner did not perform as well (having scored second in terms of performance), such a system does show promise, and different modalities of collaboration should be further explored to better understand if collaboration's cognitive load reduction effects could be further optimized to improve performance.

2.5 Designing a Simulated Version of Gamified Collaboration

As there is no prominent feature in gamification design that is directly associated with collaboration design, this study seeks to explore the use of Glowing Choice, a game design element to create a simulated collaboration.

Glowing Choice (Chou, 2015; Tondello, Mora, & Nacke, 2017) is a game design element commonly found in games, which consists of systems providing hints or clues to

help a user move forward if they struggle with a challenge too long. Gamification practitioners have discussed on its use in practice (see Chou, 2015), but it is one of the gamified elements that have yet to be extensively explored in an academic setting. Glowing choice often uses visual representations or cues to refer to the next action, and in a complex environment, is often used to make a desired action obvious, rather than leaving the user feeling stumped as to what to do next (Chou, 2015). According to Chou (2015), the application of this technique in this context recognizes that having users move swiftly through the game is of the main priority to keep the players using the platform, even if might lead to a loss. In a scenario where a player feels stuck because they were unable to find what moves to take, the player would most likely leave the app altogether to do something else. Whereas making a move despite ending in a lost level would still indicate progress and prompt the player to play again.

The rational for using Glowing Choice as a form of simulated collaboration is twofold. For one, the description of closely resembles a partner suggesting a solution in while one is feeling stuck in a problem-solving situation. Secondly, Chou (2015)'s analysis of how Glowing Choice facilitates constant movement echoes how the act of externalizing cognition can be used as a method of reducing cognitive load in problem-solving situations. In games, the external prompt from a Glowing choice facilitates the act of thinking by highlighting one solution, thereby allowing the player to offload some of the cognitive weight of identifying hard-to-find solutions when faced with a difficult roadblock, and piggyback off the given prompt to move on to the next problem, thus achieving the game's goal of reducing user drop off. This hints towards the potential cognitive offloading that can happen with complex problem solving, using a simulated collaboration that would allow for quality solutions while using leaderboards to encourage engagement that gamified platforms have attempted to achieve.

To that point, this experiment's use of Glowing Choice Design (refer Image 1 for the visualization of Glowing Choice is in this experiment) emulates that of ion Candy Crush Saga, attempting to achieve the same effect, as indicated below:

The sequential logic of a Glowing Choice Design of Candy Crush Saga

1. The system detects that the player has not made a match for a certain amount of time.
2. A possible match combination is visually highlighted with a glow.
3. The highlighted action may or may not be the most optimal move but relevant enough to keep the user moving.

4. The player performs a match, either by their own accord or following the provided suggestion.
5. The system resets the timer for detecting no activity back to zero

The sequential logic of a Glowing Choice Design to Facilitate Collaboration

1. The system detects that the player has not submitted an idea for a certain amount of time
2. An idea that is submitted by a previous user is shown as a pop-up, providing the user with a possible avenue to consider. The idea serves mainly as a prompt, and the user could choose to build on top of the idea, ignore or remove the idea.
3. The idea may or may not be something the user wants to build upon, but is relevant enough in this context that could prompt the user to think in a particular direction
4. The user submits an idea, either of their own or building on the provided idea
5. The system resets the timer for detecting activity back to zero
6. NOTE: For increased flexibility of which idea to build on, if the user "X"s out on an idea, they would be able to see another potential idea that they could build on.

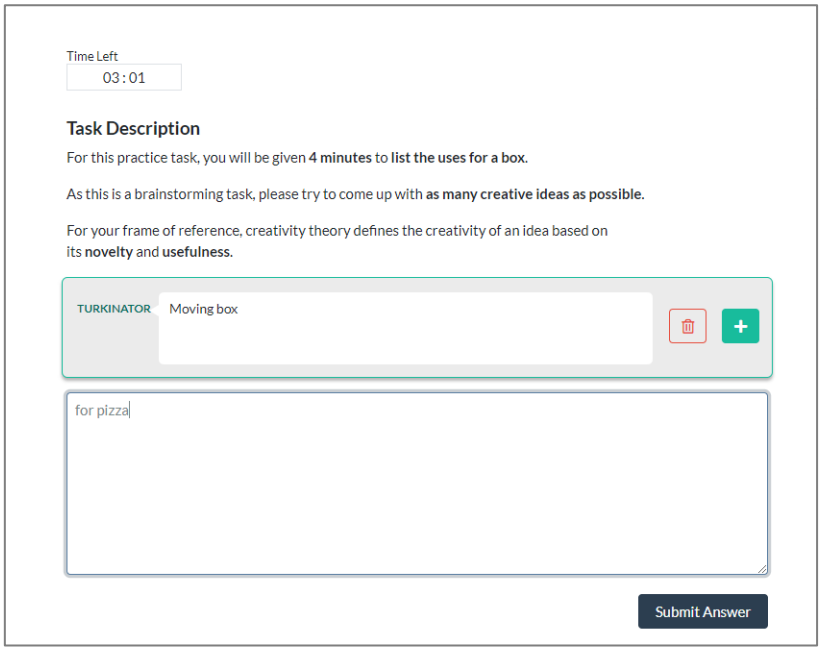


Image 1: Visualization of Glowing Choice (grey box with green outline)

2.6 Putting It all together: Using Gamification Design to Reduce Cognitive Load

By applying gamification design in a non-entertaining task, the intention is to make an activity engaging. Through the lens of goal-setting theory, engagement stems from having

a specific, and well-defined goal to work towards to - with frequent feedback about performance along the way. The challenge of constantly improving oneself drives action, and it is something easily seen with how a simple application of a leaderboard can increase performance in terms of quantity (see Landers et al., 2017). However, the introduction of a competitive element for engagement's sake may also introduce unnecessary cognitive load for the users, and harm their performance with a more complex task.

Such cognitive loads may potentially be offset through design. The potentiality of using collaboration for cognitive load reduction is not as extensively studied, but preliminary research done in instructional design suggests that collaborative environments are effective in reducing cognitive load (Kirschner et al., 2018). Following that line of thought, this study seeks to further understand the interaction effects of competition and collaboration in gamification design, and if the use of collaboration could benefit users in cognitive offloading while reaping the benefits of a competitive environment.

Using a similar brainstorming task as Landers et al. (2017) with gamification elements incorporated to elicit the competitive and collaborative environments, this study looks to answer the following research questions. Firstly, does the addition of cooperation reduce experienced cognitive load, and subsequently improve work performance by the means of increasing quantity or quality of the output? Second, given that past research has highlighted that social connectedness is core to a collaborative solution - would the users feel as though they were helped by someone else with the incorporation of a cooperative element in the design?

Based on existing research, we hypothesize the following:
H1: Participants in the competitive condition would have the highest idea quantity.
H2: Participants in the mixed condition would have lower idea quantity, but higher idea quality compared to participants in the competitive condition.
H3: Participants in the collaboration condition would have the highest idea quality.
H4: Participants will feel that the glowing choice options make them feel more connected to other users.

3 Method

3.1 Participants

80 participants signed up for the online study through several online microwork portals. They were randomly assigned to one of the four experimental conditions. Upon completion of their tasks, participants were awarded a monetary compensation of USD2 for their participation.

3.2 Materials

An online platform was created for this experiment. Elements further described in this section were served from this platform to the participants. Participants accessed this platform through an URL given to them on the microwork portals they signed up for the study.

The main experimental task derives from White, Kjelgaard, & Harkins's (1995) brain-storming task used to demonstrate goal-setting effects. Brainstorming tasks have been established in many studies as an ideal context for goal-setting research related to performance (Litchfield, 2008). White et al.'s (1995) task requests the participants to come up with use cases of household items (e.g., pen, knife, candle), which is relatively straightforward. To create a more complex problem that reflects a real-life working situation and one that would require collaboration between people, some modifications were made for this study. While staying true to the brainstorming nature, the task was made complicated by providing a real-life context. A marketing task was formulated, requesting participants to brainstorm about ideas to market a newly formed university (refer Appendix 7.1). The task was chosen because while the task in itself can be creatively oriented, but it still has restrains to be grounded to the pragmatics of reality. The original task from White, Kjelgaard, & Harkins's (1995)'s study was used as a practice task for participants to familiarize themselves with the online platform.

A demographic survey was formulated to gather participant's background information. Collected information included participant's age, education level, gaming experience, and English proficiency. The demographic information is included to better understand the participants that took part in this study, and to ensure that collected data would not be skewed by the abovementioned factors.

A post-task survey was designed to assess the social bond that the participants may have experienced while working on the tasks. As there is no existing tool that measures the social component experienced through collaboration that can be directly applied to

this study, survey items were designed by referencing experience of social connectedness that has been described in previous studies (see Riar, 2020; Witkowski, 2014), focusing on the utility, relatedness with the other person, and an intersection of both elements. The survey items related to social dimensions of competition were referenced from Landers et al. (2017) study, and adapted to fit the context of this study. Each survey item was rated on a 5-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree), with an additional option of declaring that item as Not Applicable to their experience. For the complete list of items, refer to Appendix 7.3.

3.3 Experimental Design

3.3.1 Independent Variables

A between-subjects experiment was designed with four conditions as follows:

1. **Control** - No gamification
2. **Competition** - Leaderboard as goal-setting and feedback, as per Landers et al.'s (2017) study
3. **Collaboration** - Glowing choice element designed to create a collaborative environment intended to reduce cognitive load
4. **Mixed** - With gamification elements from the competition and collaboration incorporated

Specifications of each condition are further described separately with illustrations of their implementations.

No gamification

Control group without any exposure to any gamification elements (see Image 2 control group's UI). As the participant enters an idea, they get one point added to their score.

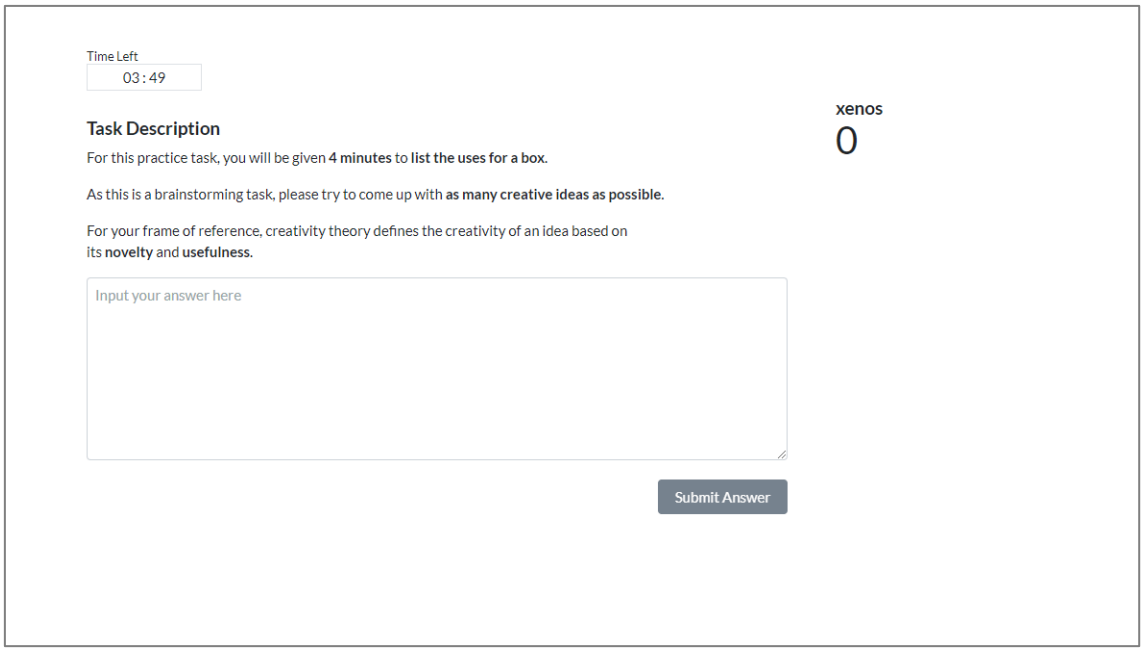


Image 2. Experiment screen UI for control group

Competitive Condition

In this condition, a leaderboard is used to create a competitive environment, as with Landers et al.'s (2017) experiment. Participants are presented with a leaderboard with pre-established scores. The scores are associated with random usernames, implying that these scores have been previously achieved by people in the past. Similar to Landers et al.'s (2017) study, the first, fourth, seventh, place scores correspond to the impossible, difficult, and easy goals that fit in the goal-setting conditions. To replicate a game-like condition, each idea generated would award the participant a score of 7. Intermediate goals were also added to increase the number of choices for the participants to benchmark to. Participants automatically move up in ranks on the leaderboard as they submit more ideas. See Image 3 for the UI for the competitive condition.

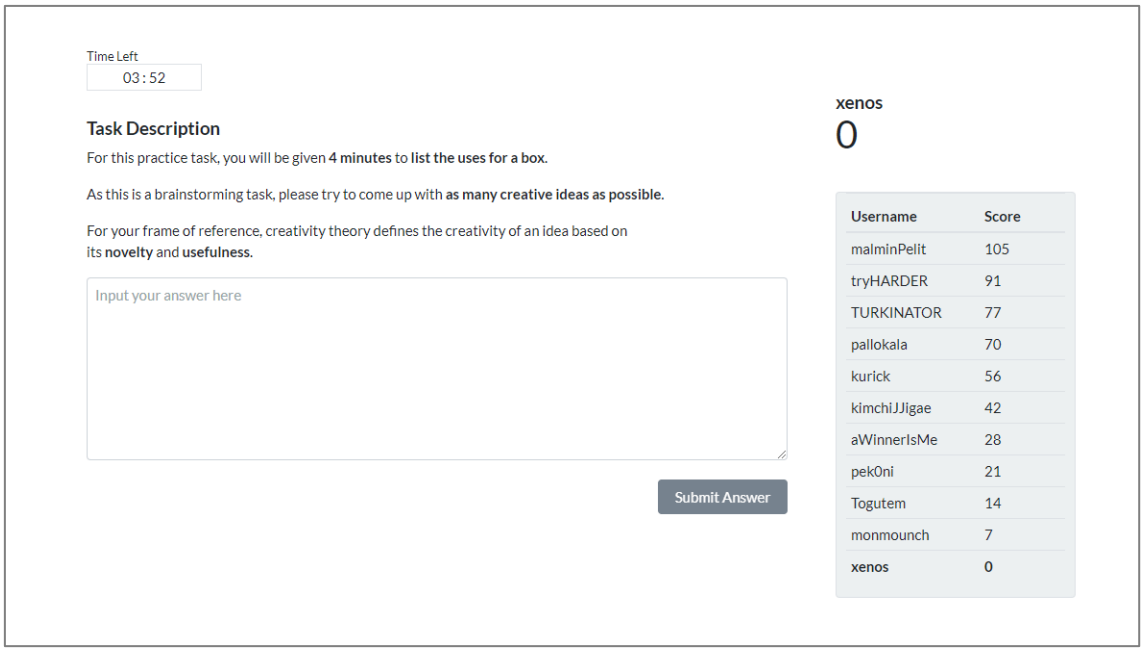


Image 3. Experiment screen UI for competition condition

Collaboration Condition

In this condition, Glowing Choice is used to create a collaborative environment, and is referred to as ideabox so that its' purpose is directly implied to the participants. If participants have not submitted an idea within 5 seconds, a previously submitted idea is shown in the ideabox. This provides participants the choice to actively choose to build upon the answer, or simply submit an answer of their own, that may or may not be inspired by the ideas in the ideabox. Participants may also choose to discard the idea that they are currently seeing, which will prompt the generation of a new idea immediately. Upon submission of an idea, the system counter resets back to 0, and is reactivated if no idea is submitted within 5 seconds. Image 4 shows the UI of the collaboration condition.

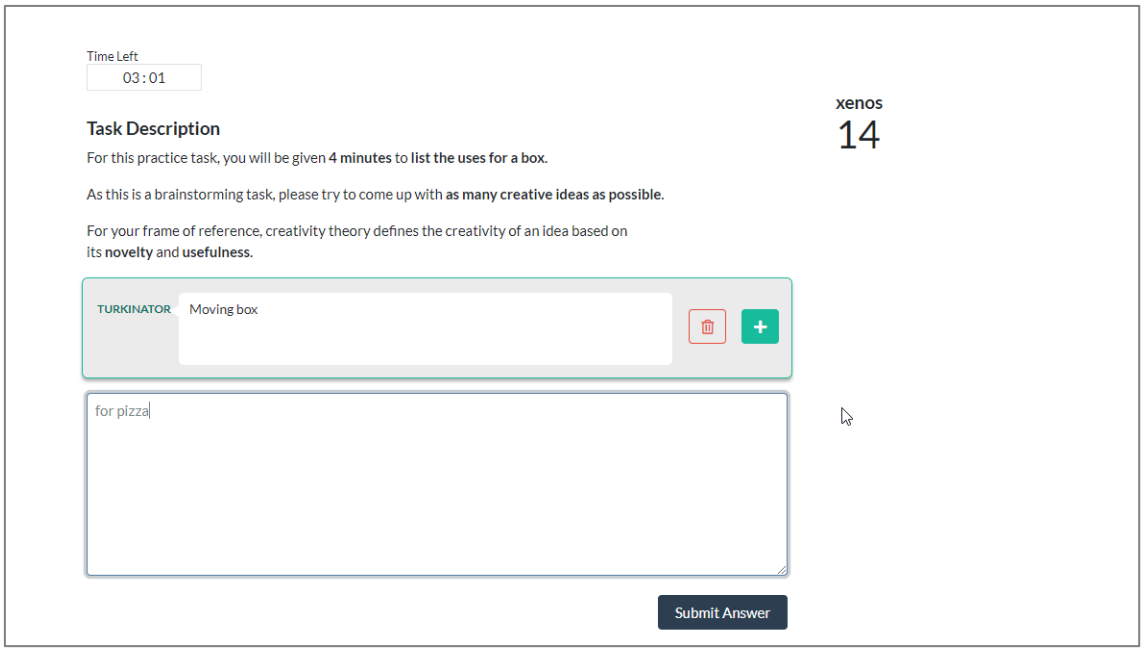


Image 4. Experiment screen UI for Collaboration condition

Mixed Condition

This condition combines both elements in the competitive and collaboration condition. A leaderboard is used to create a competitive environment and goal-setting element, as with Landers et al.'s (2017) experiment, and the incorporation of glowing choice to help users if they feel stuck. See Image 5 for the mixed condition's UI.

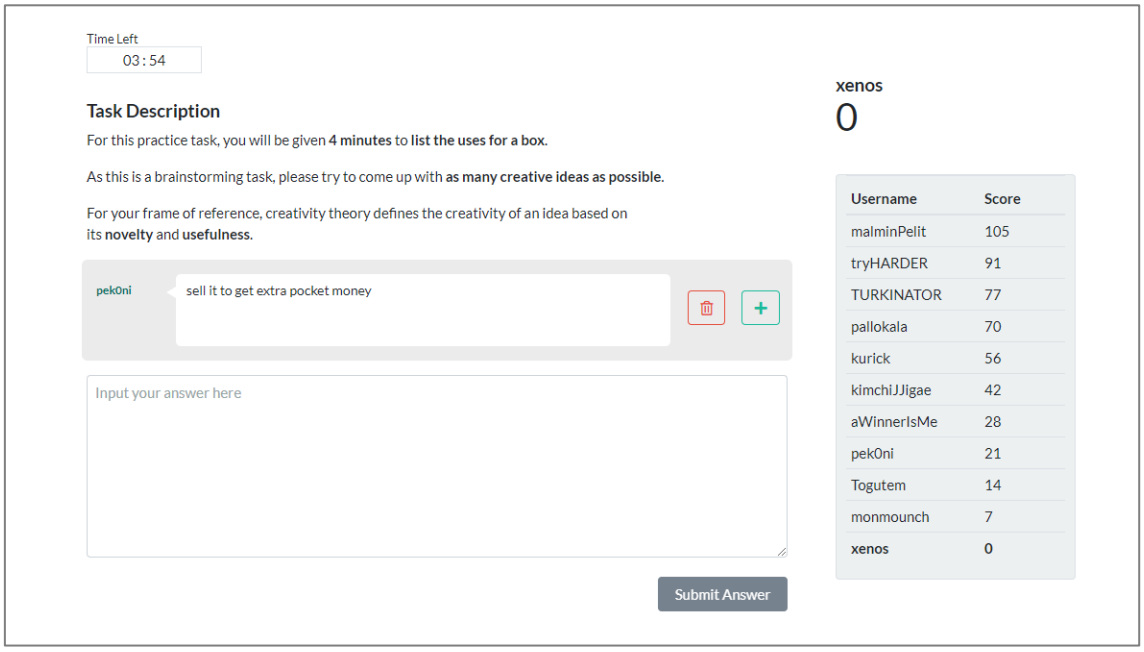


Image 5. Experiment screen UI for Mixed condition

3.3.2 Dependent Variables

Two dependent variables were measured for this study, **idea quantity,** and **quality**. Idea quantity referred to the number of unique ideas generated by a single participant. Idea quality, on the other hand, was evaluated by two peers of the participants, blind to the conditions and hypothesis of the thesis. The quality of ideas was rated with numbers on a 1-5 scale, measuring two attributes of creative ideas, which are a combination of novelty and usefulness (Amabile, 1996; Shalley, Zhou, & Oldham. 2004), and then averaged out for every single answer. The definition of these two attributes was provided to the raters before they started the rating.

A common definition was used as a baseline of what constitutes a creative idea. The definition of the assessed attributes follows Litchfield, Fan, & Brown's (2011) study as a baseline. For the novelty of each idea, raters were told that Novelty refers to "the degree to which an idea is unusual, unique or unlikely to be mentioned by others. It may or may not be a good idea. The point was to capture the degree to which the idea is one that many or few individuals would be likely to generate." Whereas usefulness was defined as "the degree to which you think the idea meets the goal of effectively marketing Tampere University. It need not be practical, novel, or creative. The point is to capture the degree to which the idea is one that you feel, if implemented, would effectively market Tampere University."

3.4 Procedure

3.4.1 Pilot

Before the actual study, a pilot was conducted to test out the design of the research instruments. This procedure helped to develop the user-generated ideas later used in the study, check if instructions were understandable, and weed out issues that would stem from the user interface. The findings from the pilot directed the development of the final version of the instruments used in the experiment.

3.4.2 Experiment Procedure

Participants (N=80) signed up for the online study through several online microwork portals. The criteria and description of the task were made known to the participants before their signing up, as well as on the first page of the online platform.

The series of tasks that the participants have done in sequence as follows:

1. The participants were briefed about the experiment, their role, and what can be expected from participating.
2. Demographic data - including participants' age group, English proficiency, familiarity with games - was collected (see Appendix 7.2 for full demographic data questions).
3. Participants were provided with instructions about the platform and a briefing about the practice task.
4. *Practice task:* Participants were required to generate as many uses for a pencil as possible during the given time frame of 3 minutes. Elements of this section differ based on the condition they were assigned to. Once the time is up, a pop-up prompted the participant to move on to the next page.
5. *Actual task instructions and refresher on how to use the platform:* Participants were provided a briefing about the experiment task, and the opportunity to refresh themselves on how to use the platform.
6. *Actual task:* Participants were given 10 minutes to generate ideas on how to market Tampere University. Once the time was up, a pop-up prompted the participant to move on to the final survey page.
7. *Final survey* (see Appendix 7.3): Participants were required to provide feedback about their gamification experience, by responding to four questions about their experience with the ideabox, and three about their experience with the leaderboard - and were then debriefed about the experiment.

3.4.3 Procedure for Rating Quality of Responses

Two peers of the targeted audience were recruited and provided guidelines (see Appendix 7.4) for scoring the quality of responses based on Litchfield et al.'s (2011) study. They were also given notes about how to handle certain unique situations, and clarified with the researcher on how to handle data in situations that were undefined by the document.

Quality of ideas was scored based on the following:

1. Novelty and usefulness of each idea was scored on a Likert scale of 1 - 5. 1 being the lowest score, and 5 being the highest.
2. The scores were then combined and divided to produce a median score as generalizable to an idea.
3. Individual score for each generated idea is then added to a participant's total, and divided by the number of assessors to achieve a median score.

4 Results

4.1 Data cleaning

To ensure valid and useful responses, 8 participants were removed from the data pool after agreement by the peer raters that the responses they produced did not correspond to the task at hand. A sample of $N = 72$ remained. Cohen's κ was run to check for inter-rater agreement (Appendix 7.5) for assessing the quality of the responses. There was moderate agreement between the two assessors, $\kappa = .440$, 95% CI [.340, .846], $p < .0001$.

4.2 Descriptive data

Further descriptive data were analyzed. All the following data discussed were normally distributed with no significant differences between the conditions, unless stated otherwise. Table 1 shows the demographic information of the participants, in total, as well as distributed across conditions. The percentages are rounded to the nearest one decimal.

	Control		**Competitive**		**Collaborative**		**Mixed**		**TOTAL**	
	Freq.	Per-cent	Freq.	Per-cent	Freq.	Per-cent	Freq.	Per-cent	Freq.	Per-cent
Age Group										
18-24 years old	3	4.2%	1	1.4%	2	2.8%	6	8.4%	12	16.7%
25-34 years old	10	13.9%	12	16.7%	14	19.5%	9	12.5%	48	66.7%
35-44 years old	4	5.6%	3	4.2%	2	2.8%	1	1.4%	10	13.9%
45+ years old	1	1.4%	1	1.4%	0	0.0%	0	0.0%	2	2.8%
Gaming Experience										
Doesn't play games	1	1.4%	1	1.4%	0	0.0%	0	0.0%	2	2.8%
Plays occasionally, but doesn't consider themself a gamer	5	7.0%	4	5.6%	4	5.6%	6	8.3%	19	26.4%
Casual gamer	7	9.7%	10	13.9%	8	11.1%	7	9.7%	35	48.6%
Core gamer	4	5.6%	0	0.0%	3	4.2%	3	4.2%	10	13.9%
Hardcore gamer	1	1.4%	2	2.8%	3	4.2%	0	0.0%	6	8.3%
English Proficiency										
Elementary Proficiency	0	0.0%	0	0.0%	3	4.1%	2	2.8%	5	6.9%
Limited Working Proficiency	3	4.2%	0	0.0%	2	2.8%	5	7.0%	10	13.9%
General Professional Proficiency	4	5.6%	5	6.9%	4	5.6%	3	4.2%	16	22.2%
Advanced Professional Proficiency	3	4.2%	0	0.0%	3	4.2%	0	0.0%	6	8.3%
Native Proficiency	8	11.1%	12	16.7%	6	8.3%	6	8.3%	35	48.6%

Education Level										
High school diploma or similar	4	5.6%	4	5.6%	1	1.4%	1	1.4%	10	13.9%
Vocational training	1	1.4%	1	1.4%	0	0.0%	1	1.4%	3	4.2%
College degree	2	2.8%	1	1.4%	1	1.4%	2	2.8%	6	8.3%
Bachelor's degree	8	11.1%	9	12.5%	10	13.9%	7	9.7%	36	50.0%
Master's degree	2	2.8%	2	2.8%	6	8.3%	5	6.9%	16	22.2%
Prefer not to answer	1	0.0%	0	0.0%	0	0.00%	0	0.00%	1	1.4%

Table 1. Demographic information of the participants: age group, gaming experience, English proficiency, education level

Age group

Of the 70 participants, 67% of the participants fell under 25-34 years old (*N*=48). The subsequent group was between 18-24 years old (*N*=12), and 35-44 years old (*N*=10). Two remaining participants were 45+ years old.

Gaming experience

Of the self-reported gaming experience, most of the participants see themselves as casual gamers (49%, *N*=35). 26% of the participants play games occasionally but do not see themselves as gamers (*N*=19), whereas 10 participants describe themselves as core gamers. The remaining 6 participants identified themselves as hardcore gamers, and 2 participants reported not to play games.

English proficiency

A majority of participants reported themselves as native English speakers (*N*=35, 49%), whereas the rest report to have some degree of professional proficiency - general working proficiency (*N*=16), limited working proficiency (*N*=10), advanced professional proficiency (*N*=6). 5 participants reported to have elementary English proficiency, but based on the assessors rating of the responses in the experiment, it did not influence their answers to the task.

Education level

The majority of participants had at least a college degree. 50% (*N*=36) reported having a Bachelor's degree; 22% (*N*=16) having a Masters's degree, and 8% (*N*=6) have a college degree. The education level of the remaining participants was graduated high school (14%, *N*=10), and have vocational training (4%, *N*=3). One participant did not respond to that question.

4.3 Gamification Feedback on Idea Quantity

A two-way ANOVA was conducted to examine the effects of competition and collaboration on idea quantity (Appendix 7.6). As data was moderately positively skewed and normality was not met, the data for idea quantity were transformed using a square root transformation. Of the transformed data, seven participants were identified as outliers by boxplot criterion (Tukey, 1977), but are kept in the data processing as based on inspection of data and past research, this could very well be the effect of the independent variable taking effect (refer Landers et al., 2017).

As the sample size is relatively small, (N=72), normality was tested with Shapiro-Wilk. Shapiro-Wilk revealed that data for idea quantity was normally distributed for the control group (*no competition, no collaboration*), and the condition with the mixed condition (*competition and collaboration*)($p > 0.05$). However, a significant departure from normality is seen for the competition group (*with competition, no collaboration*), $W(17) = 0.85$, $p = 0.01$, and the collaboration group (*no competition, with collaboration*), $W(18) = 0.89$, $p = 0.04$. However, no changes were made to the data as the ANOVA test is fairly robust to deviations from normality with respect to Type I errors (Maxwell & Delaney, 2004). According to by Levene's test for equality of variances, the null hypothesis of equal variances is rejected, $F(3,68) = 1.67$, $p = 0.018$.

There was no statistically significant interaction between competition and collaboration on idea quantity, $F(1, 68) = 1.085$, $p = 0.30$. Therefore, an analysis of the main effects was performed. There was no statistically significant main effect of collaboration on idea quantity, $F(1, 68) = 2.07$, $p = 0.155$. However, there was a statistically significant main effect of competition, $F(1, 68) = 4.96$, $p < 0.05$. Pairwise comparisons were run with 95% confidence intervals and p-values are Bonferroni-adjusted. Having a competitive element was associated with a mean idea quantity score of 0.686, 95% *CI* [0.72, 1.301] than without having the competitive element, with a statistically significant difference of $p = 0.029$. The unweighted marginal means of idea quantity for the conditions *without competition* were 2.833 ($SE = 0.225$), and *with competition* were 3.519 ($SE = 0.221$), respectively.

4.4 Gamification Feedback on Idea Quality

A two-way ANOVA was conducted to examine the effects of competition and collaboration on idea quantity (Appendix 7.7). The assumptions of the two-way ANOVA were met. Specifically, no outliers were identified by inspection of the boxplots, residuals were normally distributed ($p > 0.05$) and there was homogeneity of variances ($p = 0.755$). The interaction effect between competition and collaboration on idea quantity was not statistically significant, $F(1, 68) = 0.982$, $p > 0.05$. An analysis of the main effects was further

performed. The main effect of competition was not significant, $F(1, 68) = 0$, $p = 0.983$. Similarly, there was no statistically significant main effect of collaboration, $F(1, 68) = 0.741$, $p = 0.392$. As no main effects were statistically significant, no post hoc analysis was performed.

4.5 Gamification Feedback Survey Response Analysis

Several Kruskal-Wallis H Tests (Appendix 7.8) were run to compare participants' survey responses about their experience of the gamification feedback. The Kruskal-Wallis H was chosen with consideration of the ordinal nature of the data, and its ability to test for a difference in agreements of each statement based on the conditions participants were (Laerd Statistics, 2015). Each survey question related to the collaboration condition were individually processed across conditions - control (N=19), collaboration (N=18), competition (N=17), and mixed (N=18). The analysis of each Kruskal-Wallis H Test is indicated with their corresponding statement as follows, and subsequent pairwise comparisons were performed using Dunn's (1964) procedure with a Bonferroni correction for multiple comparisons unless stated otherwise.

Statement 1 - I feel that the items in the ideabox are useful to me.

A Kruskal-Wallis H test was run to determine if there were differences in experiencing usefulness of the ideabox items between participants of the different conditions. Distributions of experienced usefulness were not similar for all conditions, as assessed by visual inspection of a boxplot. The mean ranks of experienced usefulness were statistically significantly different between groups, $H(3) = 19.733$, $p = 0.000$. Post hoc analysis revealed statistically significant differences in experiencing usefulness between the control and mixed (mean rank = 47.81) (p= 0.000) condition, control and collaboration (mean rank = 41.36) (p= 0.007), control (mean rank = 20.25) and competition (mean rank = 37.53) (p= 0.054), but not other group combinations.

Statement 2 - I feel inspired / helped by the ideas in the ideabox.

Distributions of experiencing being helped by the ideabox items were not similar for all conditions, as assessed by visual inspection of a boxplot. The mean ranks of experienced helpfulness were significantly different between groups, $H(3) = 9.910$, $p = 0.019$. Post hoc analysis revealed statistically significant differences in experiencing being helped between the control and collaboration (mean rank = 42.22) (p= 0.40), control (mean rank = 24.39) and mixed (mean rank = 41.92) (p= 0.046), but not with competition (mean rank = 38.24) or any other group combination.

Statement 3 - I feel that the person who suggested the idea in the ideabox has helped me with my task.

Visual inspection of a boxplot indicated that distributions of experiencing being helped by the user suggesting the ideabox items were not similar for all conditions. The mean ranks of experienced were statistically significantly different between groups, $H(3) = 11.259$, $p = 0.010$. Post hoc analysis revealed statistically significant differences in experiencing being helped by the user suggestion the ideabox items between the control (mean rank = 24.00) and mixed (mean rank = 45.22) ($p= 0.008$), but not with collaboration (mean rank = 37.72), competition (mean rank = 39.94) or any other group combination.

Statement 4 - I feel connected with the users that I saw the suggestions of.

Distributions of experiencing connectedness with users of suggested ideas were not similar for all conditions, as assessed by visual inspection of a boxplot. Across the different conditions, the mean ranks of experienced connectedness in increments as follow - control(mean rank = 26.95), collaboration(mean rank = 37.22), mixed (mean rank = 39.94), competition(mean rank = 42.76), but the differences were not statically significant, $H(3) = 6.541$, $p = 0.088$. Given that the Kruskal-Wallis H test is not statistically significant, post-hoc analysis was not performed.

5 Discussion

This study set out to find if using collaboration methods in gamification design would be able to offset the cognitive load that is experienced from competitive environments. The following research questions were focused on – would the addition of cooperation reduce experienced cognitive load, and subsequently improve work performance by the means of increasing quantity or quality of the output? Second, given that past research has highlighted that social connectedness is core to a collaborative solution - would the users feel as though they were helped by someone else with the incorporation of a cooperative element in the design? We first discuss the findings of this study in reference to the hypotheses made earlier.

5.1 Types of Gamification Feedback on Idea Quantity and Quality

H1: Participants in the competitive condition would have the highest idea quantity

Based on the two 2-Way ANOVAs that were performed for gamification feedback on idea quantity and quality, no significant interaction effects were observed. Further inspection of the main effects of competition on idea quantity indicated that main effect was statistically significant. Mean of idea quantity in the competition condition was highest across all conditions (M = 3.9, SD = 1.7), supporting hypothesis 1. This result also echoes the findings of Landers et al.'s (2017) study, namely that participants in competitive environments would generate more output as a result of Goal-Setting; and the use of a leaderboard is sufficient to create a competitive environment.

H2: Participants in the mixed condition would have lower idea quantity, but higher idea quality compared to participants in the competitive condition

Hypothesis 2 is partially supported, as participants in the mixed condition did generate the second-highest amount of ideas (M = 3.14, SD = 1.21). The difference suggested that introducing an additional element that participants had to work with added some level of cognitive load into play, as suggested by Oviatt's (2006) study. As results were not statistically significant for the dependent variable of idea quality, we are unable to conclude if the mixed condition feedback has any effect on the quality of ideas generated.

H3: Participants in the collaboration condition would have the highest idea quality.

As mentioned above, the results were not statistically significant for the dependent variable of idea quality, as such, hypothesis 3 is not supported. A post examination of this study also suggests that some design limitations may have influenced the results of this study, and will be further discussed in the limitations section.

5.2 Gamification Feedback Survey Response

Participants answered several self-report statements about how gamification feedback made them feel. Four statements were used to cover most grounds of experiences when it comes to collaborative environments, and used to provide a general overview of how the gamification conditions were experienced. In assessing this, we made this hypothesis:

H4: Participants will feel that the glowing choice options make them feel more connected to other users

In judging experiencing usefulness, participants in the mixed condition reported the highest usefulness rating across all conditions, following by collaboration, and competition. While a high usefulness rating was expected from participants in the mixed and

collaboration condition, it was rather unexpected for the competition environment. An explanation would be that participants responded regarding the overall experienced usefulness despite being specifically asked to rate if items in the ideabox felt useful. If the self-report was based on overall usefulness, it would indicate that participants were consciously aware and appreciative of the goal-setting with leaderboards, as in games. Witkowski (2014) notes this similar experience in games and sports, where there exists a co-dependence on rivals to "play their best" so that one would be able to reach top levels of play themselves by demonstrating their ability in response.

In assessing how much participants felt they were helped by the ideas in the ideabox, only the collaboration and the mixed group showed significant differences against the control group. This validates the findings of past research that the sheer existence of guidance provides some level of psychological comfort to people. That said, the experienced helpfulness did not translate into results in this study, given that participants in both groups produced lower numbers of ideas than those in the competitive condition, and no significant effects could be found with the quality of ideas. However, as a cautious note of optimism, this could simply mean that certain conditions were required to be met for the experienced helpfulness to take effect. Sailer and Homner (2020) in their meta-analysis of the gamification of learning noted that although the effects of competitive-collaborative modes of interaction were positive, the effects on outcomes were indirect, and were subject to multiple conditions, and are therefore in danger of being unstable with respect to its fail-safe number. One suggested factor that may have contributed to this, is the users' subjective perceptions of whether the competition is constructive or destructive - and may be an avenue for future research in different contexts of gamification.

The analysis for the experience of being helped by the person suggesting the ideabox items yielded interesting results. The only significant difference was reported between the mixed and control group. As the same usernames both appear on the leaderboard and in the ideabox section, this could potentially be pointing towards an interaction effect of having seen the same person as both rival and a collaborator. This result suggests that the perception of experiencing a more varied interaction with a person would help foster positive opinions about them. However, if we look at Smith's (2006) study exploring different game structures – which are cooperative, competitive, and semi-cooperative - there is much nuance involved in the design considerations of eliciting the experience of competition and collaboration beyond the simple feedback explored in this study. Smith's (2006) study pointed out that as expressions of behavior increases, so does the complication between competition and collaboration. For instance, despite being designed for collabora-

tion, cooperative games themselves could also elicit aggression from teammates for having not pulling one's weight in-game. This complex interactivity may be the root cause of some failed attempts in combining competitive and collaborative design efforts in gamification, and may warrant more controlled and in-depth exploration in this direction, so that design considerations for practical implementations can be better done in the future.

Lastly, the self-report measure for experiencing connectedness was not statistically significant between any of the combined conditions. This suggests that the sheer experience of being helped by someone is not quite enough to develop some level of experienced intimacy, nor does the combined scenario of competing and collaborating with them. This experience is unlike that found reported in previous studies, where creating some level of constructive competition was seen to foster feelings of relatedness (Rigby & Ryan, 2011). This, however, very likely stems from the simplicity of what constitutes competition and collaboration in this study. As indicated above, this is an interesting area of research that would highly benefit actual implementations of gamification design - for as the complexity of interaction rises - it would only be wise to have design considerations put into place to balance out undesired interactions.

5.3 Theoretical and Practical Implications

Overall, the design and results of this study provides insight to designing for competition and collaboration. Looking at the results, this study was able to replicate the results of competition from Landers et al. (2017)'s study, supporting the Goal-Setting effect of generating more output as a result. Furthermore, we discovered that adding simple collaborative elements in a competitive environment were sufficient to allow some rapport building between people. However, more research is required to better understand what other conditions were required to further enhance those effects. The following further discusses the theoretical and practical implications of this study, followed by the limitations of this study, and proposals for future research directions.

The results of this study provide some theoretical contributions to understanding the experiences within the scope of designing for collaboration. First, it provides support that the existence of guidance from another person provides some level of psychological comfort to people. With the simple implementations of competitive and collaborative elements alone, we were also able to reproduce some level of complex experiences seen in games, where participants reported to have felt helped by someone despite competing with them at the same time. However, the effect does not extend to the feeling of relatedness that games are sometimes able to produce as noted by Witkowski (2014). This, however, sheds light on past research's findings where the effects of creating competition and collaboration in learning environments were inconclusive (see Sailer & Homner, 2020),

where, as seen in the case of this study, a simplistic execution of collaboration may work to provide some level of social interaction, it is still unable to fully emulate the full experience of working with another individual.

In terms of practical contributions, this study provides some guidance into the potential psychological effect of inserting collaborative elements within gamification design. Gamification practitioners are sometimes required to design collaborative environments, which would make users of their platforms feel welcome and connected to increase engagement. Often, such a design would be required within learning platforms or community portals (corporate or otherwise). So far, there has not been any guidance in terms of how to approach this, or how extensive a design should be to produce desired results. Thus, this finding suggests that gamification designers could consider the use of inserting user-generated input during onboardings or identified pain points of using their platforms to not only provide guidance to the user, but also establish rapport that is essential in collaborative environments. Using this as a baseline, further design choices could also be added to enhance the level of interactivity and engagement.

Beyond theoretical and practical contributions, this study also attempts to follow the process of a theoretically driven experiment in examining the effects independent gamification elements. As mentioned earlier in the opening, one recognized problem in gamification research literature is the disproportional context in which the effects of gamification are measured against control groups. Following methodical research procedure and separating game elements based on theoretical judgement directly addresses the unfair comparisons identified in both Koivisto & Hamari (2018), and Hamari, Koivisto, & Sarsa (2014) empirical gamification literature reviews. Both papers note the lack of separating game elements in the peer-reviewed papers they have reviewed, which would contribute and unfair bias and disproportionately over-report the benefits of applying gamification without identifying which constructs in the design contributed to the effects.

The steps done to address the methodological shortcomings mentioned in Hamari et al.'s (2014) paper as follows: 1) identifying and collecting a sufficient sample size to examine the effect of relationship between constructs, 2) using controls, identifying and separating affordances to understand their main and interactions, 3) presented inferential tests of study hypotheses, 4) managing the novelty effect by necessitating participants to perform a trial run of the platform based on the condition they were assigned to, 5) acquiring demographic data, and self-report psychological outcomes to establish multi-level models to have a more comprehensive understanding of the constructs studied.

Besides reporting results comprehensively, it is also recognized that articulating the design of constructs and the methodology of its testing - particularly for those not as common in application - would help clarify the rationale and provide transparency to inform future research if those were to be done. As such, a section specifically was written on the collaboration design of this study. Gamification as an academic topic of study is relatively young, and as such while it is possible to build on the methodological foundations of previous studies, it is also recommended that the reporting be adaptive and follow the Human-Centered approach in attempting to provide clarity in areas that would aid understanding and future research.

5.4 Limitations and Future Directions

There are few limitations identified with this study. Firstly, the data collection was conducted fully online as observed to have been done in previous works. While initially thought that to be able to acquire participants representative of a wider audience, further inspection of the participants revealed some issues related to this method. In rating the quality of participant's responses, the assessors have noted several responses by participants indicated that the answers provided were copied-and-pasted from online searches. This scenario was slightly unexpected, and a possible explanation was that in the process of reproducing a task that would provide the level of complexity on par with real-life problem solving, the produced task was too niche towards a specific professional domain that resulted in the need for researching online. The responses acquired in this study were not discarded, based on the consensus between the researcher and assessors that this approach was representative of modern-day problem-solving. While this strengthens the external validity with real-world systems, it lowers the internal validity of the study. This may have also contributed to the non-significant results from the data. Ideally, to maximize the internal validity and fully assess the effects of the designed conditions before validating it with real-world systems, the experiment environment should have been more controlled, conducted in person, while limiting extraneous variables by limiting participant's access to the internet. Future research should take the issues noted in consideration, or particularly in learning contexts, explore if their constructs would have varying effects on results considering perceived task difficulty.

Another limitation related to the internal validity of the study design pertains to the role of cognitive load as a measurable construct. This study attempts to explore the possibility of using collaborative systems to reduce cognitive load that is a by-product of creating a competitive environment, and thus influencing production. While the understanding is built upon past studies, further steps to further quantify the experienced cognitive load by participants in the study design may have provided more internal validity.

A possible way of approaching this to have a pre/post measure of the experienced cognitive load where all participants would be required to perform a similar brainstorming task without any gamification feedback prior to their assigned condition, and having the responses be recorded and coded to be compared with the responses with gamification feedback. Future research should take this into consideration, to establish better internal validity for their studies.

Thirdly, while this study attempts to follow the process of a theoretically driven experiment and address the methodological limitations mentioned in Hamari et al (2014)'s paper, some compromises were also made to adapt to the situation in which this study was conducted. Hamari et al recommended the use of proper, validated psychometric measurements when surveying experiences and attitudes. However, the final self-report survey measuring the experience of being exposed to different gamification feedback conditions did not adhere to this recommendation, as the context of the survey was highly specific to the construct, and there did not seem to be an existing instrument that fit within context. The alternative was to create a survey that would be able to assess the experience each construct was trying to induce. Hamari et al's paper also suggested the use of multilevel measurement models to better provide a more comprehensive view of research studies. In this study, it is recognized that understanding the personality differences in participants would provide a more extensive view of the effects of the constructs - as games studies and personality studies have pointed out generalizable groups with specific behaviors and preferences when it comes to people's behavior in games (see Bartle, 1996) as well as in work (see Christfort & Vickberg, 2018). That said, the question as to which type of construct to use within the context of gamification is still inconclusive and is as such not included in this study. However, since this study, Tondello, Mora, & Marczewki (2019) published a Gamification User Types Hexad scale that was designed specifically to parse different user motivations within the context of gamification. Future research might explore the effects of their gamification interventions on behavior with user types scale for a more comprehensive understanding of the effects of constructs.

Another avenue for future research is a further in-depth exploration of the interaction effects of designing for competition and collaboration on the same gamification system. While this study validates the existence of an interaction between elements, it is still inconclusive if the interaction effects could translate beyond the psychological experience and into a behavioral output - or if there are certain conditions required to be met for the behavioral effects to take place. The results also suggest that there may be some level of complex balancing of competition and collaboration that is required to be in place as to

having people to feel like they were being helped by another, and as such would benefit from more controlled and in-depth exploration in this direction.

6 References

Amabile, T. M. (1996). Creativity and innovation in organizations.

Bartle, R. (1996). Hearts, clubs, diamonds, spades: Players who suit MUDs. Journal of MUD research, 1(1), 19.

Bogost, I. (2015). Why gamification is bullshit. The gameful world: Approaches, issues, applications, 65.

Brühlmann, F. (2017). The effects of framing in gamification: A study of failure. Springer.

Candy Crush Saga [Video game]. (2012). Malta: King.

Chan, T. W., & Chou, C. Y. (1997). Exploring the design of computer supports for reciprocal tutoring.

Chou, C. Y., & Chan, T. W. (2016). Reciprocal tutoring: design with cognitive load sharing. International Journal of Artificial Intelligence in Education, 26(1), 512-535.

Chou, Y. K. (2015). Actionable gamification: Beyond points. Badges, and Leaderboards.

Christfort, K., & Vickberg, S. (2018). Business Chemistry: Practical Magic for Crafting Powerful Work Relationships. John Wiley & Sons.

de la Peña Esteban, F. D., Torralbo, J. A. L., Casas, D. L., & García, M. C. B. (2020). Web gamification with problem simulators for teaching engineering. Journal of Computing in Higher Education, 32(1), 135-161.

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011, September). From game design elements to gamefulness: defining" gamification". In Proceedings of the 15th international academic MindTrek conference: Envisioning future media environments (pp. 9-15).

Eickhoff, C., Harris, C. G., de Vries, A. P., & Srinivasan, P. (2012, August). Quality through flow and immersion: gamifying crowdsourced relevance assessments. In Proceedings of the 35th international ACM SIGIR conference on Research and development in information retrieval (pp. 871-880).

Fortes Tondello, G., Premsukh, H., & Nacke, L. (2018, January). A theory of gamification principles through goal-setting theory. Hawaii International Conference on System Sciences.

Gears, D., & Braun, K. (2013, April). Gamification in business: Designing motivating solutions to problem situations. In Proceedings of the CHI 2013 Gamification Workshop.

Greenfield, R. (2013, October 29). The Secrets of Candy Crush Revealed. Retrieved October 08, 2020, from *https://www.theatlantic.com/technology/archive/2013/07/secrets-candy-crush-revealed/313200/*

Hamari, J., Koivisto, J., & Sarsa, H. (2014, January). Does gamification work? A literature review of empirical studies on gamification. In 2014 47th Hawaii International Conference on System Sciences (HICSS), (pp. 3025-3034). IEEE.

Huotari, K., & Hamari, J. (2012, October). Defining gamification: a service marketing perspective. In Proceeding of the 16th international academic MindTrek conference (pp. 17-22).

Janssen, J., & Kirschner, P. A. (2020). Applying collaborative cognitive load theory to computer-supported collaborative learning: towards a research agenda. Educational Technology Research and Development, 1-23.

Kahn Jr, P. H., Ishiguro, H., Friedman, B., Kanda, T., Freier, N. G., Severson, R. L., & Miller, J. (2007). What is a Human?: Toward psychological benchmarks in the field of human–robot interaction. Interaction Studies, 8(3), 363-390.

Kirschner, P. A., Sweller, J., Kirschner, F., & Zambrano, J. (2018). From cognitive load theory to collaborative cognitive load theory. International Journal of Computer-Supported Collaborative Learning, 13(2), 213-233.

Koivisto, J., & Hamari, J. (2019). The rise of motivational information systems: A review of gamification research. International Journal of Information Management, 45, 191-210.

Laerd Statistics (2015). Kruskal-Wallis H test using SPSS Statistics. One-way MANOVA using SPSS Statistics. Statistical tutorials and software guides. Retrieved from *https://statistics.laerd.com/*

Landers, R. N., Auer, E. M., Collmus, A. B., & Armstrong, M. B. (2018). Gamification science, its history and future: Definitions and a research agenda. Simulation & Gaming, 49(3), 315-337.

Landers, R. N., Bauer, K. N., & Callan, R. C. (2017). Gamification of task performance with leaderboards: A goal setting experiment. Computers in Human Behavior, 71, 508-515.

Landers, R. N., Collmus, A. B., & Williams, H. (2019). The greatest battle is within ourselves: An experiment on the effects of competition alone on task performance. International Journal of Human-Computer Studies, 127, 51-61.

Latham, G. P., & Locke, E. A. (1991). Self-regulation through goal setting. Organizational behavior and human decision processes, 50(2), 212-247.

Latham, G. P., & Locke, E. A. (2007). New developments in and directions for goal-setting research. European Psychologist, 12(4), 290-300.

Litchfield, R. C. (2008). Brainstorming reconsidered: A goal-based view. Academy of Management Review, 33(3), 649-668.

Litchfield, R. C., Fan, J., & Brown, V. R. (2011). Directing idea generation using brainstorming with specific novelty goals. Motivation and Emotion, 35(2), 135-143.

Locke, E. A. (1968). Toward a theory of task motivation and incentives. Organizational behavior and human performance, 3(2), 157-189.

Locke, E. A., & Latham, G. P. (2002). Building a practically useful theory of goal setting and task motivation: A 35-year odyssey. American psychologist, 57(9), 705.

Locke, E. A., & Latham, G. P. (2006). New directions in goal-setting theory. Current directions in psychological science, 15(5), 265-268.

Maxwell, S. E., & Delaney, H. D. (2004). Designing experiments and analyzing data: A model comparison perspective (2nd ed.). New York: Psychology Press.

Mekler, E. D., Brühlmann, F., Tuch, A. N., & Opwis, K. (2017). Towards understanding the effects of individual gamification elements on intrinsic motivation and performance. Computers in Human Behavior, 71, 525-534.

Mora, A., Riera, D., González, C., & Arnedo-Moreno, J. (2017). Gamification: a systematic review of design frameworks. Journal of Computing in Higher Education, 29(3), 516-548.

Morschheuser B, Hamari J, Maedche A. (2018). Cooperation or competition – When do people contribute more? A field experiment on gamification of crowdsourcing. International Journal of Human-Computer Studies.

Morschheuser, B., Hassan, L., Werder, K., & Hamari, J. (2018). How to design gamification? A method for engineering gamified software. Information and Software Technology, 95, 219-237.

Nicholson, S. (2015). A recipe for meaningful gamification. In Gamification in education and business (pp. 1-20). Springer, Cham.

Ortiz-Rojas, M., Chiluiza, K., & Valcke, M. (2019). Gamification through leaderboards: An empirical study in engineering education. Computer Applications in Engineering Education, 27(4), 777-788.

Oviatt, S. (2006, October). Human-centered design meets cognitive load theory: designing interfaces that help people think. In Proceedings of the 14th ACM international conference on Multimedia (pp. 871-880).

Oviatt, S., Arthur, A., & Cohen, J. (2006, October). Quiet interfaces that help students think. In Proceedings of the 19th annual ACM symposium on User interface software and technology (pp. 191-200).

Psychological Perspectives on Motivation through Gamification (Sailer, Hense, Mandl, & Klevers, 2013)

Reeves, B., & Read, J. L. (2009). Total engagement: How games and virtual worlds are changing the way people work and businesses compete. Harvard Business Press.

Riar, M. (2020). Using Gamification to Motivate Cooperation: A Review. I*n 41st International Conference on Information Systems, ICIS 2020*.

Rigby, S., & Ryan, R. M. (2011). Glued to games: How video games draw us in and hold us spellbound: How video games draw us in and hold us spellbound. AbC-CLIo.

Sailer, M., & Homner, L. (2020). The gamification of learning: A meta-analysis.

Santhanam, R., Liu, D., & Shen, W. C. M. (2016). Research Note—Gamification of technology-mediated training: Not all competitions are the same. Information systems research, 27(2), 453-465.

Schöbel, S., Söllner, M., & Mishra, A. N. (2017). DOES THE WINNER TAKE IT ALL?–TOWARDS AN UNDERSTANDING OF WHY THERE MIGHT BE NO ONE-SIZE-FITS-ALL GAMIFICATION DESIGN.

Scott Jr, W. E. (1966). Activation theory and task design. Organizational behavior and human performance, 1(1), 3-30.

Sepehr, S., & Head, M. (2013, October). Competition as an element of gamification for learning: an exploratory longitudinal investigation. In Proceedings of the First International Conference on Gameful Design, Research, and Applications (pp. 2-9).

Shalley, C. E., Zhou, J., & Oldham, G. R. (2004). The effects of personal and contextual characteristics on creativity: Where should we go from here?. Journal of management, 30(6), 933-958.

Smith, H. (2006). Plans and Purposes How Videogame Goals Shape Player Behaviour.

Stanculescu, L. C., Bozzon, A., Sips, R. J., & Houben, G. J. (2016, February). Work and play: An experiment in enterprise gamification. In Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing (pp. 346-358).

Suh, A., & Wagner, C. (2017). How gamification of an enterprise collaboration system increases knowledge contribution: an affordance approach. Journal of Knowledge Management.

Sweller, J. (2010). Element interactivity and intrinsic, extraneous, and germane cognitive load. Educational psychology review, 22(2), 123-138.

Tondello, G. F., Mora, A., & Nacke, L. E. (2017, October). Elements of gameful design emerging from user preferences. In Proceedings of the Annual Symposium on Computer-Human Interaction in Play (pp. 129-142).

Tondello, G. F., Mora, A., Marczewski, A., & Nacke, L. E. (2019). Empirical validation of the gamification user types hexad scale in English and Spanish. International Journal of Human-Computer Studies, 127, 95-111.

Tukey, J. W. (1977). Exploratory data analysis (Vol. 2, pp. 131-160).

Viberg, O., Khalil, M., & Lioliopoulos, A. (2020, July). Facilitating ideation and knowledge sharing in workplaces: The design and use of gamification in virtual platforms. In International Conference on Human-Computer Interaction (pp. 353-369). Springer, Cham.

White, P. H., Kjelgaard, M. M., & Harkins, S. G. (1995). Testing the contribution of self-evaluation to goal-setting effects. Journal of Personality and Social Psychology, 69(1), 69.

Witkowski, E. (2014). 20 COMPETITIONAND COOPERATION. The Routledge Companion to Video Game Studies.

Wolf, T., Jahn, S., Hammerschmidt, M., & Weiger, W. H. (2020). Competition versus cooperation: How technology-facilitated social interdependence initiates the self-improvement chain. International Journal of Research in Marketing.

Yee, N. (2006). Motivations for play in online games. Cyber Psychology & behavior, 9(6), 772-775.

7 Appendix

7.1 Tasks Description (Practice & Actual)

Practice Task Description

For this practice task, you will be given **4 minutes** to list the uses for a box.

As this is a brainstorming task, please try to come up with **as many creative ideas as possible**.

For your frame of reference, creativity theory defines the creativity of an idea based on its **novelty** and **usefulness**.

Actual Task Description

A new university has recently been established in the city of Tampere, Finland.

TAMPERE UNIVERSITY is a combination of the city's previous 3 higher education institutes, offering undergraduate, postgraduate and doctoral programs across various disciplines.

It is currently looking for creative ideas to market itself as a destination for higher learning to people all across the world.

For this task, you will be given **12 minutes** to list down the ideas that you have for the university to market itself.

As this is a brainstorming task, please try to come up with **as many creative ideas as possible**.

For your frame of reference, creativity theory defines the creativity of an idea based on its **novelty** and **usefulness**.

7.2 Demographic Questionnaire

Your Background

First, please answer some general questions about yourself.

1. How old are you?
    - <18 years old
    - 18 -24 years old
    - 25 - 34 years old
    - 35 - 44 years old
    - 45+ years old
    - I prefer not to answer
2. What is the highest degree or level of school have you completed?
    - No formal education
    - High school diploma or similar
    - College degree
    - Vocational training
    - Bachelor's degree
    - Master's degree
    - Ph.D or higher
    - Other
    - I prefer not to answer
3. What best describes your experience with games?
    - I don't play games
    - I play occasionally, but don't consider myself a gamer
    - Causal gamer
    - Core gamer
    - Hardcore gamer
4. How do you rate your level of English?
    - No proficiency
    - Elementary proficiency
    - Limited working proficiency
    - General professional proficiency
    - Advanced professional proficiency
    - Native proficiency

7.3 Post-Task Survey

Please rate the following statements based on how much it relates to your experience in the series of tasks you've performed earlier.

If you find any statement not applicable to your experience, please select Not Applicable as a response.

Statements

1. I feel that the items in the ideabox are useful to me.
2. I feel inspired / helped by the ideas in the ideabox.
3. I feel that the person who suggested the idea in the ideabox has helped me with my task.
4. I feel connected with the users that I saw the suggestions of.
5. I feel that I was in competition with the user(s) who were above me in the leaderboard ranking.
6. I felt inspired by the user scores on the leaderboard.
7. I feel that the leaderboard helped me with my task.

Responses

0 - Not Applicable
1 - Strongly Disagree
2 – Disagree
3 – Undecided
4 – Agree
5 - Strongly Agree

7.4 Rating Instructions

How to Rate Novelty

- Rate on how unique the idea is (whether you think other people will come up with something like it)
- It **DOES NOT** have to be a good idea
- Rating scale (1-5)
    - 1 - Not Unique
    - 2 - Slightly Unique
    - 3 - Moderately Unique
    - 4 - Unique
    - 5 - Very Unique

How to Rate Usefulness

- Rate on how useful you think this idea is to effectively market Tampere University.
- It **DOES NOT** have to be practical, novel, or creative.
- Rating scale (1-5)
    - 1 - Not Useful
    - 2 - Slightly Useful
    - 3 - Moderately Useful
    - 4 - Useful
    - 5 - Very Useful

Unique Situations

- You might encounter statements that look odd, if that is the case, rate both Usefulness and Freshness based on the following.
- Rate 0 = Use Desc column to elaborate if required. Possible situations:
    - Agreement → Statement looks like its agreeing with something
    - Comment → Statement looks like its a comment / replying to something
- Rate 1 = If the line that you're rating looks like something related to advertising (eg. slogan).
- Some instances I've encountered and tried to fix in the file, but if you see some yourself, please:
    - Duplicate answer from the same user -> just remove them.
    - Lengthy (and odd looking) answers -> Double tap column to display text in full view. The answers might be multiple responses submitted in one go. Based on your judgement, if all of the text belongs to a single response, rate them as a such; if not, count that as a new response for the same username.

7.5 Cohen's κ for Inter-rater Agreement

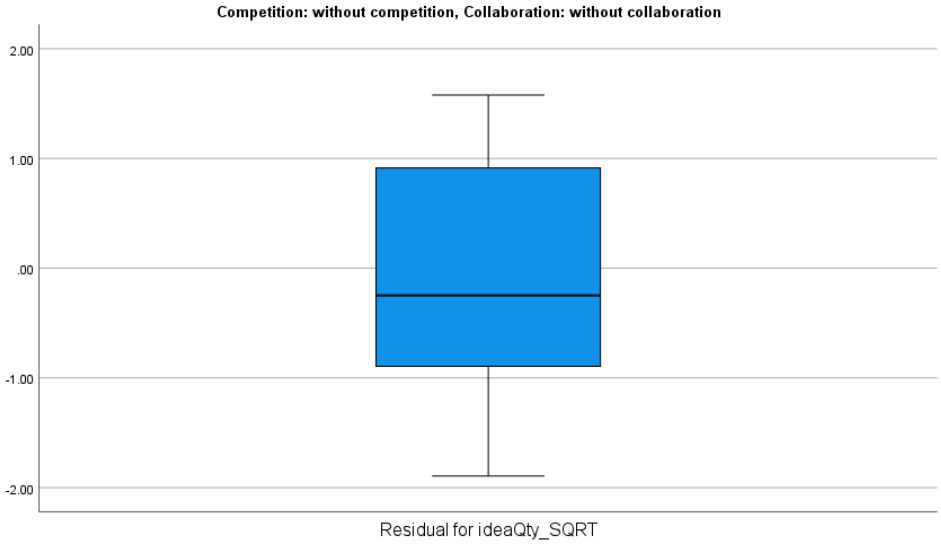
Symmetric Measures

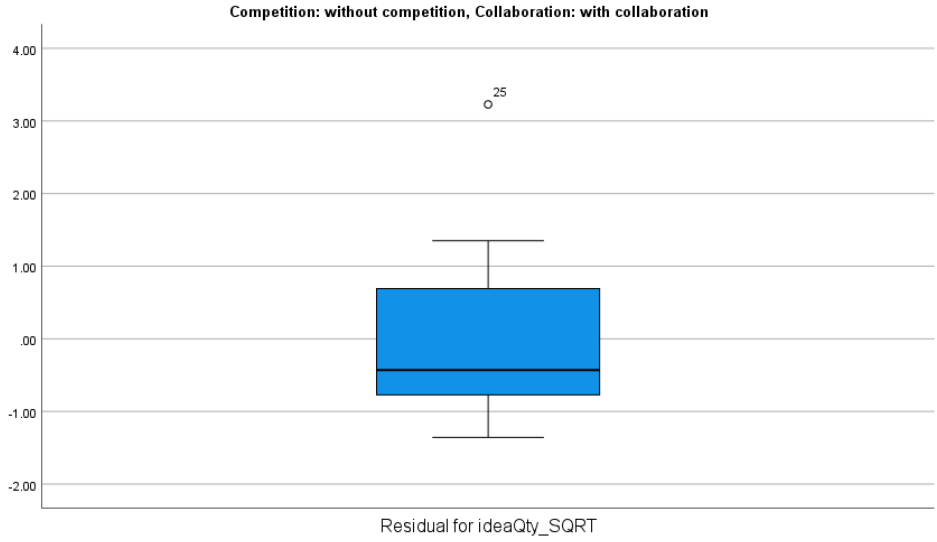
		Value	Asymptotic Standard Error[a]	Approximate T[b]	Approximate Significance
Measure of Agreement	Kappa	.440	.058	21.397	.000
N of Valid Cases		72			

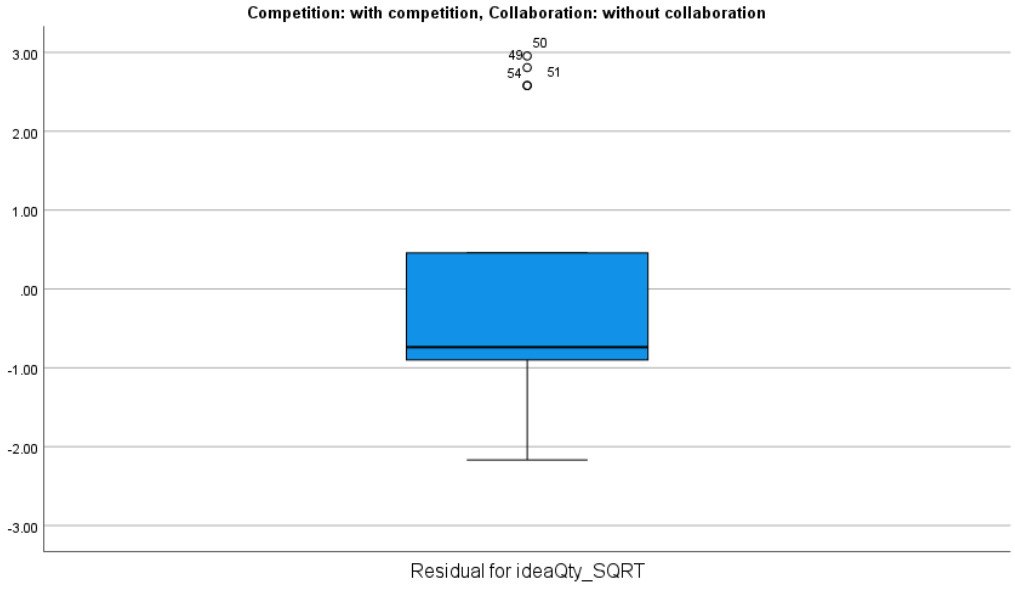
a. Not assuming the null hypothesis.

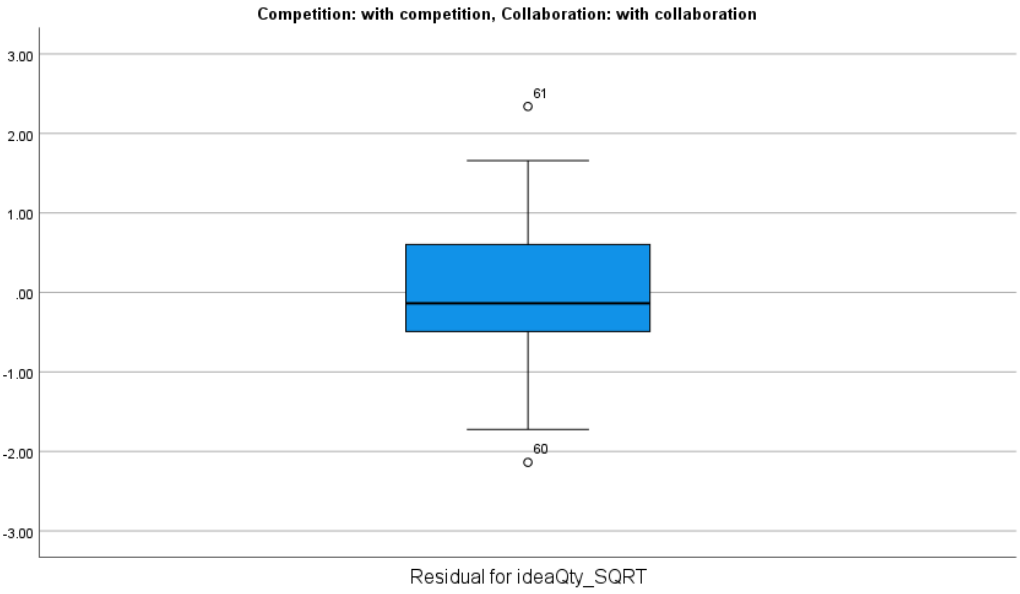
b. Using the asymptotic standard error assuming the null hypothesis.

7.6 2-Way ANOVA for Gamification condition on Idea Quantity






Competition: with competition, Collaboration: without collaboration
3.00
2.00
1.00
.00
-1.00
-2.00
-3.00
50
49
54
51
Residual for ideaQty_SQRT


Competition: with competition, Collaboration: with collaboration
3.00
2.00
1.00
.00
-1.00
-2.00
-3.00
61
60
Residual for ideaQty_SQRT

Tests of Normality

Competition	Collaboration		Kolmogorov-Smirnov[a] Statistic	df	Sig.	Shapiro-Wilk Statistic	df	Sig.
without competition	without collaboration	Residual for ideaQty_SQRT	.153	19	.200*	.940	19	.264
	with collaboration	Residual for ideaQty_SQRT	.175	18	.151	.893	18	.044
with competition	without collaboration	Residual for ideaQty_SQRT	.222	17	.025	.853	17	.012
	with collaboration	Residual for ideaQty_SQRT	.163	18	.200*	.959	18	.573

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Descriptive Statistics

Dependent Variable: ideaQty_SQRT

Competition	Collaboration	Mean	Std. Deviation	N
without competition	without collaboration	2.8935	1.07811	19
	with collaboration	2.7717	1.18116	18
	Total	2.8343	1.11525	37
with competition	without collaboration	3.9004	1.70262	17
	with collaboration	3.1370	1.20944	18
	Total	3.5078	1.49847	35
Total	without collaboration	3.3690	1.47745	36
	with collaboration	2.9544	1.19265	36
	Total	3.1617	1.34938	72

Levene's Test of Equality of Error Variances[a,b]

		Levene Statistic	df1	df2	Sig.
ideaQty_SQRT	Based on Mean	1.676	3	68	.180
	Based on Median	.680	3	68	.567
	Based on Median and with adjusted df	.680	3	48.488	.569
	Based on trimmed mean	1.588	3	68	.200

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Dependent variable: ideaQty_SQRT

b. Design: Intercept + competition + collaboration + competition * collaboration

Tests of Between-Subjects Effects

Dependent Variable: ideaQty_SQRT

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	13.390[a]	3	4.463	2.619	.058	.104
Intercept	724.979	1	724.979	425.396	.000	.862
competition	8.459	1	8.459	4.964	.029	.068
collaboration	3.521	1	3.521	2.066	.155	.029
competition * collaboration	1.849	1	1.849	1.085	.301	.016
Error	115.889	68	1.704			
Total	849.000	72				
Corrected Total	129.279	71				

a. R Squared = .104 (Adjusted R Squared = .064)

Estimated Marginal Means

1. Competition * Collaboration

Dependent Variable: ideaQty_SQRT

Competition	Collaboration	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
without competition	without collaboration	2.894	.299	2.296	3.491
	with collaboration	2.772	.308	2.158	3.386
with competition	without collaboration	3.900	.317	3.269	4.532
	with collaboration	3.137	.308	2.523	3.751

2. Competition

Estimates

Dependent Variable: ideaQty_SQRT

Competition	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
without competition	2.833	.215	2.404	3.261
with competition	3.519	.221	3.078	3.959

Pairwise Comparisons

Dependent Variable: ideaQty_SQRT

(I) Competition	(J) Competition	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
without competition	with competition	-.686*	.308	.029	-1.301	-.072
with competition	without competition	.686*	.308	.029	.072	1.301

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Bonferroni.

Univariate Tests

Dependent Variable: ideaQty_SQRT

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Contrast	8.459	1	8.459	4.964	.029	.068
Error	115.889	68	1.704			

The F tests the effect of Competition. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

3. Collaboration

Estimates

Dependent Variable: ideaQty_SQRT

Collaboration	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
without collaboration	3.397	.218	2.962	3.832
with collaboration	2.954	.218	2.520	3.389

Pairwise Comparisons

Dependent Variable: ideaQty_SQRT

(I) Collaboration	(J) Collaboration	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
without collaboration	with collaboration	.443	.308	.155	-.172	1.057
with collaboration	without collaboration	-.443	.308	.155	-1.057	.172

Based on estimated marginal means

a. Adjustment for multiple comparisons: Bonferroni.

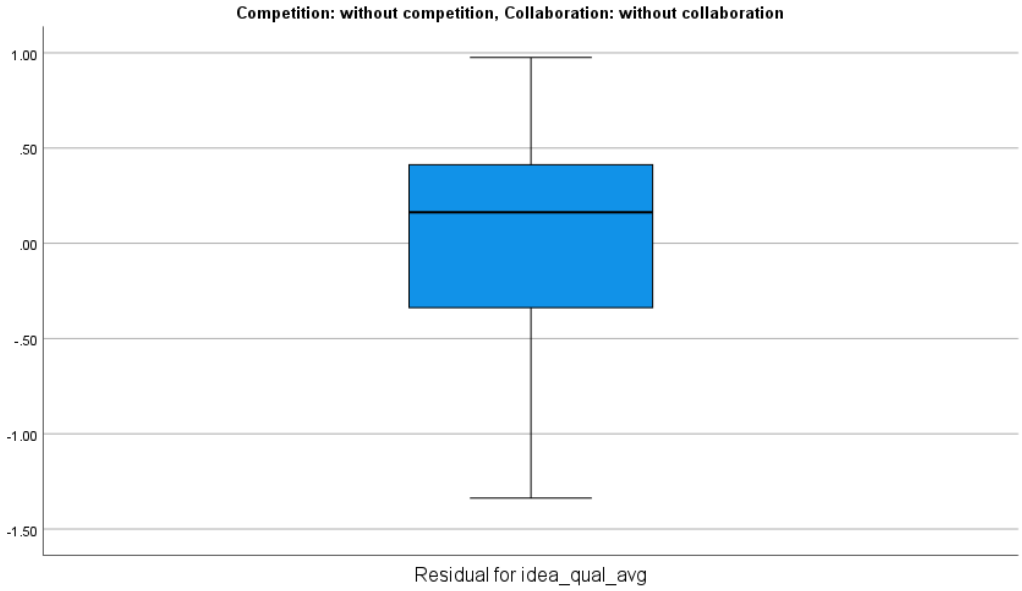
Univariate Tests

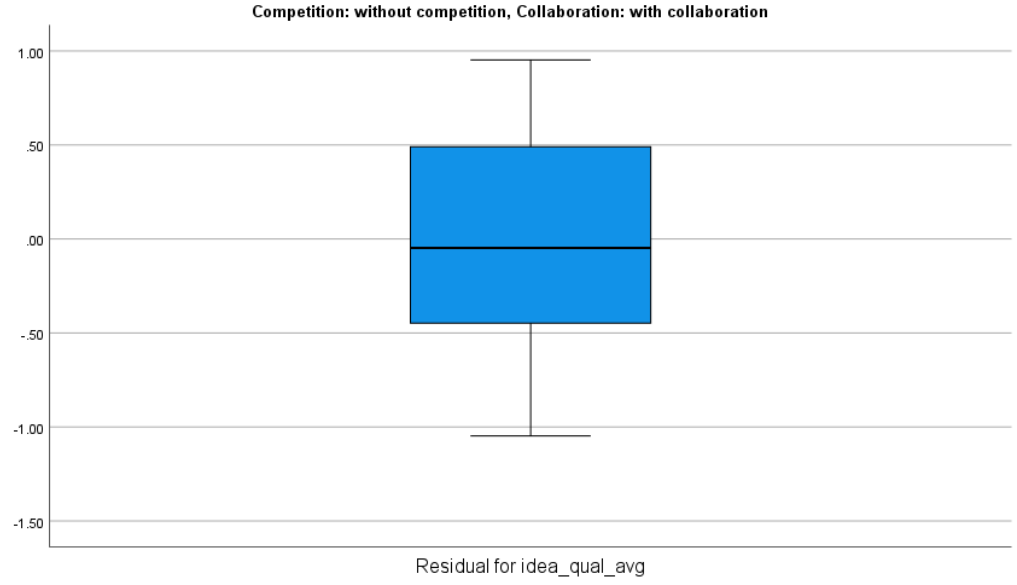
Dependent Variable: ideaQty_SQRT

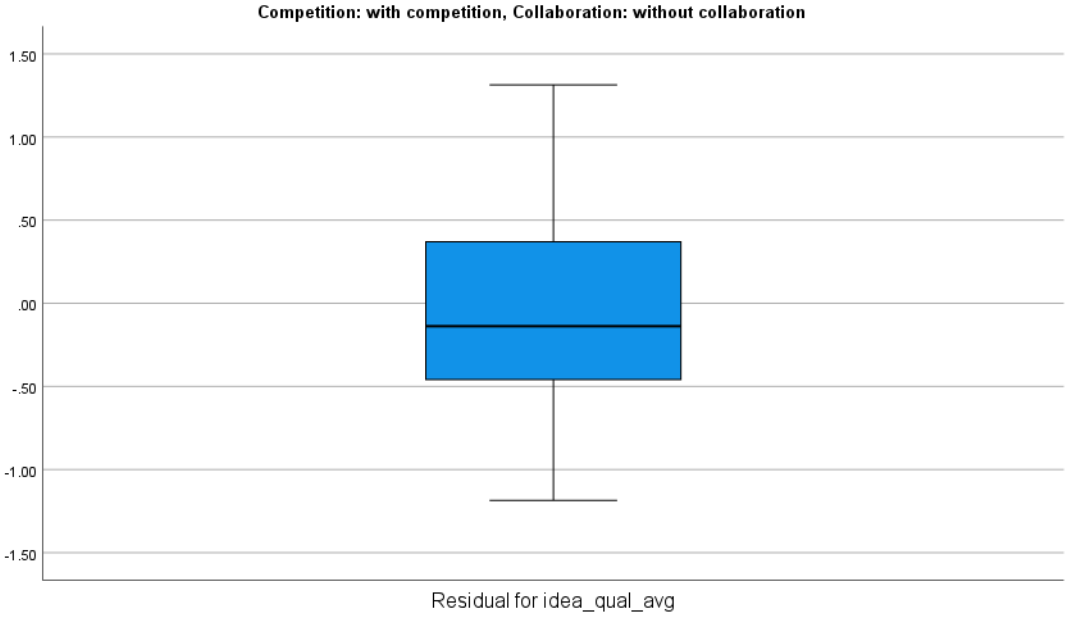
	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Contrast	3.521	1	3.521	2.066	.155	.029
Error	115.889	68	1.704			

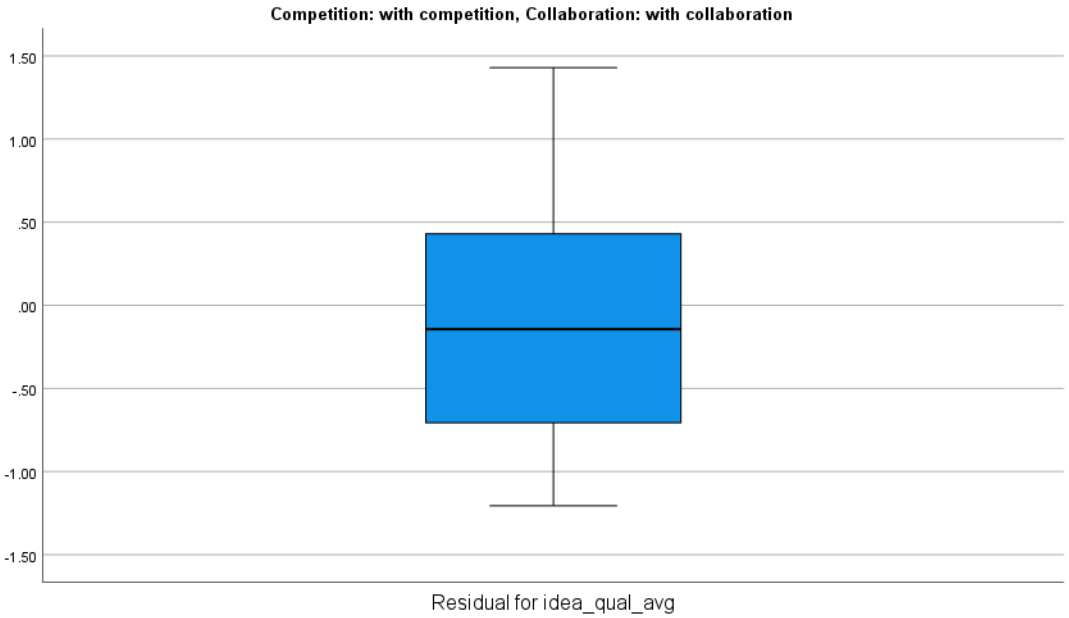
The F tests the effect of Collaboration. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

7.7 2-Way ANOVA for Gamification condition on Idea Quality






Competition: with competition, Collaboration: without collaboration
1.50
1.00
.50
.00
-.50
-1.00
-1.50
Residual for idea_qual_avg


Competition: with competition, Collaboration: with collaboration
1.50
1.00
.50
.00
-.50
-1.00
-1.50
Residual for idea_qual_avg

Tests of Normality

Competition	Collaboration		Kolmogorov-Smirnov[a] Statistic	df	Sig.	Shapiro-Wilk Statistic	df	Sig.
without competition	without collaboration	Residual for idea_qual_avg	.175	19	.127	.919	19	.109
	with collaboration	Residual for idea_qual_avg	.135	18	.200*	.961	18	.613
with competition	without collaboration	Residual for idea_qual_avg	.115	17	.200*	.979	17	.948
	with collaboration	Residual for idea_qual_avg	.116	18	.200*	.970	18	.800

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Descriptive Statistics

Dependent Variable: Idea quality averaged

Competition	Collaboration	Mean	Std. Deviation	N
without competition	without collaboration	2.33721	.668076	19
	with collaboration	2.04739	.589101	18
	Total	2.19622	.639226	37
with competition	without collaboration	2.18553	.674580	17
	with collaboration	2.20583	.716141	18
	Total	2.19597	.686061	35
Total	without collaboration	2.26558	.665930	36
	with collaboration	2.12661	.651245	36
	Total	2.19610	.657707	72

Levene's Test of Equality of Error Variances[a,b]

		Levene Statistic	df1	df2	Sig.
Idea quality averaged	Based on Mean	.398	3	68	.755
	Based on Median	.337	3	68	.798
	Based on Median and with adjusted df	.337	3	65.163	.798
	Based on trimmed mean	.387	3	68	.763

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Dependent variable: Idea quality averaged

b. Design: Intercept + competition + collaboration + competition * collaboration

Tests of Between-Subjects Effects

Dependent Variable: Idea quality averaged

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	.780[a]	3	.260	.591	.623	.025
Intercept	346.043	1	346.043	786.119	.000	.920
competition	.000	1	.000	.000	.983	.000
collaboration	.326	1	.326	.741	.392	.011
competition * collaboration	.432	1	.432	.982	.325	.014
Error	29.933	68	.440			
Total	377.958	72				
Corrected Total	30.713	71				

a. R Squared = .025 (Adjusted R Squared = -.018)

7.8 Kruskal-Wallis Data Analysis

Overall Test Summary

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.[a,b]	Decision
1	The distribution of I feel that the items in the ideabox are useful to me. is the same across categories of Gamification condition.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
2	The distribution of I feel inspired / helped by the ideas in the ideabox. is the same across categories of Gamification condition.	Independent-Samples Kruskal-Wallis Test	.019	Reject the null hypothesis.
3	The distribution of I feel that the person who suggested the idea in the ideabox has helped me with my task. is the same across categories of Gamification condition.	Independent-Samples Kruskal-Wallis Test	.010	Reject the null hypothesis.
4	The distribution of I feel connected with the users that I saw the suggestions of. is the same across categories of Gamification condition.	Independent-Samples Kruskal-Wallis Test	.088	Retain the null hypothesis.
5	The distribution of I feel that I was in competition with the user(s) who were above me in the leaderboard ranking. is the same across categories of Gamification condition.	Independent-Samples Kruskal-Wallis Test	.061	Retain the null hypothesis.
6	The distribution of I felt inspired by the user scores on the leaderboard. is the same across categories of Gamification condition.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
7	The distribution of I feel that the leaderboard helped me with my task. is the same across categories of Gamification condition.	Independent-Samples Kruskal-Wallis Test	.055	Retain the null hypothesis.

a. The significance level is .050.
b. Asymptotic significance is displayed.

I feel that the items in the ideabox are useful to me. across Gamification condition

Independent-Samples Kruskal-Wallis Test Summary

Total N	72
Test Statistic	19.733[a]
Degree Of Freedom	3
Asymptotic Sig.(2-sided test)	.000

a. The test statistic is adjusted for ties.

Pairwise Comparisons of Gamification condition

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
Control-Competition	-17.266	6.617	-2.609	.009	.054
Control-Collaboration	-21.098	6.520	-3.236	.001	.007
Control-Mixed	-27.542	6.520	-4.224	.000	.000
Competition-Collaboration	-3.832	6.704	-.572	.568	1.000
Competition-Mixed	-10.276	6.704	-1.533	.125	.752
Collaboration-Mixed	-6.444	6.607	-.975	.329	1.000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same. Asymptotic significances (2-sided tests) are displayed. The significance level is .050.
a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

I feel that the person who suggested the idea in the ideabox has helped me with my task. across Gamification condition

Independent-Samples Kruskal-Wallis Test Summary

Total N	72
Test Statistic	11.259[a]
Degree Of Freedom	3
Asymptotic Sig.(2-sided test)	.010

a. The test statistic is adjusted for ties.

Pairwise Comparisons of Gamification condition

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
Control-Collaboration	-13.722	6.624	-2.072	.038	.230
Control-Competition	-15.941	6.723	-2.371	.018	.106
Control-Mixed	-21.222	6.624	-3.204	.001	.008
Collaboration-Competition	2.219	6.811	.326	.745	1.000
Collaboration-Mixed	-7.500	6.713	-1.117	.264	1.000
Competition-Mixed	-5.281	6.811	-.775	.438	1.000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same. Asymptotic significances (2-sided tests) are displayed. The significance level is .050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

I feel inspired / helped by the ideas in the ideabox. across Gamification condition

Independent-Samples Kruskal-Wallis Test Summary

Total N	72
Test Statistic	9.910[a]
Degree Of Freedom	3
Asymptotic Sig.(2-sided test)	.019

a. The test statistic is adjusted for ties.

Pairwise Comparisons of Gamification condition

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
Control-Competition	-13.841	6.668	-2.076	.038	.228
Control-Mixed	-17.522	6.569	-2.667	.008	.046
Control-Collaboration	-17.827	6.569	-2.714	.007	.040
Competition-Mixed	-3.681	6.755	-.545	.586	1.000
Competition-Collaboration	-3.987	6.755	-.590	.555	1.000
Mixed-Collaboration	.306	6.658	.046	.963	1.000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same. Asymptotic significances (2-sided tests) are displayed. The significance level is .050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

I feel connected with the users that I saw the suggestions of. across Gamification condition

Independent-Samples Kruskal-Wallis Test Summary

Total N	72
Test Statistic	6.541[a,b]
Degree Of Freedom	3
Asymptotic Sig.(2-sided test)	.088

a. The test statistic is adjusted for ties.

b. Multiple comparisons are not performed because the overall test does not show significant differences across samples.