Gordon Institute of Business Science
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Testing the effects of individual gamification elements on motivation and performance quality to better understand how they can be implemented in an organisational context

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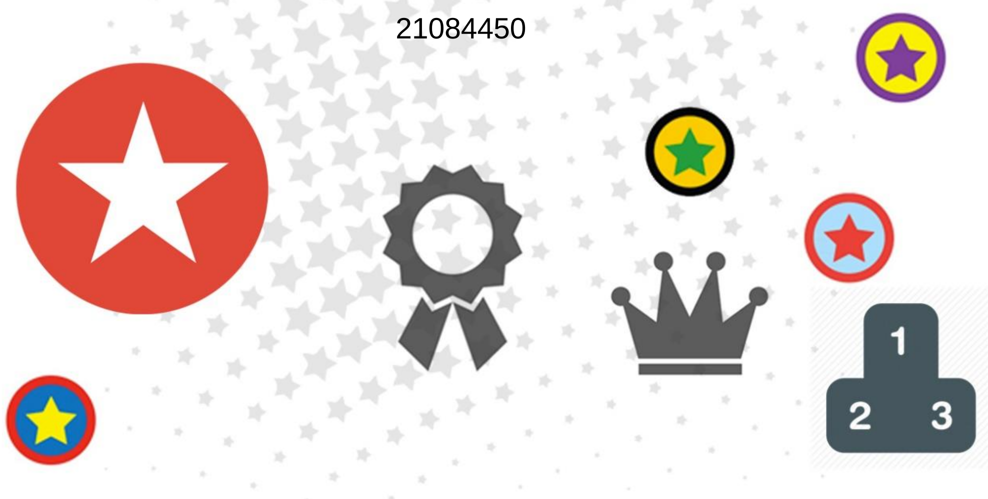

A research project submitted to the Gordon Institute of Business Science, University of Pretoria, in partial fulfilment of the requirements for the degree of Master of Business Administration.

9 November 2015

DECLARATION

I declare that this research project is my own work. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration at the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree or examination in any other University. I further declare that I have obtained the necessary authorisation and consent to carry out this research.

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Signature: ____________________ Date: 9 November 2015

ABSTRACT

Over the past four years gamification (the use of game elements in non-game contexts) has been implemented in various organisational contexts to drive performance outcomes, with varying degrees of success. One reason for this is the lack of research on the individual game elements and their underlying motivational mechanisms. Further to this gamification, makes use of extrinsic incentives, such as points and levels, to drive intrinsically motivated behaviours, which lead to performance gains in quality. Up until recently it has been widely accepted that extrinsic incentives crowd out intrinsic motivation for interesting tasks, which has led to a further lack of research on intrinsic motivation, incentives and performance. What has been proposed is that if the incentives are perceived by the user as informative and not controlling, they may support intrinsic motivation, by enhancing the feeling of competence. It has been said that extrinsic motivation leads to an increase in performance quantity whilst intrinsic motivation leads to an increase in performance quality.

This research made use of an online experiment to individually assess the effect of points, levels and leaderboards, against a control condition, on intrinsic motivation, flow and performance quality outcomes (point scores for correctly completed tasks), using graphical perception tasks. The tasks were structured in a way that is intrinsically motivating to the user, in that they offered performance feedback which allowed for task mastery.

The study found that the points and leaderboards conditions had no significant effect on intrinsic motivation, flow or performance quality. The levels condition however led to a significant increase in performance quality, where intrinsic motivation and more specifically, perceived competence predicted the performance quality. This shows that the levels incentive supported intrinsic motivation, and its associated behavioural outcomes.

KEYWORDS

Gamification, game design elements, points, levels, leaderboards, extrinsic incentives, intrinsic motivation, flow, performance quality, autonomy, competence

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CHAPTER 1: INTRODUCTION TO RESEARCH PROBLEM

Gamification is an emerging area of interest which has created a fair amount of hype. The terminologies central to it are still in a state of flux (Robson, Plangger, Kietzmann, McCarthy, & Pitt, 2015b), and many have argued both in favour and against its effectiveness. Can enjoyable, motivating, game-like experiences be successfully transferred from games to non-game, utilitarian contexts, through the use of gamification mechanics? The purpose of this research is to explore gamification in an attempt to further the understanding of how game elements can be used to motivate and drive user behaviour.

1.1 Problem definition

The pervasiveness of digital technologies and social media has changed how employees and organisations participate in, co-create, share, discuss and reshape experiences. Firms are looking to turn traditional processes into engaging game-like experiences for customers and employees (Robson et al., 2015b). There is therefore a growing interest in how gamification, the use of game design elements (such as points, levels or leaderboards) in non-game contexts (Deterding, Dixon, Khaled, & Nacke, 2011), can be used by business. The aim of gamification within a business is to drive desired outcomes by engaging and motivating employees (Ruhi, 2015). Examples of these outcomes include, improved productivity, organizational transformation and innovation (Raftopoulos, 2014). The underlying motivational mechanisms of gamification have only recently become objects of empirical research (Mekler, Brühlmann, Tuch, & Opwis, 2015), and to date, only a few studies have attempted to experimentally investigate how individual game elements affect motivation and performance (Deterding, 2011; Hamari, Koivisto, & Sarsa, 2014; Seaborn & Fels, 2015). Further to this, most suggested approaches to gamification, do not offer guidance on how certain mechanics should be implemented or in which contexts (Deterding, 2015).

1.1.1 Emergence and challenges of gamification

Gamification has become a popular topic of discussion for both business and academics, since 2011 (Hamari, 2015). Many agree that the application in this domain warrants further exploration and that empirical evidence needs to address the usefulness of particular game elements in different contexts when applied to interactive systems (Seaborn & Fels, 2015).

Gartner (2011) stated that 50% of companies were predicted to gamify at least one aspect of their workplace by 2015, but that by 2014, 80% of these gamified applications would fail to meet business objectives primarily due to poor design (Gartner, 2012). This is one example demonstrating the need for studies to help understand how gamification can be successfully implemented in an organizational context. Further to this, market researcher M2 Research, forecast the gamification market in the US to reach $242 million by the end of 2012 and climb to $2.8 billion by 2016, with enterprise gamification capturing 38% of the market. ("M2 Research," 2015). Global companies such as Nike, Apple, Facebook and Starbucks have already implemented gamification within their marketing strategies (Kim & Lee, 2013), and companies such as SAP, EMC, Microsoft, Deloite and Google have implemented enterprise gamification within their organisations (Epstein, 2012).

1.1.2 Engagement of employees

With the use of gamification, employers seek to engage employees, improve their productivity and drive positive behavioural outcomes. Engaging employees could assist the organization in realizing business process improvements, service efficiencies, talent development, innovative research ideas and constructive collaboration practices (Ruhi, 2015). Some of gamification applications being deployed by organizations include, employee performance, healthcare, marketing and training (Dale, 2014). Salesforce.com offers an out-the-box solution with various gamification elements, such as leaderboards to create competition among users by creating social comparison (Epstein, 2012). Deterding (2011) warns that as participation in the gamified system might not be voluntary or free of consequence, it could be experienced as controlling and thus decrease motivation. In the salesforce example, the use of the leaderboard game element might not transfer the same motivational affordances from a play to a work context, and could thus have unintended negative consequences. LiveOps Inc., which runs virtual call centres, implemented badges, points and leaderboards and found that they achieved a 23% improvement in employee performance (Bourque, 2012). In another example Slalom Consulting, found that only 5% of their employees where interested in their gamified program, which failed, as most were uninterested in the gamification incentives (Epstein, 2012).

As established above, game elements are implemented to drive engagement. They motivate users of the gamified system to engage with an application or service, or in a certain behaviour (Deterding, 2011). It therefore follows that one must understand how people are motivated, to better understand the design of an effective gamified system.

1.1.3 Advances in the understanding of intrinsic and extrinsic motivation

Motivation is driven by intrinsic and extrinsic motives. Intrinsic motivation is described as an activity which is performed to gain pleasure and satisfaction derived from the activity itself (e.g., task enjoyment) (Cerasoli, Nicklin, & Ford, 2014; Guay, Vallerand, & Blanchard, 2000). Extrinsic motivation, describes actions motivated solely to gain certain outcomes regardless of the activity (Almarshedi, Wills, Wanick, & Ranchhod, 2014). To obtain desired outcomes, gamification is used to direct people's motivations towards intrinsically motivated, gameful experiences and behaviours (Deterding et al., 2011; Hamari, 2015), even though it is often associated more strongly with extrinsic motivation (Armstrong, Landers, & Collmus, 2015), and incentives. The reason for driving intrinsic motivation, is that it is mostly associated with positive outcomes (Guay et al., 2000). When intrinsically motivated towards a task or behaviour one has a "greater sense of personal commitment and persistence, more positive self-perceptions and a better quality of engagement" (M. R. Ryan & Deci, 2000). Intrinsic motivation also increases the extent and quality of the effort people put into a task (Cerasoli et al., 2014). Intrinsic motivation enhances creativity and learning outcomes (M. R. Ryan & Deci, 2000).

Motivation theorists have for the last four decades (Cerasoli et al., 2014) debated that extrinsic motivation crowds-out intrinsic motivation for interesting tasks, in what is termed "the undermining effect" (Edward L Deci, Koestner, & Ryan, 1999; Osterloh & Frey, 2000). This is when the promise of external incentives on an initially enjoyable task, subsequently reduces the intrinsic motivation towards the task after the incentives are offered (Edward L. Deci, Koestner, & Ryan, 1999).

This argument poses a problem with using gamification incentives to drive intrinsically motivated experiences and behaviours. There is a lack of research on intrinsic motivation, incentives and performance. Cerasoli, Nicklin, & Ford (2014) believe that this is because of what they term the "uncomfortable conclusion", which argues that if incentives boost performance, and intrinsic motivation boosts performance, then it logically follows that incentives cannot reduce intrinsic motivation.

They believe that the “undermining effect” body of research is no longer relevant, because both intrinsic and extrinsic motivation is functional in performance contexts. Intrinsic motivation predicts “quality performance” type behaviours and extrinsic motivation predicts “quantity type” performance behaviours.

Furthermore, cognitive evaluation theory states that how someone perceives the extrinsic rewards or incentives, mediates the undermining effect (Edward L Deci & Ryan, 1985; M. R. Ryan & Deci, 2000). If they are perceived as controlling, intrinsic motivation will be reduced. Deterding (2011) says that if mechanics are not voluntary and free of consequence, they could be experienced as controlling. On the other hand, if mechanics are perceived as informative, non-controlling, and competence boosting, they may increase intrinsic motivation, by increasing a sense of competence, which is the need to feel competent (R. M. Ryan, Rigby, & Przybylski, 2006). Positive feedback, perceived competition and enhanced opportunities for the user to be optimally challenged are other ways to improve competence (Francisco, Luis, González, & Isla, 2012). It is also important to note that a sense of competence will not increase intrinsic motivation unless the person experiences autonomy. That is that the person believes their behaviour is self-determined and not controlled by the extrinsic rewards (Edward L Deci et al., 1999).

From this, it is clear that when using gamification mechanics and incentives to motivate performance, performance being an achievement related behaviour (Cerasoli et al., 2014), one must first understand the type of performance that is required. This will determine if extrinsic motivation should be used or if the incentives need to be internalized as intrinsic motivation, by enhancing the sense of competence.

1.1.4 Gamification, motivation and performance

As established above, understanding how incentives affect intrinsic motivation and how both intrinsic and extrinsic motivation affect user performance are important in understanding how to effectively implement gamification mechanics in different contexts. However, the underlying motivational mechanisms of gamification have only recently become the object of empirical research (Mekler et al., 2015). One recent study was an experiment done by Mekler et al., (2015). Individual gamification mechanics were implemented on an image tagging task. They found that the game elements did not affect intrinsic motivation nor did performance mirror intrinsic motivation.

Even with competence supporting feedback the mechanics functioned as extrinsic incentives which led to an increased frequency of tags being produced, without an increase in the quality of the tags, as was intended (Mekler et al., 2015).

This is possibly because the design of the task is as important as the feedback. The design of the task should also allow for improved levels of competence (control, mastery, etc.) which is derived from overcoming well-balanced challenges. Challenge is described as the basis of any gaming experience and the central dynamic for motivating optimal enjoyable experiences. (Deterding, 2015). Achievement motivation and intrinsic challenge are where people derive pleasure from, improving their level of competence (Carbonneau, Vallerand, & Lafrenière, 2012; Francisco et al., 2012). This leads to a boost in one of the three types of intrinsic motivation; intrinsic motivation towards accomplishment, that is, partaking in an activity for the enjoyment experienced when attempting task mastery (Carbonneau et al., 2012). Achievement motivation has been described in a few ways, one is through achievement goal theory (Ziegler, Schmukle, Egloff, & Bühner, 2010). Achievement goal theory defines two goal types, one being mastery goals (Benita, Roth, & Deci, 2014), which happens when individuals attempt to increase their level of competence, advance their skills or achieve a level of mastery based on their own personal standards (Benita et al., 2014).

1.2 Research objectives

Based on the preceding discussion, the objective of this research is to explore the impact of three of the most commonly implemented gamification mechanics; points, levels and leaderboards (Hamari, Koivisto, & Sarsa, 2014; Seaborn & Fels, 2015) on user motivation and behaviour. Specifically, intrinsic motivation, the flow construct and the performance quality aspect of behaviour. The aim is to assess if these mechanics are internalised as intrinsic motivators, by supporting the user's psychological needs of autonomy and competence. Direct, positive informational feedback will be used to support competency. The design of the task will also support competency, by allowing for challenge and mastery goals. The flow measure will be used to determine if this was successfully done, as mastery and autonomy are two important predictor elements for flow in gamification. They help in balancing users' skills with the presented challenges (Almarshedi et al., 2014).

1.3 Research scope

The scope of this research is limited by the design of the online experiment and tasks used within the study. Points, levels and leaderboards are measured against a control group and their effect on performance quality, intrinsic motivation and the flow construct are measured. User personality determinants, which might determine intrinsic motivation, were intentionally omitted (Carbonneau et al., 2012). The definitions of the items for the purpose of this research include:

Points: extrinsic incentive and goal metric, used to provide feedback on player performance

Levels: extrinsic incentive and goal metric, used to provide feedback on player performance, and show progression

Leaderboard: extrinsic incentive and goal metric, used to provide feedback on player performance, and allow for social comparison.

Challenge: a specific kind of obstacle which requires a certain level of effort and skill to overcome. This is overcoming the resistance, relative to the user's current ability, posed by the system, which impedes the user from achieving their current goals. (Deterding, 2015).

Feedback: deliberate and immediate information, autonomously offered by the system on each action taken by the user. This is used to inform the user of their current and accumulated progress (Deterding, 2015).

Autonomy**:** the experience of freedom to act with self-governance and willingness, in accordance with one's own values, needs, goals and identity (Deterding, 2015).

1.4 Research problem

To date only a few studies have attempted to experimentally investigate the effects of particular game elements on motivation and performance (Deterding, 2011; Hamari, Koivisto, & Sarsa, 2014; Seaborn & Fels, 2015). The research attempts to assess if the individual elements, points, levels and leaderboards, can be used to drive intrinsic motivation, and its associated performance behaviours by supporting the users' psychological need of autonomy and competence. The aim is to enhance the understanding of how gamification elements can ultimately be used by organisations to drive motivation and engagement. These topics are explored both theoretically and practically in more detail in the following chapter.

2. THEORY AND LITERATURE REVIEW

2.1 Introduction

The literature review looked at the main themes relating to gamification, including; needs satisfaction theories, competence and challenge, intrinsic motivation and extrinsic incentives, motivational affordances, cognitive flow theory, and designing for gamification. These themes were explored in an attempt to understand the underlying motivational mechanisms of gamification, to aid with answering the research question. Can the individual gamification elements, points, levels and leaderboards, be used to drive intrinsic motivation and its associated performance behaviours by supporting the users' psychological need of autonomy and competence?

2.2 Background to gamification

Game design elements are the aspects of an interactive system used to enhance it with affordances for gameful experiences. This is done to enhance and create value for the user (Huotari & Hamari, 2012) and to motivate and engage users (Seaborn & Fels, 2015). Gameful design endeavours to create systems with specific functions that are facilitated by motivating and enjoyable experiences (Deterding, 2015). The emotions elicited in a gamified experience should be fun-oriented (Deterding, 2011), and creating user enjoyment should be the single-most important goal for gamification (Robson et al., 2015b). The experiences created by gamification have similar aspects to games, such as flow, mastery and autonomy, but they tend to not be direct hedonic experiences (Hamari & Koivisto, 2013) which are typically sought after in traditional games. In enterprise gamification it has been found that end users mostly seek instrumental gratifications geared towards achieving specific valued outcomes such as learning and recognition. They seek these outcomes in the context of an enjoyable and fun experience (Ruhi, 2015). End users might have different emotional responses based on the gratifications they seek, but the gamification platform should be able to deliver these responses in a delightful or pleasurable manner (Ruhi, 2015).

Enterprise Gamification has been shown to enhance employee engagement and produce desired business outcomes in a variety of functions, including marketing, logistics, human resources, customer service, trainee engagement, learning and knowledge collaboration (Ruhi, 2015; Stone, Deadrick, Lukaszewski, & Johnson, 2015).

Other purposes of gamification include increasing customer loyalty and engagement (Robson, Plangger, Kietzmann, McCarthy, & Pitt, 2015) motivating users, increasing user activity (Deterding et al., 2011) and ultimately shifting behaviour (Almarshedi et al., 2014).

2.3 Motivation

The primary motive of gamification is to affect motivations rather than attitude and/or behaviour directly (Hamari & Koivisto, 2013). To be motivated means to be moved to do something, someone who is energized or mobilised toward an end is considered motivated (M. R. Ryan & Deci, 2000).

2.3.1 Self-Determination Theory

Self Determination Theory (SDT) (Edward L Deci & Ryan, 1985), the underlying theory of motivation is arguably the empirically most well researched psychological theory of intrinsic motivation. SDT is one of the theories of need satisfaction. The fulfilment or satisfaction of needs is what accounts for a significant portion of the enjoyment and motivation attained through gaming. It is also what leads to the positive experiences experienced when using interactive products, and in life in general (Deterding, 2015). Need satisfaction theories contend that people seek out and engage in activities which promise, and are successful in satisfying ones motivational needs. These needs have been found to include; competence, autonomy and relatedness (Deterding, 2011). All three of these motivational needs when afforded through game elements, have been found to increase intrinsic motivation in people (Francisco et al., 2012).

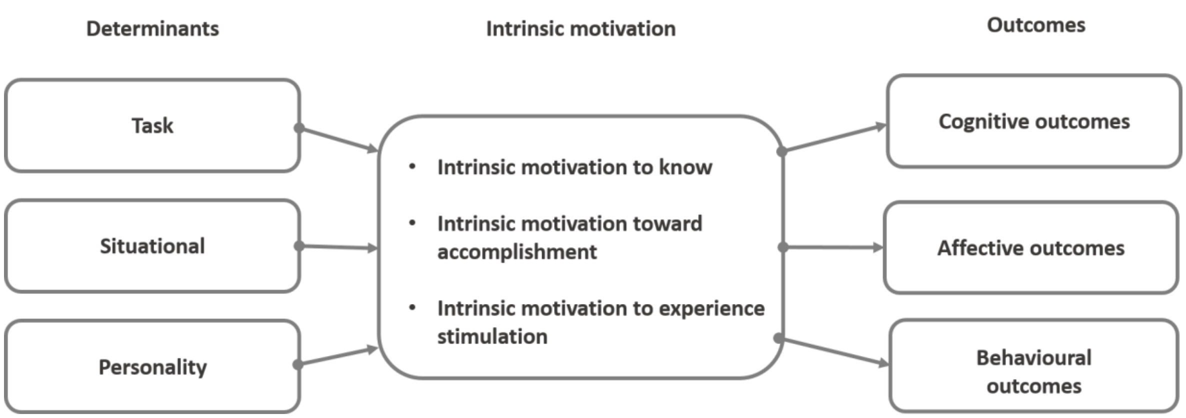
Self-determination theory characterizes motivation as driven by intrinsic and extrinsic motives (Armstrong et al., 2015). Both types are used in gamification (Almarshedi et al., 2014).

2.3.2 Intrinsic motivation

“Intrinsic motivation describes the innate propensity to pursue interesting tasks that challenge one’s skills and foster growth” (Edward L Deci & Ryan, 1985). It is characterized by the satisfaction of a person’s needs to be competent, autonomous, and to feel related to those around them (Armstrong et al., 2015; Carbonneau et al., 2012; M. R. Ryan & Deci, 2000).

Intrinsic motivation is further described as an activity that is performed to gain enjoyment and satisfaction inherent in the activity itself (e.g., task enjoyment) (Cerasoli et al., 2014; Guay et al., 2000). There are three general categories for intrinsic motivation, including; intrinsic motivation to know, intrinsic motivation toward accomplishment and intrinsic motivation to experience stimulation. Carbonneau et., (2012) further stated- that each of the intrinsic motivation types can result from task, situational and personality determinants, which in turn lead to different cognitive, affective and behavioural outcomes, as shown below in figure 1. Situational and interpersonal factors are two antecedents that either support or undermine intrinsic motivation (Hagger & Chatzisarantis, 2011).

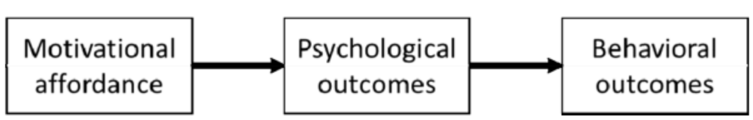
Figure 1 - The tripartite model of IM, adapted from Carbonneau et., (2012)



2.3.3 Task determinants and motivational affordances

Considering SDT and needs satisfaction theories, (the need for competence, autonomy, or relatedness) motivational affordance can be described as the following; "Motivation is afforded when the relation between the features of an object and the abilities of a subject allow the subject to experience the satisfaction of such needs when interacting with the object." (Deterding, 2011). Motivational affordances are used in interactive systems to ultimately influence people's attitudes and behaviours (Hamari, Koivisto, & Pakkanen, 2014). The conceptual framing can be seen in figure 2.

Figure 2 - Persuasive technologies framing (Hamari, Koivisto, & Pakkanen, 2014).



Gamified systems use game mechanics to create motivational affordances which invoke enjoyable, intrinsically motivating "gameful" experiences (Karanam et al., 2014). These motivational affordances have been divided into ten categories, namely; points, leaderboards, achievements/badges, levels, story/theme, clear goals, feedback, rewards, progress and challenge. Psychological outcomes include, engagement, encouragement, motivation, awareness, enjoyment, fun, self-efficacy, trust, credibility, commitment, sense of community, and adherence (Hamari, Koivisto, & Pakkanen, 2014).

2.3.4 Situated motivational affordances

The concepts of autonomy, intrinsic motivation, and the playful experience felt when using video games are closely related. The voluntariness and freedom from consequence of play leads to a strong experience of autonomy, and is thus intrinsically motivating. With gamification the context and social situation in which the extrinsic motivators are used is important, as it determines when and how the game elements engender motivational affordances in non-game contexts. The 'transfer' of a design element from a 'play' context into another usage context does not necessarily lead to the same motivational affordances (Deterding, 2011). Hanus & Fox (2015) found that giving extrinsic rewards, such as badges and coins, to encouraged competition and social comparison, harmed the intrinsic motivation and caused lower performance in a classroom situation. The rewards were interpreted as controlling, due to the context in which they were administered (Hanus & Fox, 2015).

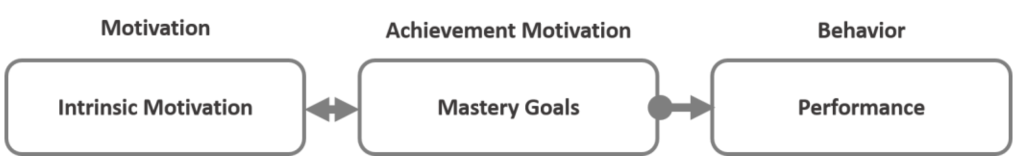
With gamification, one must look at the situated motivational affordances, which are "the opportunities to satisfy motivational needs provided by the relation between the features of an artefact and the abilities of a subject in a given situation" (Deterding, 2011). Context, consequences and the characteristics of users are key determinants in interactive gameplay, and consequently they play an important role in ensuring end-user engagement and the overall success of gamification initiatives (Ruhi, 2015; Stone et al., 2015). This fits in with Carbonneau et al's., (2012) notion that task, situational and personality determinants determine intrinsic motivation.

2.3.5 Intrinsic motivation and achievement motivation

Intrinsic motivation towards accomplishment, is when someone engages in an activity for the satisfaction and enjoyment gained from the process of attempting to accomplish something. This relates to achievement motivation and intrinsic challenge, where people derive pleasure from improving their level of competence (Carbonneau et al., 2012; Francisco et al., 2012). Intrinsic motivation and achievement motivation are both approach forms of motivation and there is an overlap of these two constructs (Cerasoli & Ford, 2014).

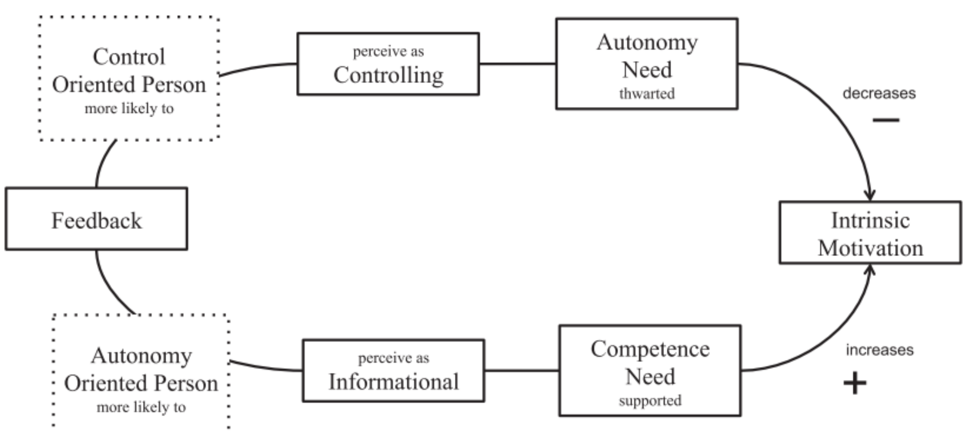
Achievement motivation has been described in numerous ways, one is through achievement goal theory (Ziegler et al., 2010). Achievement goal theory speaks to two kinds of goals, performance goals and mastery goals. Performance goals are an ambition to perform better than others. Orientating people to compare their competence to others is likely to promote performance goals, which leads to poorer performance and lower intrinsic motivation than mastery goals (Benita et al., 2014). Mastery goals are generally considered to be the most adaptive achievement goals and happen when people aim to acquire new skills, improve their level of competence or achieve a sense of mastery based on personal standards (Benita et al., 2014). Performance is an achievement related behaviour with an evaluation component and intrinsic motivation has been found to be a medium to strong predictor of performance, when measuring performance as either performance quality or quantity (Cerasoli et al., 2014). Cerasoli & Ford (2014) found that mastery goals are what mediate the effect of intrinsic motivation on performance, and that mastery goals and intrinsic motivation have a reciprocal effect on each other, as shown in figure 3.

Figure 3 – IM and mastery goals reciprocal model, in mediating performance



Cognitive Evaluation Theory (CET), a sub-theory of SDT, states that occurrences such as rewards, communication and feedback that are conducive toward feelings of competence, enhance intrinsic motivation, by supporting the psychological need for competence (Edward L Deci & Ryan, 1985; M. R. Ryan & Deci, 2000). One way in which goals enhance intrinsic interest is by creating standards for the evaluation of one's performance, and successfully obtaining these standards can enhance the perception of competence (Elliot, A.J. & Harackiewicz, 1994). Challenge is central to optimal experiences, as overcoming challenges is what leads to a sense of mastery and control in gaming. To this end, the main enjoyment and motivation which arises from gaming is through a sense of competence (Deterding, 2015). Challenges should be identified, which already exist in the user's pursuit of their goals or needs, and these should be restructured in a motivating manner instead of adding challenges indiscriminately (Deterding, 2015). Either self-referenced or norm-referenced feedback (social comparison) are required for achievement motivation to predict task performance (Ziegler et al., 2010). Externally referenced negative feedback, undermines intrinsic motivation (Hagger & Chatzisarantis, 2011), and it is important to note that a person's causality orientation may impact the interpretation of feedback as either informational or controlling (Mekler et al., 2015).

Figure 4 – Feedback, causality orientation and intrinsic motivation (Mekler et al., 2015).



To aid task mastery, a system could offer enhanced opportunities for the user to be optimally challenged and offer positive feedback which aids in the user achieving task mastery (Francisco et al., 2012).

Figure 5 - Performance feedback in relation to intrinsic motivation and mastery goals.

Intrinsic motivation is positively associated with engagement in performance behaviours, increasing the duration, persistence and the intensity (effort) of the behaviour, whilst mastery goals focus one's effort and drive cognitions to competence, rather than merely being satisfaction relevant (Cerasoli et al., 2014).

SDT differentiates between two primary qualities of motivation, related to different types of behavioural regulation: regulating oneself autonomously, with a sense of choice, versus being controlled or regulated, with a sense of internal or external compulsion (Benita et al., 2014).

Research has shown that there is a strong relationship between intrinsic interest and enjoyment, mastery goals and behavioural engagement when there is a higher level of choice (experience of autonomy) (Benita et al., 2014). This follows CET which states that a sense of competence will not improve intrinsic motivation unless one also experiences a sense of autonomy (M. R. Ryan & Deci, 2000), as SDT has found autonomy to be a basic motivational need (Edward L Deci & Ryan, 1985). Environmental factors that promote choice, competence or personal agency, generally tend to promote intrinsic motivation (Hagger & Chatzisarantis, 2011; R. M. Ryan et al., 2006), whereas events that reduce perceived autonomy or competence undermine intrinsic motivation (R. M. Ryan et al., 2006).

2.3.6 Extrinsic motivation and incentives

"Extrinsic motivation pertains to a wide variety of behaviours where the goals of action extend beyond those inherent in the activity" (Edward L Deci & Ryan, 1985). Extrinsically motivated actions are caused by rational or emotional evaluation of desired outcomes and explicit decisions to pursue those outcomes (Armstrong et al., 2015; M. R. Ryan & Deci, 2000).

Put differently, they are actions motivated solely to gain a certain outcome regardless of the activity (Almarshedi et al., 2014). Typically, extrinsic motivations involve some of the processes involved in intrinsic motivation (external regulation, introjection, identification, and integration), but not all (Armstrong et al., 2015).

Extrinsic rewards or incentives are anything provided by an external agent contingent on a particular performance behaviour, examples include; awards, praises, promotion, recognition etc. (Cerasoli et al., 2014). Incentive contingency, describes how incentives are predicted on performance, and there are four SDT contingencies. Engagement contingent incentives are incentives offered for engagement in a task or behaviour, completion contingent incentives are offered for completing a task, performance contingent incentives are offered for attaining a certain level of performance on a task, and non-contingent incentives are incentives that are not related to the task (E. L. Deci, Koestner, & Ryan, 2001). Further to this, completion and performance contingent incentives tend to be directly performance salient, that is, they provide a clear, immediate and unambiguous link between the incentive and the performance (Cerasoli et al., 2014).

2.3.7 Intrinsic motivation and incentives

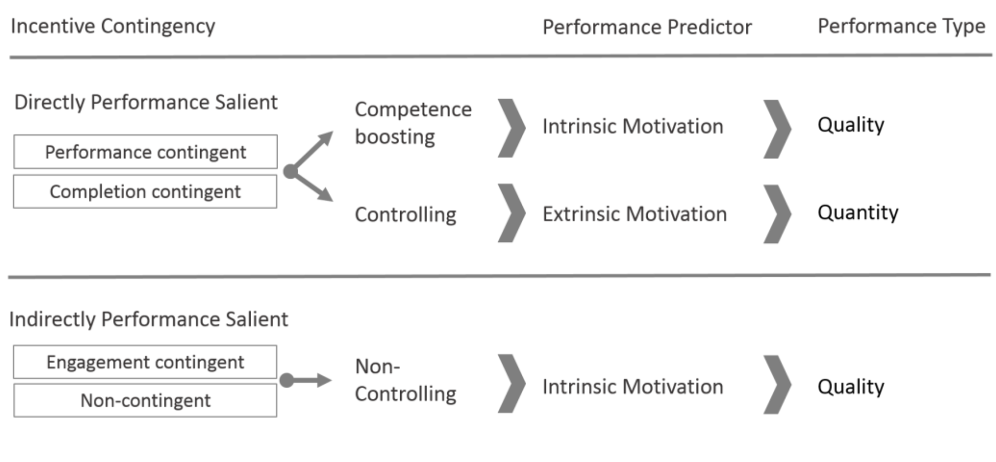
Previous articles suggested that under certain circumstances extrinsic motivators, such as performance contingent incentives, had a crowding out effect on intrinsic motivation for interesting activates (Edward L Deci et al., 1999; Murayama, Matsumoto, Izuma, & Matsumoto, 2010; Osterloh & Frey, 2000). This was because individuals perceived their actions towards the task or behaviour to be controlled by the external incentive or reward (Hagger & Chatzisarantis, 2011). Directly salient incentives have two factors necessary for controlling behaviour, namely; immediacy and salience. These incentives give a direct and clear link between behaviour and reward, and thus create a strong extrinsic incentive to perform. Indirectly salient incentives are less controlling (Cerasoli et al., 2014).

In the context of gamification, some studies on the use of the extrinsic incentives, points, levels and leaderboards have proved to decrease the users overall intrinsic motivation, as with a study by Hanus & Fox, (2015) were leaderboards and badges where used in an educational setting. One reason identified for the result, was that the users of the gamified system found it to be controlling (Hanus & Fox, 2015). This fits with the notion that if the incentives are designed to, or even perceived to, control an individual externally, they will reduce the satisfaction of the need for autonomy, and by extension reduce the users intrinsic motivation (R. M. Ryan et al., 2006). Nicolson, (2012) supports this, by stating that with the use of gamification, lack of autonomy could lead to the game elements being perceived as controlling, resulting in loss of intrinsic motivation. Providing opportunities for voluntary participation and choice, using positive feedback and non-controlling instructions, have been shown to improve the autonomy in a gamified system (Francisco et al., 2012). Nicholson (2012), recommends making systems more transparent by “providing users with information, instead of providing them with a score, based on a scoring system born out of assumptions and biases that the organization might have about a user, as such scoring systems might be perceived as controlling”.

During a recent 40-year meta-analysis, Cerasoli, Nicklin & Ford (2014) found that contrary to the notion that all incentives reduce intrinsic motivation by providing an “undermining effect”, intrinsic and extrinsic motivation can be complimentary, and that the joint impact of intrinsic and extrinsic motivation are critical to performance. Incentives given on a completion or performance contingent could impart a competence-boosting message, and therefore boost intrinsic motivation. This would be done by administering the incentive with an informative rather than controlling style (Edward L. Deci et al., 1999). Cerasoli, Nicklin & Ford (2014) stated that controlling incentives reduce but supporting incentives enhance intrinsic motivation. What should be taken into consideration is the performance type (quality or quantity) and the incentive contingency (directly or indirectly performance salient), as these factors change the relationship between intrinsic motivation, incentives and performance. Further to this they found that whilst intrinsic motivation was a moderately strong predictor of quantity performance, it mattered more for quality performance criteria. Incentives were a predictor for quantity performance criteria, as they focus attention and direct behaviour (Cerasoli et al., 2014).

For this reason they suggest that simple, repetitive tasks that are not inherently enjoyable should be motivated by extrinsic incentives. It should also be noted that with the use of extrinsic incentives the action or behavioural outcome motivated by the reward will remain only as long as the external reinforcing agents (badges, rewards, points, etc.) are present (Hagger & Chatzisarantis, 2011). Complex tasks or tasks that require overall quality and focus should be motivated intrinsically. Almarshedi (2014) suggests that gamification elements used to support intrinsic motivation lead to a more unsustainable gamified system. Figure 6 summarises how different incentive contingencies can be perceived as either competence boosting, controlling or non-controlling, leading them to be either intrinsic or extrinsic motivators, which predict the type of performance outcome.

Figure 6 –Incentives, motivation and performance



The complimentary effect of intrinsic and extrinsic motivation relates to gamification as gamification is increasingly being used to direct people's motivations towards intrinsically motivated, gameful experiences and behaviour (Hamari, 2015), even although gamification is often associated more strongly with extrinsic motivation (Armstrong et al., 2015). One strategy is to craft or target extrinsic motivators and system mastery in such a way that the user internalises them as intrinsic motivators (Zichermann, 2011). One's motivation can range from a state of amotivation, which describes the unwillingness to act, to a motivated state. The movement from amotivation to motivation is described as internalisation, and with increasing internalisation comes an increase in active personal commitment, greater persistence, more positive self- perceptions, and better quality of engagement (M. R. Ryan & Deci, 2000). Internalisation could be enhanced by using completion or performance contingent incentives to impart a competence-boosting message (Cerasoli et al., 2014).

2.4 Cognitive flow construct

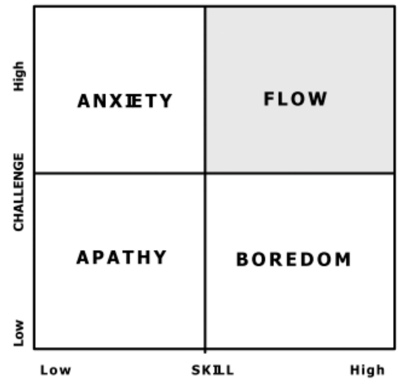
Gamification can be viewed as an attempt to convert utilitarian services into more hedonically oriented, gameful experiences. (Hamari, 2013). Hedonic constructs include perceived enjoyment and flow, where flow is a state used to describe an optimal experience (Csíkszentmihályi, 1990). Flow is one of the most influential models of enjoyment, (Deterding, 2015) and is characterised as a state of being fully focused and engaged in an activity (Csíkszentmihályi, 1990). It has been noted as a useful construct for describing Human-Computer Interactions (Novak & Hoffman, 1997), and is described as "a holistic sensation where one acts with total involvement and focused attention" (Novak & Hoffman, 1997).

Hoffman and Novak (1996) customised the definition of flow for computer related environments, stating that it is characterised as:

1. a seamless sequence of responses facilitated by machine interactivity,
2. intrinsically enjoyable
3. accompanied by a loss of self-consciousness, and
4. self-reinforcing

Online components of flow include the dimensions of perceived enjoyment, perceived control and attention focus (Hoffman & Novak, 2009). Mastery and autonomy are two important elements for the flow in gamification as they help in balancing users' skills with the presented challenges (two predictors of flow) (Almarshedi et al., 2014), whilst immediate feedback is regarded as a prerequisite (Ruhi, 2015). Flow reflects a balance between the users' skills and challenges. When the user's skills are such, that they don't find tasks challenging, they feel bored. In contrast, when tasks are too challenging for the user's level of skills, they feel anxious (Zhou, 2012). Challenge induces motivating enjoyable experiences by creating a feeling of competence, and through the experience of autonomy felt when one chooses to tackle a challenge for the sake of enjoyment. Overcoming challenges collaboratively, can also lead to the satisfaction of relatedness needs, which again adds to the enjoyment of an experience (Deterding, 2015).

Figure 7 - Four channel flow model (Novak & Hoffman, 1997)



Perceived enjoyment and concentration are the two factors most commonly and consistently used to measure flow (Zaman, Anandarajan, & Dai, 2010; Zhou & Lu, 2011). Perceived enjoyment relates to intrinsic motivation that emphasises usage behaviour, and affects user satisfaction when using a gamified system. This is important because with enterprise gamification, end users mostly seek instrumental gratifications geared towards achieving specific valued outcomes in the context of an enjoyable and fun experiences (Ruhi, 2015). Concentration improves the quality output of a user's performance (Cerasoli et al., 2014).

2.5 Gamification design

2.5.1 Game Mechanics

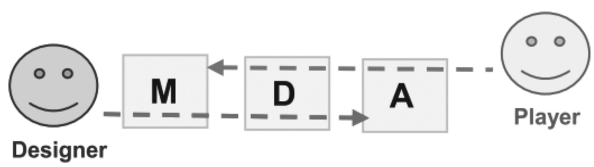
Gamification has most prominently been associated with points, levels and leaderboards, (Hamari, Koivisto, & Sarsa, 2014; Seaborn & Fels, 2015)

2.5.2 Gamification models

The Mechanics, Dynamics and Emotions (MDE) framework, which was adapted from the Mechanics, Dynamics and Aesthetics (MDA) framework for game design (Hunicke, Leblanc, & Zubek, 2004), explains how gamified experiences can be created (Robson et al., 2015b). In the framework, mechanics refer to the game elements, (such as goals, rules and rewards), dynamics are how users enact the mechanics, (the user interactions and behaviours), and emotions are the psychological outcomes a user experiences, (such as how they feel, or if they are motivated toward the gamified experience).

In game design, 'aesthetics' describes the desirable emotional responses. The term is switched with 'emotions' as it speaks to the desired business outcomes of employee and customer engagement (Robson et al., 2015b). Both the MDA and MDE recognize that the designer and end user have different perspectives of the game or gamified system. The designer sets the mechanics, which create the dynamic behaviour, to ultimately meet the organisational and end-user requirements. From the end users perspective, the emotions and goals that they aspire to achieve and the gratifications they receive from the enterprise gamification applications are the most important aspect and they set the tone, which is born out of the dynamics and shape the mechanics (Robson et al., 2015b; Ruhi, 2015). Therefore for gamification to be meaningful, user-cantered game design elements should be integrated into non-game contexts by understanding the needs and goals of the users (Nicholson, 2012). Challenges should be identified, which already exist in the user's pursuit of their goals or needs, and these should be restructured in a motivating manner instead of adding challenge indiscriminately (Deterding, 2015).

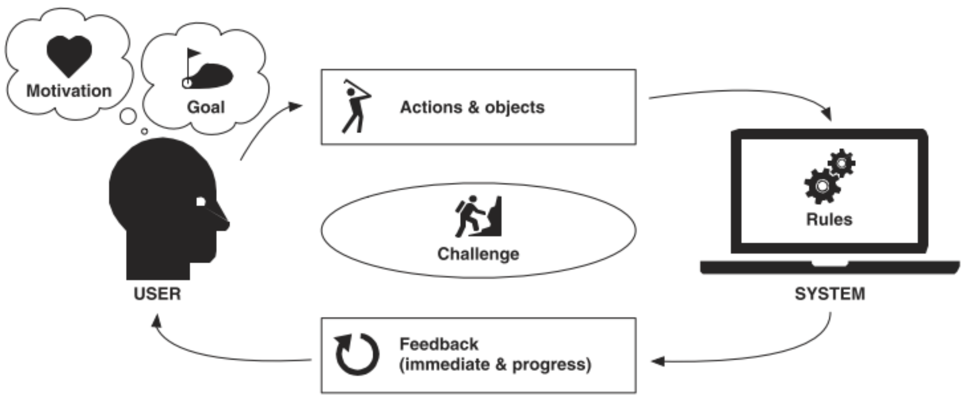
Figure 8 - MDA Framework (Hunicke et al., 2004)



Ruhi (2015), adapted the MDA framework to explain how gamification can be used to leverage human psychology and technology platforms to drive organizational outcomes in what he termed "meaningful enterprise gamification". This model lists the specific mechanics, which generate dynamics and aesthetics relevant to organisations, in what is termed the 20Cs of meaningful enterprise gamification. In this model, challenge, commendation, confidence, cognizance, creativity, contribution, community and compliance are listed as some of the desired aesthetics. As neither of these models offer guidance on how certain mechanics should be implemented or in which contexts. Deterding (2015) recommends taking the player experience of need satisfaction or PENS model into consideration. PENS is based on SDT and the satisfaction of the psychological needs of competence, autonomy and relatedness, which account for a significant part of gaming enjoyment and motivation. One should first design for basic need satisfaction around inherent skill-based challenges.

To do this Deterding recommends designers consider a feedback loop called a skill atom. Users take actions, which form inputs into a system. The system uses predefined rules to process the inputs, which get returned as feedback to the user. By repeatedly running through the atom, the user masters the skill by overcoming the emerging challenges that are presented. See figure 9.

Figure 9 - Schematic of a skill atom (Deterding, 2015)



Goals, are set in the system and actively perused by the user

Motivation, is the satisfaction of psychological needs, directing the user to continue engaging with the system

Actions, relate to what the user can do in attempting to reach the goals

Objects, are items that the user acts upon

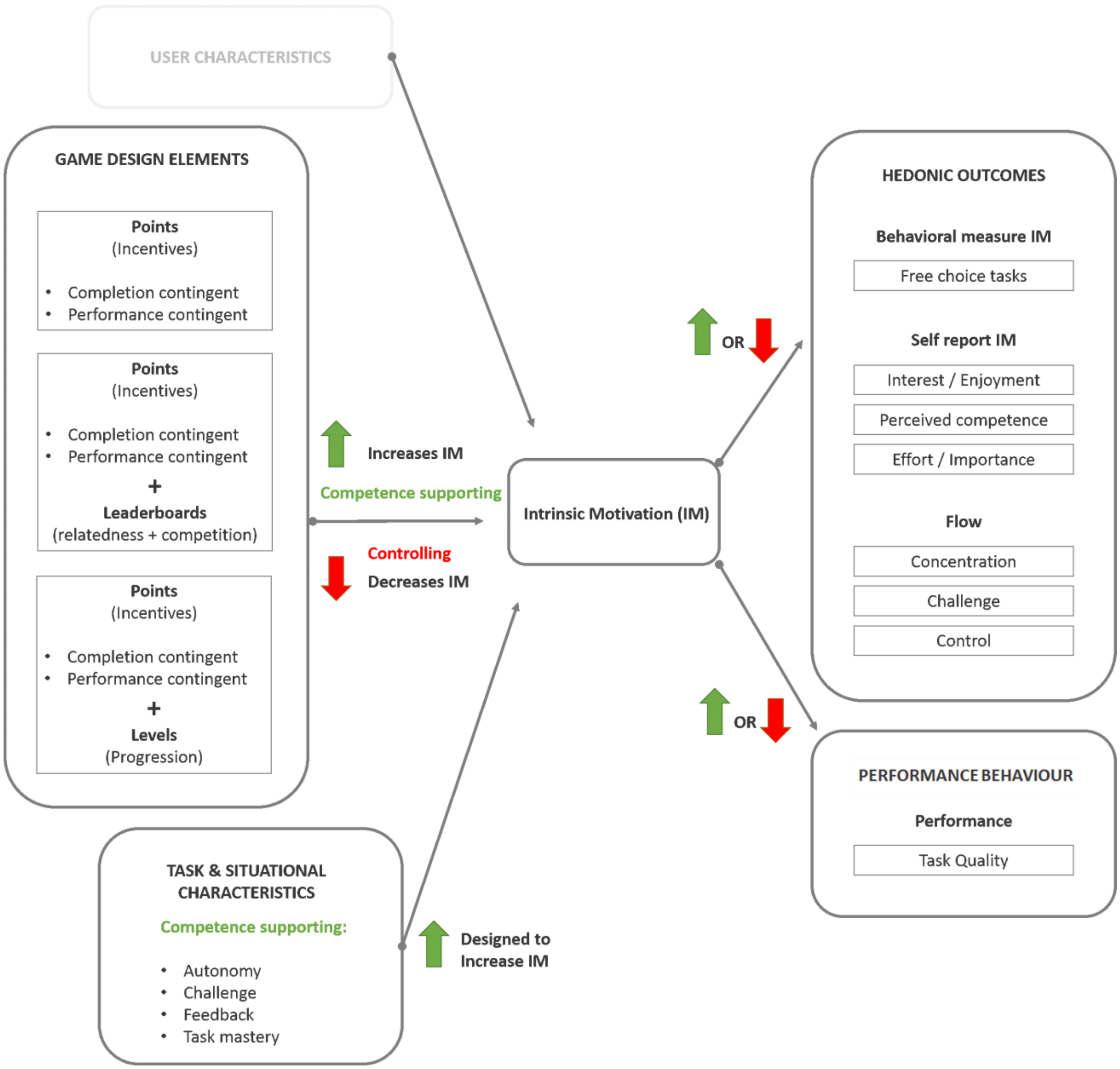
Rules, are used to specify what actions the user can take and how these actions affect the system state.

2.6 Conclusion

The literature review has dealt with the main themes relating to gamification, including; needs satisfaction theories, competence and challenge, intrinsic motivation and extrinsic incentives, motivational affordances, cognitive flow theory, and designing for gamification. As with any emerging area of endeavour, the terminologies central to gamification are still in flux (Robson et al., 2015b), therefore this research draws on all of the above theory in an attempt to understand the underlying motivational mechanisms of gamification, to answer the research problem. Can the individual gamification elements, points, levels and leaderboards, be used to drive intrinsic motivation, and its associated performance behaviours by supporting the user's psychological need of autonomy and competence? The aim is to enhance the understanding of how gamification elements can ultimately be used by organisations to drive motivation and engagement.

Given the diverse range of topics within the literature review, figure 10 has been created to summarise the concepts pivotal to the design of the research experiment.

Figure 10 – Framework used for research design on points, levels and leaderboards



CHAPTER 3: RESEARCH QUESTIONS AND HYPOTHESES

3.1 Introduction

Mekler et al., (2015) conducted an experiment online that attempted to methodically examine how points, leaderboards and levels, influence intrinsic motivation, competence and performance (tag quantity and quality) in an image annotation task. They attempted to enhance intrinsic motivation (and thus tag quality) by making sure the mechanics were perceived as informational, to promote competence. Instead they found that the mechanics acted as extrinsic motivators and promoted tag quantity. Deterding (2015) suggests that the design of the actual task should allow for improved levels of competence (control, mastery, etc.) by creating well-balanced challenges. As this in turn creates an intrinsically motivating task (with or without the gamification incentives) see chapter two, figure 9, a high level of intrinsic motivation can be expected. From this and the literature reviewed in chapter two, the following research questions have been identified, and form the basis of the study and discussion to follow in chapter six.

3.2 Primary research question:

Can the individual gamification elements, points, levels and leaderboards, be used to drive performance quality behaviours by means of enhancing intrinsic motivation in meeting the user's psychological needs of autonomy and competence?

To answer the primary research question, the hypotheses below need to be assessed.

3.3 Research hypotheses

All Hypotheses assess the points, levels and leaderboards conditions individually and are compared to the control condition.

3.3.1 Hypothesis 1

Intrinsic motivation predicts quality performance type behaviours (Cerasoli et al., 2014). Complex tasks or tasks that require overall quality and focused concentration should be motivated intrinsically (Almarshedi, 2014). To determine if the game elements could be used to increase performance quality by supporting intrinsic motivation, it needed to be determined if intrinsic motivation predicted performance quality for this specific task. Performance quality was measured by using the score obtained by the respondent during the experiment.

- **$H1_A$:** Self-reported intrinsic motivation positively predicts performance quality

The effects of extrinsic rewards on intrinsic motivation are typically measured using a free-choice period, which constitutes a behavioural measure of intrinsic motivation (Wiechman & Gurland, 2009).

- **$H1_B$:** A behavioural measure of intrinsic motivation positively predicts performance quality

3.3.2 Hypothesis 2

Deterding (2011), stated that if mechanics are perceived as informative, non-controlling, and competence boosting, they may increase intrinsic motivation, by increasing a sense of competence.

- **$H2_A$:** The perceived competence sub-construct of intrinsic motivation positively predicts performance quality

3.3.3 Hypothesis 3

- **$H3_A$:** Points, levels and leaderboards increase the users perceived level of competence

3.3.4 Hypothesis 4

Mastery goals (competence) mediate the relationship between intrinsic motivation and performance (Cerasoli et al., 2014).

- **$H4_A$:** Points, levels and leaderboards increase the users performance quality

3.3.5 Hypothesis 5

- **$H5_A$:** Points, levels and leaderboards increase the flow state

CHAPTER 4: RESEARCH METHODOLOGY

This chapter outlines the chosen research methodology and design, including details about the population, unit of analysis, sampling size and method, information about the data gathering and analysis process. The chapter concludes with possible limitations of the chosen research methodology.

4.1 Introduction & rationale for proposed methodology

The study's methodology aimed to further the understanding of the effects of individual gamification mechanics on intrinsic motivation and performance quality, building on work done by Mekler et al., (2015) and Deterding, (2015), on the use of individual game elements and the design of gamification systems respectively.

From the literature review it was found that gamification is used to direct people's motivations towards intrinsic motivation, and that there are various other aspects that can affect intrinsic motivation, such as task (complex vs simple, interesting vs repetitive), situational (free of consequence vs controlling), personal and other extrinsic motivators. The research methodology was therefore conducted in conjunction with an experimental design, to allow for the controlling of various factors, which may have otherwise influenced the results.

4.2 Research method

To test the hypotheses the research methodology used for this study was quantitative and explanatory (causal), using a fractional factual design (Field, 2013) in an attempt to explain the relationship between the variables (Sanders & Lewis, 2012). Given the research questions, the explanatory study allowed for the manipulation of the independent variables to see if there was an effect on the dependent variables (Sanders & Lewis, 2012, p. 113). An online experiment was conducted to study causal links between variables. Sanders & Lewis (2012, p114) state that the essential components of an experiment are the following:

1. Manipulating the independent variable
2. Controlling the experiment by holding all other variables, except the dependent variable constant

3. Observing the effect of the manipulation of the independent variable on the dependent variable
4. Predicting the events the will occur in the experimental setting

Four experimental groups or factors were exposed to different conditions, and three of the experimental conditions were measured against a control group.

4.3 Population and unit of analysis

The target population for this study consisted of individuals employed by organisations, and who currently use online applications and websites. The reason for using this population was because the individuals needed to have access to the internet, as gamification is commonly used in interactive systems (Seaborn & Fels, 2015). As the study aimed to enhance the understanding of how gamification elements can ultimately be used by organisations to drive motivation and engagement. The unit of analysis for the study was the user of the gamified application and their motivational and performance outcomes constituted individual data sources.

4.4 Sampling

While the population is the complete set of group members, the sample is a subgroup of the whole population (Sanders & Lewis, 2012, p. 132). The research sampling frame was unknown and the researcher did not have access to the entire population or know the chance or probability of each member in the population being selected (Sanders & Lewis, 2012, p. 134). This indicated the appropriateness of using a non-probability, purposive sampling method. The researcher's judgement was used to conveniently and actively choose who was best suited to help in answering the research questions and meet the objectives. Snowball sampling was also used to help increase the sample size, by asking sample members to help identify additional sample members. (Sanders & Lewis, 2012, pp. 138–139). A sample of at least 20 data points are suggested for each cell of an ANOVA to be statistically significant, and to control for false negatives (Simmons, Nelson, & Simonsohn, 2011).

4.5 General experiment design

4.5.1 Experiment variables

The purpose of an experiment is to study causal links between variables, to establish if a change in one independent variable produces a change in another dependent variable (Sanders & Lewis, 2012). Based on the hypotheses in chapter three, the independent and dependent variables in this experiment could be identified.

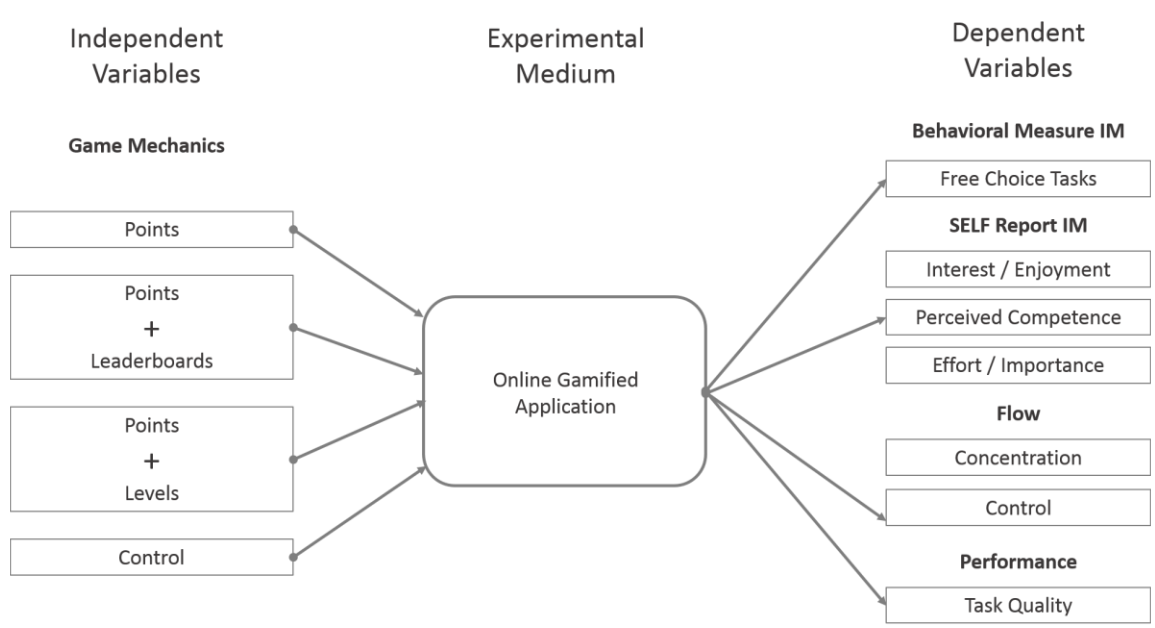
The independent variables were the gamification conditions and were identified as follows:

- Points
- Points and Levels
- Points and Leaderboard

Each of these independent variables sought to drive the dependent variables, which included:

- A behavioural measure of intrinsic motivation, measured by a free-choice period
- Self-report measures of intrinsic motivation, measured by established constructs
- Flow, measured by established constructs
- Performance, measured by the score obtained on the tasks

Figure 11 – Independent and dependent variables



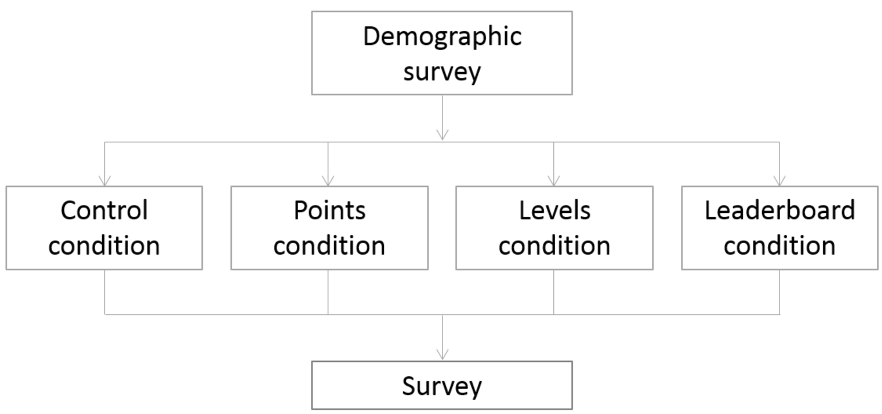
4.5.2 Experiment measurement

The main objective of the experiment was to measure the participant's level of intrinsic motivation, flow and performance in terms of task quality. Data were collected from both the experiment and the online survey, and a three step process was required to measure the outcome of each experimental condition:

1. Participants completed a pre-test demographic survey
2. They were then randomly assigned to one of four experimental conditions, where they were required to complete 30 tasks. After the 30 tasks were completed they were given the option to try a few more tasks of their own will, during a free-choice period.
3. A post-test questionnaire was asked after the experiment

The questions in the post-test questionnaire were used to measure the participant's self-reported intrinsic motivation and flow from the experiment.

Figure 12 – Flow of experiment



4.5.3 Detailed experiment design

The experiment took the form of an online gamified app (Deterding et al., 2011), which controlled for social factors by only allowing for a single user to interact at a given time. As the aim was to test the effects of the gamification elements, points, levels and leaderboards, on performance quality and motivation constructs, four identical variations of the experiment were created, differing only in the motivational affordances of points, levels and leaderboards. The control condition had no gamification element.

Point's condition: The user received five points for each task that was completed. They got an additional five points for estimating within 5% of the correct answer and fifteen points if the task was answered correctly. The points score was reflected on the top right hand side of the screen. (Appendix C). The five points given for the completion of each task, acted as directly salient completion contingent incentives. The points given for answering within 5% or for the correct answer were directly salient, performance contingent incentives, as they provided a clear, immediate and unambiguous link between the incentive and the performance (Cerasoli et al., 2014).

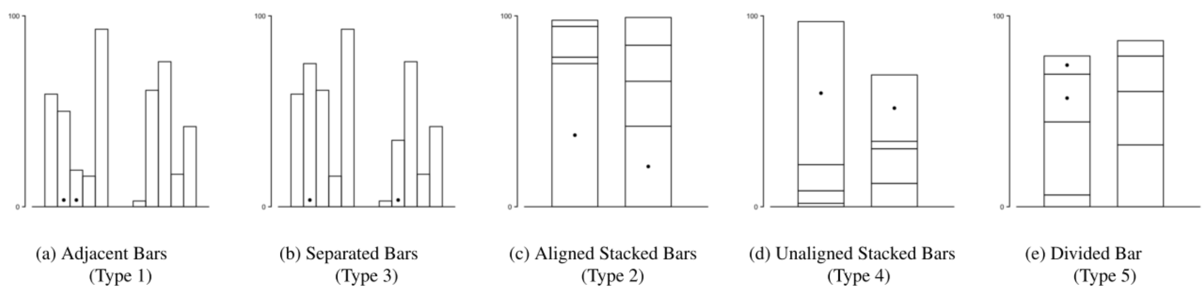
Levels condition: The user received the same point incentives as with the point's condition. In addition, the screen displayed a vertical progress bar showing the current level, as well as giving an indication as to how many points were needed to progress to the next level. (Appendix C). The levels acted as an indication of progression, and the points needed to progress from one level to the next, mirrored the leaderboard condition (Appendix D).

Leaderboard condition: The user received the same point incentives as with the point's condition, but were able to compare their current scores to fictional participant scores on the top right hand corner of the screen. The users were not made aware that the participants on the leaderboard were fictional, and were able to see themselves in relation to these participants as their scores increased. A fictitious leaderboard was used so that each participant had the same chance to rise up the board, and so that the level of challenge did not change from user to user as with an actual leaderboard.

The leaderboard added an incentive for social comparison and competition, where social comparison refers to the process of evaluating one's own abilities and opinions by comparing them to the abilities and opinions of others (Zuckerman & Gal-Oz, 2014). (Appendix C).

Experiment tasks: The tasks used for this experiment were adapted from an experiment conducted by Talbot, Setlur, & Anand (2014). They recreated an experiment originally done by Cleveland & McGill (1984) on graphical perception. Cleveland & McGill, ranked five types of bar charts in the order of difficulty in terms of perceiving quantitative values. The difficulty level was ranked from type 1 to type 5 and is illustrated in figure 13:

Figure 13 – Graphs (Cleveland & McGill 1984)



Talbot, et al., (2014) added insights as to why some graphs are more difficult to read than others. As this experiment was conducted online, the same image sizes and bar-heights were used. The reason this experiment was chosen was because it had already been tested on an online crowd-sourced platform. Heer & Bostock (2010), replicated Cleveland & McGill's, original lab experiment while examining the viability of using crowd-sourcing for perceptual experiments. They found that their results were similar to that of Cleveland & McGill and thus proved that this experiment is viable as an online experiment. Further to this the five different bar graph types allowed for the design of the tasks to increase in difficulty and thus become increasingly challenging. The bar graph images used in the experiments can be seen in Appendix B.

Experiment procedure: The experiment required the user to perform 30 short sequential tasks, and gave instant performance feedback on each task, thereby providing the user with information on how and why they were achieving the scores as they progressed through the exercises. (Appendix E). This allowed the user to improve as they moved through the exercise, assisting task mastery. Carbonneau et al., (2012) stated that intrinsic motivation toward accomplishment, might be achieved by engaging in an activity for the pleasure experienced when attempting task mastery. To aid with task mastery a system could offer enhanced opportunities for the user to be optimally challenged and offer positive feedback which aids in the user achieving task mastery (Francisco et al., 2012). Feedback and challenge were included in the design of the experiment tasks, in line with the skill atom described by Deterding, (2015). Once the 30 tasks were completed the user was given the option to continue with additional free-choice tasks. This was used to determine the behavioural outcomes of intrinsic motivation.

4.6 Data collection tool

The data collected from the experiment, included the respondents answers to each of the questions and their overall scores, which measured their performance on the tasks. The number of free-choice questions they attempted was also captured, as the free-choice paradigm has been used in various experimental studies which measured intrinsic motivation (E. L. Deci et al., 2001; Hagger & Chatzisarantis, 2011). The rest of the data were gathered by making use of a self-administered questionnaire made available online after the experiment was competed. This type of collection method was chosen to allow the researcher to rapidly access the sample member's and to minimised data collection errors by using a standardised process and questionnaire (Field, 2013).

4.6.1 Questionnaire design

The questionnaire was designed making use of questions from existing instruments. The intrinsic motivation inventory (IMI) (Edward L Deci & Ryan, 1985; McAuley, Duncan, & Tammen, 1989), was used for the intrinsic motivation constructs, as it is an established tool which is still being used in similar studies (Guay et al., 2000; Mekler, Brühlmann, Opwis, & Tuch, 2013; Mekler et al., 2015). The Flow concentration construct was measured by using a four item instrument adapted from Ghani's work (Ghani & Deshpande, 1994).

As the design of the task intended to increase competence, and a sense of competence will not increase intrinsic motivation unless the person experiences autonomy. (Edward L Deci et al., 1999), autonomy was a condition needed to determine the success of the experiment. A key aspect of autonomously regulated behaviour is the experience of choice (Benita et al., 2014). According to SDT, sense of choice is an important indicator of autonomous motivation (Ghani & Satish, 1994). Therefore choice questions from the flow instrument were used as filter questions (Sanders & Lewis, 2012, p. 147) to ensure that the respondents felt that they had a choice and acted autonomously. This helped filter out those respondents who might have been asked to complete the experiment, and felt that they had no choice in doing so.

4.6.2 Reliability of scale items

The scale items used to measure the individual constructs within the survey questionnaire tool were chosen due to their internal consistency and reliability from previous studies. Reliability means that the measure or questionnaire should consistently reflect the construct that it is measuring, and Cronbach's α is the most common measure of scale reliability. After the pilot experiment the constructs Cronbach α was measured to test for reliability. A coefficient alpha value of 0 infers no consistency and a value of 1 represents complete consistency. A Cronbach's α of 0.8 and above represents good reliability, but when dealing with psychological constructs, values below 0.7 can be expected due to the diversity of the constructs being measured. An alpha of 0.6 to .07 indicate fair reliability (Field, 2013).

Field (2013) warns that having too many scale items can also lead to a high α value, which does not necessarily mean that the scale is reliable. It is also possible to get a high α with two uncorrelated factors.

4.7 Data collection process

Participants were sent a link via email to the online experiment. The link was also published on Linkedin to access the researcher's professional social network. The link opened a short survey that captured demographic information (Appendix A) and informed the user on how the experiment would work. After the experiment (Appendix C), a self-administered survey was presented (Appendix F). The online application captured all the required data.

4.8 Processing and data analysis

4.8.1 Editing and coding

The raw data were coded after the collection phase to convert it into a format necessary to answer the research questions. The editing process was done to correct for respondent errors and coding assisted in categorising the results into a format that facilitated data analysis. The data were coded categorically so that descriptive statistical analysis could be conducted to determine correlations between the different variables (Sanders & Lewis, 2012, p. 179). A data matrix was created by coding each variable with a numerical value and placing it in a cell corresponding to the question column (Sanders & Lewis, 2012). The seven-point Likert scale answers, that ranged from “very untrue” to “very true” were coded from 1 to 7 respectively, and reverse-phrased items were reversed from 1 to 7.

4.8.2 Data analysis

The appropriateness of applying analytical techniques to data is dependent on the research questions that need to be answered to meet the objectives of the study, and the type of information collected (Sanders & Lewis, 2012).

To determine the effect of the individual gamification elements on people’s intrinsic motivation, flow and performance, the following statistical techniques were applied to the dataset:

1. Test for normality
2. Descriptive statistics
3. Principle component analysis
4. Correlation
5. Inferential statistics – ANOVA
6. Effect size calculation
7. Regression analysis

4.8.2.1 Test for normality

Both the pilot and final experiment data were tested for normality using Kolmogorov-Smirnov and Shapiro-Wilk tests. The data were found to fit normal distribution, as the tests were non-significant ($p>0.05$). Parametric analytical techniques were then used (Field, 2013).

4.8.2.2 Descriptive statistics

Descriptive statistics were done to indicate the variety and characteristics of the data sample collected. These were presented in a summarised manner. Age, gender, education level and experiment conditions were assessed.

4.8.2.3 Principle component analysis

Most psychological questionnaires are based on factor analysis. The aim is to reduce the set of variables into a smaller set of dimensions called 'factors' or 'components' (Field, 2013), which helps with the data analysis. Each variable measured had several questions in the questionnaire. The variables for each of the constructs were then combined to achieve a single value for intrinsic motivation, which provided a better measure (Field, 2013).

The Kaiser-Meyer-Olkin (KMO) index and the Bartlett's test of sphericity ensured that factor analysis was appropriate as the data reduction tool for this study. The KMO index ranges from 0 to 1, with indices greater than 0.6 inferring a positive indication of factor analysis. Barlett's test of sphericity also needed to be significant ($p<0.05$) to indicate that factor analysis was appropriate (Field, 2013).

4.8.2.4 Correlation

Correlation analysis was used to indicate the level of association of one variable to another. The correlation coefficient is the statistical measure of co-variation between the variables. A Persons correlation coefficient is used when attempting to determine relationships between continuous variables where a correlation coefficient of +- .1 represents a small effect, +- .3 a medium effect and +- .5 a large effect (Field, 2013) This technique was used to assess the associations between the individual instrument measures.

4.8.2.5 Inferential statistics

The hypotheses required the comparison of the means of various independent data sets. An analysis of variance (ANOVA), was used to accommodate the dependent variables of flow, intrinsic motivation and task performance, to test the absolute difference between the observed scores and the mean of the group from which the scores came (Field, 2013).

An ANOVA is part of a group of tests that extend basic analysis of variance to situations in which more than one outcome variable has been measured (Field, 2013), and was therefore used to test the hypotheses.

4.8.2.6 Effect size calculation

Cohen's d is one of the most commonly used measures of effect size, which is the standardised measure of the magnitude of the observed effect. This is done to gage the importance of an effect beyond its statistical significance (Field, 2013).
It can be expressed as follows:
$M_1 - M_2 / \sigma_{pooled}$
where $\sigma_{pooled} = \sqrt{[(\sigma_1^2 + \sigma_2^2) / 2]}$,
and the effect size correlation is: $r_{Yl} = d / \sqrt{(d^2 + 4)}$

4.8.2.7 Regression analysis

Multiple regressions were conducted to predict outcome variables via a linear combination of more than two predictor variables. The co-efficient (β) was used to determine the strength of the relationships between variables, where β ranged from negative one to positive one, with a high absolute value indicating a strong relationship (Field, 2013).

4.9 Limitations

- Given the non-probability sampling method, the sample was not representative of the entire population.
- The study was a cross-sectional design, meaning that it was of a particular topic at a particular point in time (Sanders & Lewis, 2012, p. 123). It can also be argued that as gamification becomes more prevalent, people's attitudes and feelings

towards the game mechanics could change, and thus the results of this study might differ over time.

- The survey measured self-reported intrinsic motivation, which might have been compromised by the actual survey. I.e. respondents may have become frustrated or bored with answering the actual questions, which may have impacted the results.
- Given the nature of the experiment, certain factors such as situated motivational affordances (Deterding, 2011) have been controlled for. As with social factors which were removed. This is therefore not necessarily representative of a real-world application of gamification.
- The sample population size attained for this study may have limited the sensitivity of the results.

CHAPTER 5: RESULTS

5.1 Introduction

This chapter presents the quantitative results of the pilot experiment and final experiment laid out in chapter 4. Interpretation of the results follows in chapter 6. The samples required a minimum of 20 respondents for each cell to be statistically viable and to control for false negatives (Simmons et al., 2011).

Adjustments made to the final experiment included;

1. deleting nine questions from the final survey
2. deleting three questions from the demographic survey
3. showing the participants how many levels there were to complete in the levels condition
4. adjusting the leaderboard and levels scores to reflect the 10^{th}, 25^{th}, 50^{th} and 75^{th} percentile of the scores achieved in the pilot experiment, to make the targets more closely reflective of a real-life simulation (Appendix D)

The control and points conditions remained unchanged.

5.2 Test for normality

H_o the observed distribution of the dataset fits the normal distribution

H_a the observed distribution does not fit the normal distribution

See Appendix G for test results.

5.2.1 Pilot data

The data were tested for normality using both Kolmogorov-Smirnov and Shapiro-Wilks tests. $p>0.05$ for the dataset variables, therefore H_o was not rejected as the tests were not significant, inferring that the dataset was normally distributed. (Appendix G)

5.2.2 *Final experiment data*

The data were tested for normality using both Kolmogorov-Smirnov and Shapiro-Wilks tests. p>0.05 for the dataset variables, therefore H_0 was not rejected as the tests were not significant, inferring that the dataset was normally distributed. (Appendix G)

5.3 Data transformation

Prior to analysis in both the pilot and final experiment, data were filtered by IP address and duplicates were removed. In some cases it was found that the system had captured the information more than once, and in others participants had chosen to retake the experiment.

In cases where respondents had answered questions by repeating the same score across multiple questions, especially reverse questions that were similar to normal questions, the results were discarded. This may indicate the respondent might have become bored or frustrated with the questionnaire.

The responses were also filtered by the filter question "I believe I had a choice about doing this activity" by removing any respondents that had less than a neutral score of four to this question. A total of 98 responses were removed from the pilot experiment and 37 from the final experiment.

Data were then coded by creating an identifier for each of the four experimental conditions to be used as independent variables. Each question and the individual constructs were also coded to be used as dependent variables. The participant's actual point scores were left as numeric values. Behavioural measures of intrinsic motivation were coded with two options: either the participant did additional tasks or did not. The number of additional tasks attempted was not analysed. All the data were then merged to produce a total sample upon which the statistics were run.

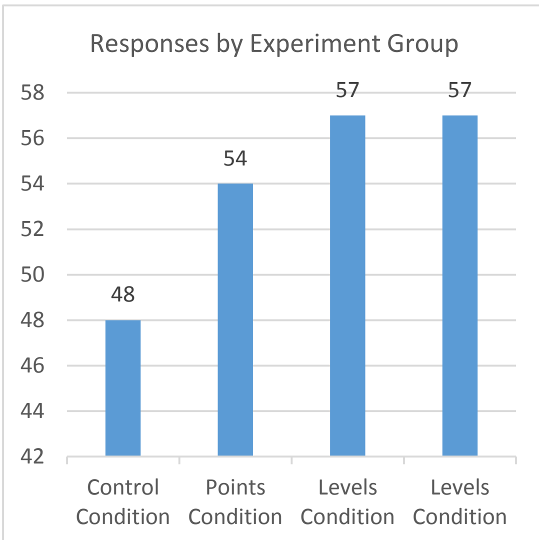
5.4 Sample description

For both the pilot and final experiment, four groups of respondents completed the experiments and two surveys. A total of 216 usable responses were obtained for the pilot and 92 for the final experiment. A breakdown of experiments conducted per condition is shown in figures 14 and 15.

As the experiment links were posted on social media and due to snowball sampling, the total number of individuals that received the request to partake in the experiment was unknown, and thus the response rate cannot be determined.

Pilot

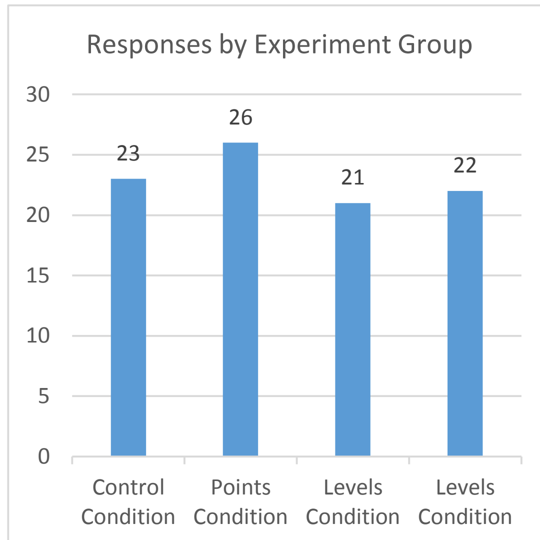
Figure 14 – Pilot responses



216 usable responses

Final Experiment

Figure 15 – Final experiment responses



92 usable responses

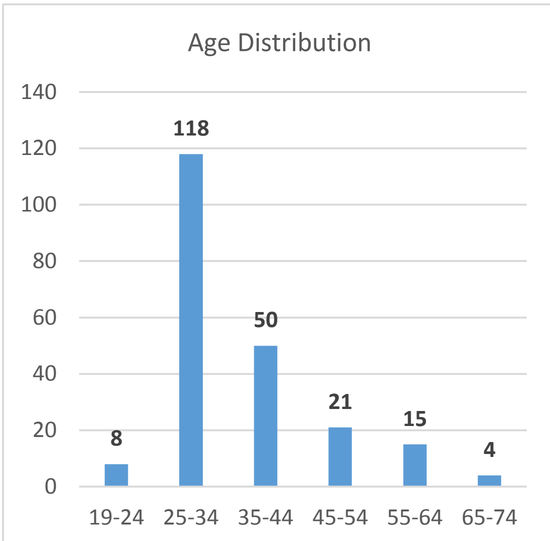
The demographics for both the pilot and final experiment are presented in Figure 16 and Figure 17 respectively. Respondents were required to complete the demographic questions before being able to move on to the experiment.

- For the pilot experiment, the concentration was towards male (58%) respondents between the ages of 25-34 (54.6%) with a bachelor's degree (33.3%).
- For the final experiment, the concentration was towards male (59%) respondents with a master's degree (37%).

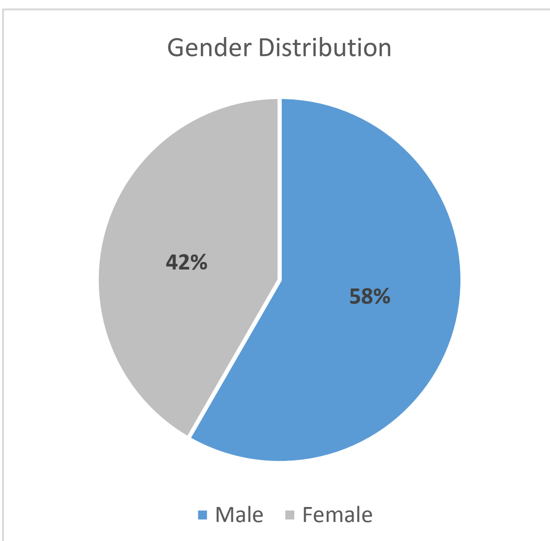
While a more even distribution in age groups would have been desirable in the pilot experiment, the results were considered satisfactory, as the majority of responses fell within the 25-44 age groups.

Pilot

Figure 16 – Pilot demographics



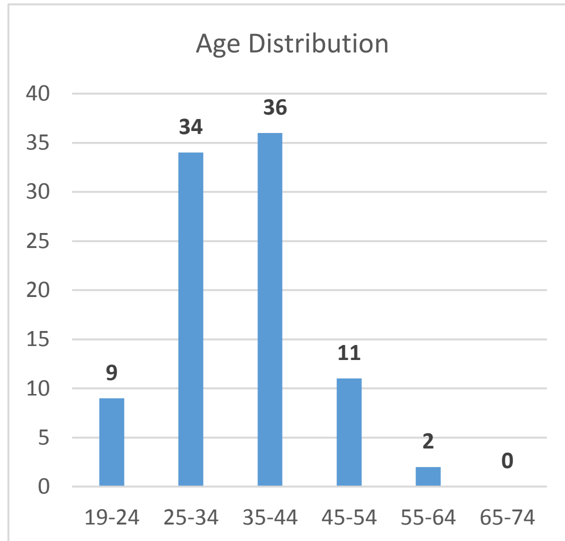
Total: 216



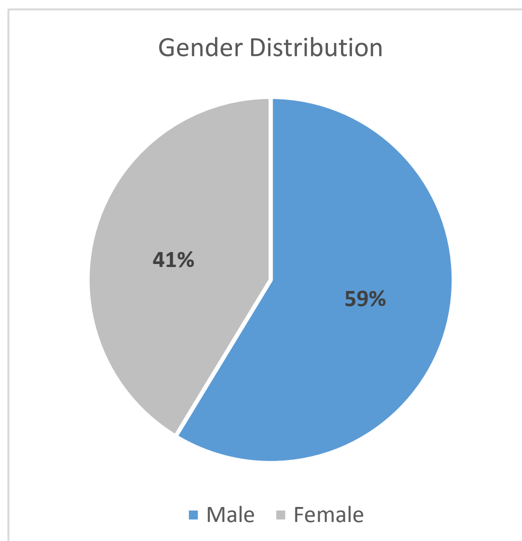
Total: 216

Final Experiment

Figure 17 – Final experiment demographics



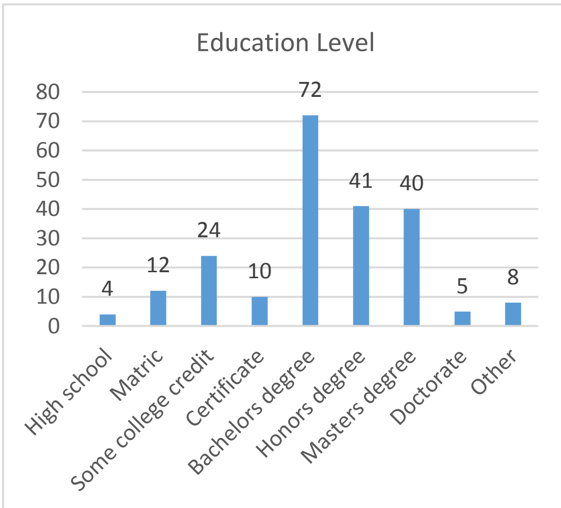
Total: 92



Total: 92

Pilot

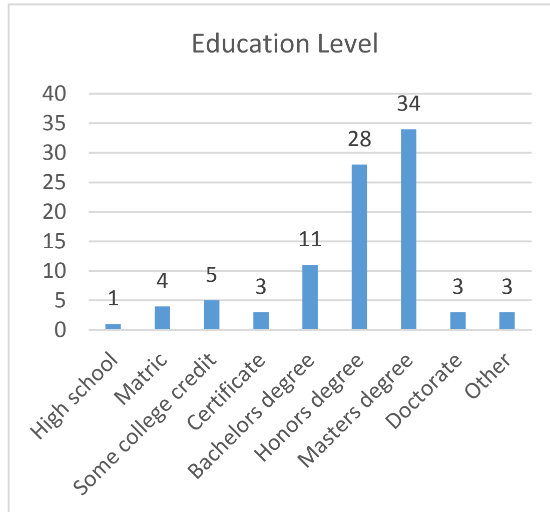
Figure 18 – Pilot education levels



Total: 216

Final Experiment

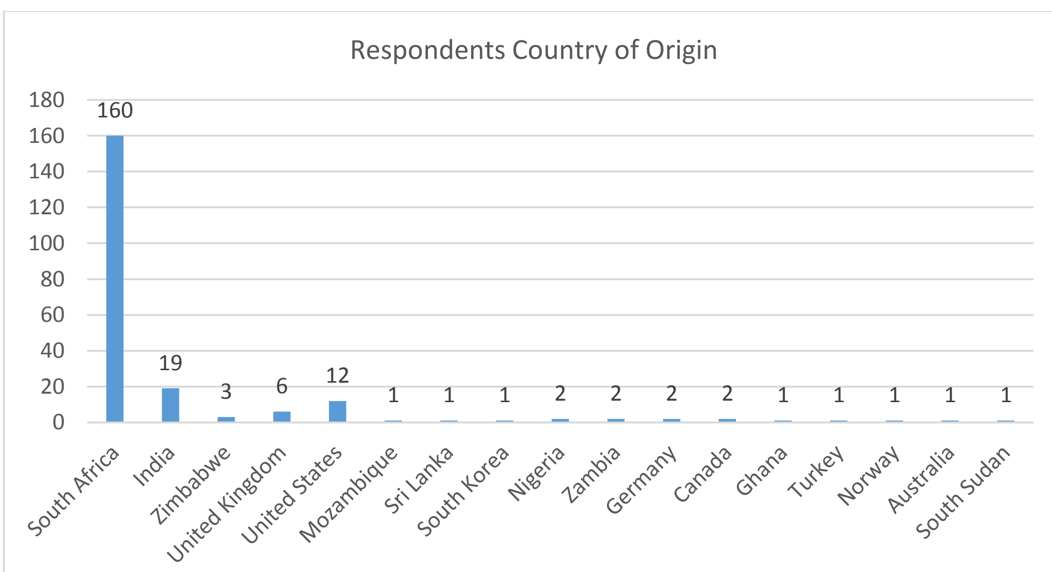
Figure 19 – Final experiment education levels



Total: 92

For the pilot, respondents were located in seventeen different countries, with the majority residing in South Africa, as seen in Figure 20. For the purposes of the final experiment it was decided to only distribute the experiment link within South Africa, as there were not enough respondents to be statistically representative of the other regions.

Figure 20 – Pilot regions



5.5 Scale reliability and refinement

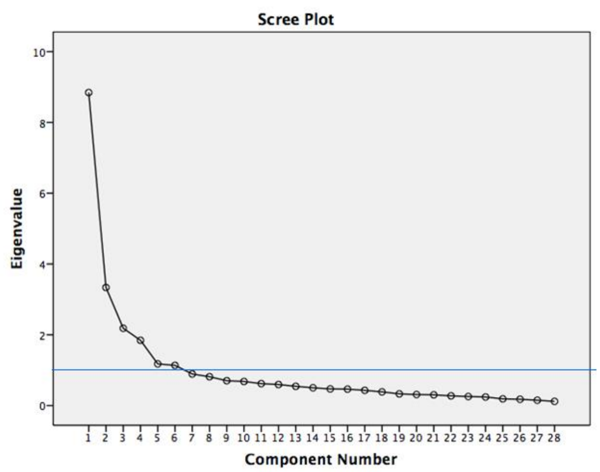
5.5.1 Construct validity to determine Intrinsic Motivation (IM) and flow

After the pilot experiment, the twenty-eight individual measurement items were tested by entering them into a principle components analysis, with varimax techniques of rotation (Field, 2013). The Kaiser- Meyer-Olkin test of sampling adequacy recorded 0.883, which was well above the recommended 0.6 to continue with principle components analysis. Bartlett's Test of Sphericity recorded a significance of .000, less than the required 0.05, confirming that principle components analysis was suitable, see table 1.

Table 1 – KMO and Bartlett's test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		**.883**
Bartlett's Test of Sphericity	Approx. Chi-Squ	3393.856
	df	378
	Sig.	**.000**

Figure 21 – Scree plot



With a scree plot, it is recommended that all components with eigenvalues greater than 1 be retained. This is because the eigenvalues represent the amount of variation explained by a component and that an eigenvalue of 1 represents a substantial amount of variation. It is also best advised to use a scree plot with sample sizes greater than 200 (Field, 2013). As the sample size was 216, it could be said that using a scree plot was a valid way of determining how many components to retain. Figure 21 suggests that the first six components extract the most variance within the model. Components above the blue line on the x-axis have eigenvalues greater than 1.

This is further supported by table 2, which shows the total variance which is explained by the components. Of the components extracted component 1 accounted for 31.60% of the variance, component 2 for 11.90%, component 3 for 7.80%, component 4 for 6.59%, component 5 for 4.21%, and component 6 for 4.06%. With 66.2% of the total variance explained by the six components.

Table 2 – Total variance explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.844	31.586	31.586	8.844	31.586	31.586	5.735	20.481	20.481
2	3.337	11.918	43.504	3.337	11.918	43.504	3.604	12.872	33.353
3	2.185	7.803	51.307	2.185	7.803	51.307	2.911	10.397	43.750
4	1.845	6.589	57.896	1.845	6.589	57.896	2.284	8.158	51.907
5	1.179	4.210	62.106	1.179	4.210	62.106	2.205	7.874	59.781
6	1.137	4.060	66.166	1.137	4.060	66.166	1.788	6.385	66.166
7	.892	3.187	69.353						
8	.816	2.913	72.266						
9	.703	2.509	74.776						
10	.681	2.432	77.207						
11	.620	2.215	79.423						
12	.595	2.124	81.546						
13	.544	1.944	83.490						
14	.503	1.796	85.286						
15	.471	1.682	86.968						
16	.465	1.662	88.630						
17	.431	1.540	90.170						
18	.388	1.384	91.554						
19	.331	1.184	92.738						
20	.313	1.118	93.855						
21	.304	1.086	94.942						
22	.275	.983	95.925						
23	.257	.917	96.842						
24	.243	.866	97.708						
25	.191	.681	98.390						
26	.179	.639	99.029						
27	.152	.544	99.573						
28	.120	.427	100.000						

Extraction Method: Principal Component Analysis.

In the rotated component matrix (table 3), the highest factor loadings for each of the six components has been bolded to demonstrate which specific questions loaded on each of the six components. Negative numbers pertain to reverse scale questions.

Table 3 – Rotated component matrix

	Component					
	1	2	3	4	5	6
1	**.794**	.117	.288	.014	-.113	.023
2	-.043	.079	.158	.100	-.083	**.751**
3	.186	.033	.265	-.093	-.216	**.688**
4	.113	.117	**.695**	-.071	-.162	.315
5 (R)	**-.714**	-.153	.071	.023	.349	-.108
6	.134	-.087	**.766**	.151	-.221	.036
7	.135	**.726**	.193	.161	.116	-.026
8	**.799**	.139	.180	.120	-.041	.035
9	**.614**	.146	.160	.326	-.055	-.029
10 (R)	-.200	.191	-.227	.129	**.594**	-.321
11 (R)	.006	.005	-.197	-.004	**.653**	-.352
12	.381	**.475**	-.151	.215	.092	.045
13 (R)	-.066	**-.586**	.108	-.293	.409	-.101
14	**.896**	.116	.059	.044	-.106	.086
15	**.552**	.469	.328	.168	.183	.092
16	.446	.291	**.559**	.098	-.038	.082
17	**.772**	.185	.276	-.053	.091	.028
18 (R)	-.337	-.215	.255	-.357	**.479**	-.025
19	.342	-.031	-.146	.415	.024	**.537**
20	**.848**	.081	.084	.235	-.084	.175
21 (R)	-.127	.061	-.334	-.068	**.662**	.090
22	.159	**.740**	.050	.248	.145	.070
23 (R)	-.095	**-.793**	.150	.032	.246	.034
24	.015	.265	.138	**.825**	-.059	.059
25	.399	.425	.169	**.590**	.059	.004
26	.347	-.021	**.739**	.214	-.067	.159
27	.224	.481	.294	**.627**	-.032	.082
28	.270	**.543**	.168	.096	.381	.045

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 10 iterations.

From table 3, table 4 was created to compare the original construct questions with the questions that loaded on specific constructs during the principal component analysis. Table 4 demonstrates that most individual measurement items were suitably measuring the correct underlying construct. Seven of the twenty-eight questions loaded with different constructs than originally anticipated, these questions have been bolded in table 4.

Table 4 – Construct questions

Construct (Component)	Loaded Questions	Original Questions per construct
1 IM Interest / Enjoyment	1, 5, 8, **9,** 14, 17, 20	1, 5, 8, 14, 17, 18, 20
2 IM Effort / Importance	7, **12**, 13, 22, 23, **28, 15**	7, 13, 22, 23
3 IM Perceived Competence	4, 6, 16, 26	4, 6, 16, 21, 26
4 Flow - Concentration	24, 25, 27	9, 24, 25, 27
5 Flow - Control	10, 11, **18**, **21**	3, 10, 11
6 IM Perceived Choice (filtering questions)	2, **3**, 19	2, 19
7 Flow - Challenge		12, 15, 18

Reverse scale questions: 5, 18, 21, 13, 23, 10, and 11

Flow – challenge: As seen in table 4, the flow - challenge construct was deemed invalid in this context. The individual measurement items loaded with different constructs, showing that what it measured was too closely related to other existing constructs, and not adequately measuring the same latent construct. It was therefore decided to disqualify the flow – challenge construct. This should not significantly affect the overall flow construct, as perceived enjoyment and concentration are the two factors most commonly and consistently used to measure flow (Zaman et al., 2010; Zhou & Lu, 2011).

Flow-perceived control: This construct no longer made sense as a construct, as more than 50% of its components had changed. The most direct component relating to perceived control, "I felt in control" loaded on the IM perceived choice construct, showing that the two were closely related.

For the refinement of the final instrument, the following individual measurement items were removed:

- Flow, perceived control construct: 10, 11, 18, 21
- Items which did not make sense in the constructs in which they loaded : 12, 28, 19

In an attempt to further reduce the number of questions, so that the questionnaire had the least possible number of items, to reduce user frustration, which may erode intrinsic motivation, the reverse score items were assessed, as they affect Cronbach's α (Field, 2013). From this, questions 5, 13 and 23 were deemed redundant and thus removed.

A total of ten questions were removed, leaving eighteen questions. A construct needs to contain a minimum of three variables for confirmatory factor analysis, and two for exploratory factor analysis (Field, 2013). All of the constructs contained three or more items, except for the filtering questions. The final questions per construct can be seen in table 5, and the actual questions in Appendix F.

Table 5 – Final construct questions

Construct	Questions
1 Intrinsic Motivation Interest / Enjoyment ***IMIE***	1, 8, 9, 14, 17, 20
2 Intrinsic Motivation Effort / Importance ***IMEI***	7, 15, 22
3 Intrinsic Motivation Perceived Competence ***IMPC***	4, 6, 16, 26
4 Flow – Concentration ***FC***	24, 25, 27
5 IM Perceived Choice (filtering questions)	2, 3

Field (2013) recommends that if items are deleted, one should re-do the factor analysis to ensure that the factor structure still holds.

Table 6 – KMO and Bartlett's test 2

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		**.886**
Bartlett's Test of Sphericity	Approx. Chi-Squ	2203.308
	df	120
	Sig.	**.000**

The Kaiser- Meyer-Olkin test of sampling adequacy recorded 0.886, and Bartlett's Test of Sphericity recorded a significance of .000 confirming that principle components analysis was suitable. The second time round, all factors had a relatively high loading on their components, confirming the factor structure (Table 7).

Table 7 – Rotated component matrix 2

	Component			
	1: IMIE	2: IMPC	3: IMEI	4: FC
1	**.813**	.287	.085	.070
8	**.815**	.152	.108	.177
9	**.662**	.091	.098	.365
14	**.889**	.090	.132	.041
17	**.767**	.236	.274	-.064
20	**.843**	.155	.116	.186
7	.109	.065	**.792**	.210
22	.121	-.014	**.782**	.299
15	.532	.257	**.600**	.135
4	.092	**.796**	.161	-.025
6	.146	**.840**	-.068	.162
16	.413	**.547**	.403	.071
26	.329	**.788**	.018	.215
24	.020	.106	.166	**.893**
25	.391	.089	.414	**.632**
27	.235	.209	.413	**.737**

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.[a] a. Rotation converged in 6 iterations.

A Pearson's correlation analysis was performed to determine the strength of the association between the individual measurement items, the results of which indicate that the strength among the items within groups was strong and statistically significant at a 0.01 level, which shows that the probability of getting a correlation coefficient this size in the given sample size is large. As most correlation coefficients were +-5 or greater, the effect of the relationship was large (Field, 2013). Further associations could be observed for individual measurement items between the groups. For example 1 – 20 was significantly correlated with 7 – 15, highlighted in dark blue, showing a medium to large effect. The only items not significantly correlated are highlighted in dark orange, and the items correlated to 0.05 significance are highlighted in light orange.

Table 8 – Pearson's Correlation, individual measurement items

	1	8	9	14	17	20	7	15	22	4	6	16	26	24	25	27
1	1															
8	.716**	1														
9	.583**	589**	1													
14	.709**	.702**	.531**	1												
17	.658**	.646**	.489**	697**	1											
20	.699**	.710**	.532**	.819**	.642**	1										
7	.241**	.329**	.311**	.183**	.251**	.215**	1									
15	.535**	.489**	.468**	.574**	.590**	.586**	.462**	1								
22	.204**	.225**	.243**	.271**	.266**	.291**	.572**	.500**	1							
4	.330**	.232**	.122	.190**	.324**	.245**	.138*	.309**	.108	1						
6	.396**	.260**	.264**	.232**	.258**	.263**	.137*	.272**	.061	.525**	1					
16	.479**	.448**	.425**	.442**	.517**	.477**	.361**	.602**	.269**	.437**	.409**	1				
26	.457**	.436**	.357**	.374**	.420**	.456**	.145*	.414**	.171*	.521**	.701**	.574**	1			
24	.141*	.230**	.260**	.107	.074	.260**	.343**	.262**	.392**	.140*	.196**	.205**	.244**	1		
25	.425**	.406**	.498**	.429**	.417**	.506**	.442**	.576**	496**	.220**	.169*	.436**	.315**	.572**	1	
27	.308**	.401**	.465**	.322**	.338**	.368**	.459**	.547**	.531**	.232**	.265**	.453**	.404**	.674**	.713**	1

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Each of the individual constructs were then tested using separate reliability analyses. The scale items pertaining to the following four constructs were analysed:

I. Intrinsic Motivation - Interest / Enjoyment (IMIE)
II. Intrinsic Motivation - Effort / Importance (IMEI)
III. Intrinsic Motivation - Perceived Competence (IMPC)
IV. Flow - Concentration (FC)

5.5.2 Intrinsic Motivation – interest, enjoyment construct

This construct had a very high Cronbach's Alpha of **.914**, illustrating that this scale had a very high level of reliability, well above the cut-off of 0.6. (Appendix G)

5.5.3 Intrinsic Motivation – effort, importance construct

This construct had a very high Cronbach's Alpha of **.7.56**, illustrating that this scale had a good level of reliability. (Appendix G)

5.5.4 Intrinsic Motivation – perceived competence construct

This construct had a very high Cronbach's Alpha of **.813**, illustrating that this scale had a high level of reliability. (Appendix G)

5.5.5 Flow – concentration construct

This construct had a very high Cronbach's Alpha of **.849**, illustrating that this scale had a high level of reliability. (Appendix G)

5.6 Results pertaining to research hypotheses

The following key was used during the analysis of the data:

- Intrinsic motivation interest / enjoyment construct: **IM-IE**
- Intrinsic motivation effort / importance construct: **IM-EI**
- Intrinsic motivation perceived competence construct: **IM-PC**
- Flow concentration construct: **F-CON**
- Behavioural measure of intrinsic motivation: **BM**
- Intrinsic motivation total: **IM-total**
- Flow total: **F-total**

5.6.1 Intrinsic motivation in control condition

Table 9 – Intrinsic motivation of control condition

Pilot

Experiment		IM-Total	IM-IE
1.0	Mean	59.531	28.408
	Median	60.000	29.000

Final experiment

Experiment		IM-Total	IM-IE
1.0	Mean	58.368	27.632
	Median	58.000	28.000

For the control condition, the total number of individual items making up the intrinsic motivation (IM) construct was thirteen and the total number of items comprising the intrinsic motivation- interest enjoyment sub construct (IM-IE) was six. As each item was answered using a seven point Likert scale, the total values obtainable for these constructs could thus be calculated as follows:

IM-Total: 13*7 = 91 and IM-IE: 6*7 = 42

Given a mean score of 59.5 for the IM-Total of the pilot, it could be said that the task led to high levels of intrinsic motivation (65%) and high levels of interest and enjoyment (68%) regardless of the gamification elements (points, levels, leaderboards). Likewise for the final experiment, the intrinsic motivation level was (64%) and the interest and enjoyment (66%).

5.6.2 Results pertaining to $H1_A$ and $H1_B$

Hypothesis one sought to determine whether intrinsic motivation, positively predicted the performance quality for this experiment. To answer this question a multiple regression analysis was conducted, using "score" as the dependent variable, and measure of performance quality. The predictor variables included; behavioural motivation (BM), gender, experiment condition, IM-total, age, education and flow-total.

Table 10 – Regression: (IM – performance quality), model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.452[a]	.204	.130	39.4712

a. Predictors: (Constant), BM, Gender, Experiment, IM-Total, Age, Education, Flow-Total b. Dependent Variable: score

R Square = .204, indicating that the model explains 20.4% of the variance relating to the score obtained by the respondents. An acceptable Pearson's correlation *r* value for the social sciences is where 0.1 is regarded as a small effect and 0.5 a large effect (Cohen, 1992). As R Square is calculated as r^2, the effect size *r* can be calculated as;

$r = \sqrt{.204} = 0.45$, indicating a large effect size.

Table 11 – Regression: (IM – performance quality), ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	30015.892	7	4287.985	2.752	.013[b]
	Residual	116847.964	75	1557.973		
	Total	146863.855	82			

a. Dependent Variable: score

b. Predictors: (Constant), BM, Gender, Experiment, IM-Total, Age, Education, Flow-Total

In the ANOVA table $p<0.05$ and is therefore significant.

Table 12 – Regression: (IM – performance quality), coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	157.294	41.704		3.772	.000
	Gender	-5.227	9.159	-.061	-.571	.570
	Age	3.482	5.257	.074	.662	.510
	Education level	7.552	3.343	.253	2.259	.027
	Experiment	-2.425	4.011	-.063	-.605	.547
	IM-Total	2.441	.954	.778	2.558	.013
	Flow-Total	-1.832	1.183	-.470	-1.548	.126
	BM	25.903	15.045	.191	1.722	.089

From table 12, it can be seen that independent predictor variables; education level and IM-total are significant in predicting score as a measure of performance quality. IM-total has the largest coefficient with a β value of .778 showing that it is the strongest predictor in explaining the users' score. BM is only significant for a one-tailed test, but as the hypothesis is directional, this significance can be considered at .0445

Table 13 – Regression: (IM – performance quality), Pearson correlation

		score	Gender	Age	Education	Experiment	IM-Total	Flow-Total	BM
Pearson Correlation	score	1.000	.006	.015	.185	.311	.311	.238	.125
	Gender	.006	1.000	-.096	.178	.045	.045	.003	-.046
	Age	.015	-.096	1.000	.237	-.179	-.179	-.153	-.274
	Education	.185	.178	.237	1.000	-.106	-.106	-.134	-.293
	Experiment	-.045	-.075	.072	-.020	.064	.064	.056	-.051
	IM-Total	.311	.045	-.179	-.106	1.000	1.000	.939	.111
	Flow-Total	.238	.003	-.153	-.134	.939	.939	1.000	.138
	BM	.125	-.046	-.274	-.293	.111	.111	.138	1.000
Sig. (1-tailed)	score	.	.478	.445	.047	.002	.002	.015	.131
	Gender	.478	.	.194	.054	.345	.345	.489	.341
	Age	.445	.194	.	.015	.053	.053	.084	.006
	Education	.047	.054	.015	.	.169	.169	.114	.004
	Experiment	.344	.252	.260	.430	.284	.284	.307	.322
	IM-Total	.002	.345	.053	.169	.	.	.000	.158
	Flow-Total	.015	.489	.084	.114	.000	.000	.	.106
	BM	.131	.341	.006	.004	.158	.158	.106	.

The Pearson's correlation of .311 for IM-Total represents a medium effect size.

5.6.3 Results pertaining to $H2_A$

Hypothesis two sought to determine whether the perceived competence sub-construct of intrinsic motivation, positively predicted the performance quality for this experiment. To answer this question a multiple regression analysis was conducted, using “score” as the dependent variable.

Table 14 – Regression: (PC – performance quality), model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.515[a]	.266	.164	38.7017

a. Predictors: (Constant), BM, Gender, Experiment, IM-Total, Age, Education, Flow-Total b. Dependent Variable: score

R Square = .266, indicating that the model explains 26.6% of the variance relating to the score obtained by the respondents. An acceptable Pearson’s correlation *r* value for the social sciences is where 0.1 is regarded as a small effect and 0.5 a large effect (Cohen, 1992). As R Square is calculated as r^2, the R Square value is acceptable.

Table 15 – Regression: (PC – performance quality), ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	39020.484	10	3902.048	2.605	.009[b]
	Residual	107843.372	72	1497.825		
	Total	146863.855	82			

a. Dependent Variable: score

b. Predictors: (Constant), BM, Gender, Experiment, IM-Total, Age, Education, Flow-Total

In the ANOVA table $p<0.05$ and is therefore significant.

Table 16 – Regression: (PC – performance quality), coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	124.554	46.477		2.680	.009
	Gender	-1.831	9.459	-.021	-.194	.847
	Age	1.106	5.371	.023	.206	.837
	Education level	7.064	3.291	.237	2.146	.035
	Experiment	-3.045	4.063	-.079	-.749	.456
	IM-IE	1.113	.805	.204	1.383	.171
	IM-PC	2.635	1.321	.267	1.995	.050
	IM-EI	-.357	1.714	-.034	-.209	.835
	F-CH	4.455	2.973	.184	1.498	.138
	FL-CON	-1.433	1.677	-.142	-.854	.396
	BM	23.113	14.821	.171	1.559	.123

From table 15, it can be seen that independent predictor variable, education level is significant in predicting score as a measure of performance quality. For a significant level $p<0.05$. However, as this hypothesis is directional, a one-tailed test can be applied, allowing for the p-value to be divided by two. In this case the p-value of 0.05 for IM-PC, translates to a p-value of 0.025 making it statistically significant. IM-PC has the largest coefficient with a β value of .267 showing that it is the strongest predictor in explaining the users' score in this set of variables.

Table 17 – Regression: (PC – performance quality), Pearson correlation

		IM-IE	IM-PC	IM-EI	F-CH	FL-CON	BM
Pearson Correlation	score	.276	.362	.123	.342	.105	.125
	Gender	.075	-.104	.116	-.067	-.130	-.046
	Age	-.184	.005	-.250	.032	-.056	-.274
	Education	-.108	-.056	-.088	.044	-.147	-.293
	Experiment	.032	.049	.099	.221	.087	-.051
	IM-IE	1.000	.486	.640	.340	.613	.132
	IM-PC	.486	1.000	.412	.474	.504	.057
	IM-EI	.640	.412	1.000	.237	.697	.057
	F-CH	.340	.474	.237	1.000	.174	.002
	FL-CON	.613	.504	.697	.174	1.000	.113
	BM	.132	.057	.057	.002	.113	1.000
Sig. (1-tailed)	score	.006	.000	.133	.001	.173	.131
	Gender	.251	.174	.149	.273	.121	.341
	Age	.048	.481	.011	.388	.309	.006
	Education	.167	.306	.213	.346	.093	.004
	Experiment	.388	.331	.186	.023	.217	.322
	IM-IE	.	.000	.000	.001	.000	.116
	IM-PC	.000	.	.000	.000	.000	.305
	IM-EI	.000	.000	.	.015	.000	.306
	F-CH	.001	.000	.015	.	.058	.494
	FL-CON	.000	.000	.000	.058	.	.155
	BM	.116	.305	.306	.494	.155	.

The Pearson's correlation of .362 for IM-PC represents a medium effect size.

5.6.4 Results pertaining to $H3_A$, $H4_A$, $H5_A$,

Table 18 – ANOVA: final experiment

		Sum of Squares	df	Mean Square	F	Sig.
IM-IE	Between Groups	106.331	3	35.444	.578	.631
	Within Groups	4844.729	79	61.326		
	Total	4951.060	82			
IM-PC	Between Groups	85.277	3	28.426	1.582	.200
	Within Groups	1419.879	79	17.973		
	Total	1505.157	82			
IM-EI	Between Groups	33.673	3	11.224	.676	.569
	Within Groups	1310.929	79	16.594		
	Total	1344.602	82			
FL-CON	Between Groups	17.133	3	5.711	.315	.814
	Within Groups	1432.047	79	18.127		
	Total	1449.181	82			
IM-Total	Between Groups	598.417	3	199.472	1.100	.354
	Within Groups	14327.246	79	181.358		
	Total	14925.663	82			
Flow-Total	Between Groups	181.067	3	60.356	.502	.682
	Within Groups	9500.740	79	120.263		
	Total	9681.807	82			
12	Between Groups	20.339	3	6.780	3.505	.019
	Within Groups	152.818	79	1.934		
	Total	173.157	82			
score	Between Groups	25705.204	3	8568.401	5.587	.002
	Within Groups	121158.651	79	1533.654		
	Total	146863.855	82			
BM	Between Groups	.368	3	.123	1.267	.291
	Within Groups	7.656	79	.097		
	Total	8.024	82			

- There was a significant effect for question 12; $F(3,79)= 3.5$, $p=.0.19$
- There was a significant effect for scores; $F(3,79)= 5.6$, $p=.0.002$

The p-value of the F tests in the ANOVA was less than 0.05 for question 12 (p=0.019) and the score achieved on the tasks (p=0.002) which means that the null hypothesis was rejected for $H_{4\,0}$, meaning that it can be concluded that:

H_{4A}: Points, levels and leaderboards significantly increased the user's performance quality of the task

For all other cases the p-value of the F test in the ANOVA was greater than 0.05, which means that the null hypothesis could not be rejected for any of these cases, proving the hypotheses to be untrue.

Table 19 – Post Hoc test: final experiment

Multiple Comparisons

Tukey HSD

Dependent Variable	(I) Experiment	(J) Experiment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
12	Control	Points	-1.096	.427	.058	-2.22	.02
		Levels	-1.263*	.446	.029	-2.43	-.09
		Leaderboard	-1.163	.446	.052	-2.33	.01
	Points	Control	1.096	.427	.058	-.02	2.22
		Levels	-.167	.421	.979	-1.27	.94
		Leaderboard	-.067	.421	.999	-1.17	1.04
	Levels	Control	1.263*	.446	.029	.09	2.43
		Points	.167	.421	.979	-.94	1.27
		Leaderboard	.100	.440	.996	-1.05	1.25
	Leaderboard	Control	1.163	.446	.052	-.01	2.33
		Points	.067	.421	.999	-1.04	1.17
		Levels	-.100	.440	.996	-1.25	1.05
score	Control	Points	-14.9671	12.0258	.601	-46.530	16.596
		Levels	-36.0921*	12.5460	.026	-69.020	-3.164
		Leaderboard	11.9079	12.5460	.778	-21.020	44.836
	Points	Control	14.9671	12.0258	.601	-16.596	46.530
		Levels	-21.1250	11.8569	.290	-52.244	9.994
		Leaderboard	26.8750	11.8569	.115	-4.244	57.994
	Levels	Control	36.0921*	12.5460	.026	3.164	69.020
		Points	21.1250	11.8569	.290	-9.994	52.244
		Leaderboard	48.0000*	12.3841	.001	15.497	80.503
	Leaderboard	Control	-11.9079	12.5460	.778	-44.836	21.020
		Points	-26.8750	11.8569	.115	-57.994	4.244
		Levels	-48.0000*	12.3841	.001	-80.503	-15.497

*. The mean difference is significant at the 0.05 level.

The Post Hoc Tukey results indicated that the levels condition resulted in a significantly higher score than both the control and leaderboard conditions. Question 12 had a significantly higher result in the levels condition, when compared to the control condition. The relevance of looking specifically at this question will be discussed in chapter six.

5.6.5 *Effect size*

5.6.5.1 *Cohen's d*

Cohen's d was used to calculate the effect size of the significant results, using the mean and standard deviation values of the two variables. (Appendix G)

Question 12:

- Control and levels: *d* = 0.9174
- Control and points: *d* = 0.8541
- Control and leaderboard: *d* = 0.7476

Score:

- Control and levels: *d* = 0.8979
- Control and leaderboard: *d* = 0.31224

Given that *d* = 0.2 (small effect size), *d = 0.5* (medium effect size) and *d* = 0.8 (large effect size) Field (2013), it can be see that all the effect sizes are large, for all significant values, except for the control and leaderbord effect size pertaining to the point scores, which is a small effect size.

Table 20 – Mean and std. deviation for Cohen's d

Descriptives

			N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum	Between-Component Variance
12	Control		19	3.74	1.408	.323	3.06	4.42	2	6	
	Points		24	4.83	1.129	.231	4.36	5.31	2	7	
	Levels		20	5.00	1.338	.299	4.37	5.63	1	7	
	Leaderboard		20	4.90	1.683	.376	4.11	5.69	1	7	
	Total		83	4.64	1.453	.160	4.32	4.96	1	7	
	Model	Fixed Effects			1.391	.153	4.33	4.94			
		Random Effects				.287	3.73	5.55			.234
score	Control		19	288.158	39.5534	9.0742	269.094	307.222	195.0	365.0	
	Points		24	303.125	39.4476	8.0522	286.468	319.782	215.0	390.0	
	Levels		20	324.250	40.8229	9.1283	305.144	343.356	275.0	455.0	
	Leaderboard		20	276.250	36.6662	8.1988	259.090	293.410	185.0	340.0	
	Total		83	298.313	42.3205	4.6453	289.072	307.554	185.0	455.0	

5.6.5.2 Partial Eta squared

A partial Eta squared was also calculated to explain the proportion of variance by the variables (Field, 2013).

Table 21 – Levene's test of equality of error variances: score

Dependent Variable: score

F	df1	df2	Sig.
.025	3	79	.995

The result of the Levene's test is not significant (p>0.05), therefore the null hypothesis, stating that the error variance of the dependent variable is equal across groups, cannot be rejected.

Table 22 – Partial Eta Squared: score
Tests of Between-Subjects Effects

Dependent Variable: score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	25705.204[a]	3	8568.401	5.587	.002	.175
Intercept	7310135.322	1	7310135.322	4766.483	.000	.984
Experiment	25705.204	3	8568.401	5.587	.002	.175
Error	121158.651	79	1533.654			
Total	7533100.000	83				
Corrected Total	146863.855	82				

a. R Squared = .175 (Adjusted R Squared = .144)

Using the rule of thumb by Cohen; .02 shows a small effect size, .13 a medium effect size and .26 a large effect size. With a Partial Eta squared of .175, it can be said that the score has a medium effect size.

Table 23 – Levene's test of equality of error variances: 12

Dependent Variable: 12

F	df1	df2	Sig.
1.072	3	79	.366

The result of the Levene's test is not significant (p>0.05), therefore the null hypothesis, stating that the error variance of the dependent variable is equal across groups, cannot be rejected.

Table 24 – Partial Eta Squared: 12
Tests of Between-Subjects Effects

Dependent Variable: 12

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	20.339[a]	3	6.780	3.505	.019	.117
Intercept	1755.792	1	1755.792	907.668	.000	.920
Experiment	20.339	3	6.780	3.505	.019	.117
Error	152.818	79	1.934			
Total	1959.000	83				
Corrected Total	173.157	82				

a. R Squared = .117 (Adjusted R Squared = .084)

From table 22, the Partial Eta squared of .117 shows a medium effect size.

5.6.6 Results summary

Table 25 – Summary of results

$H1_A$	Self-reported intrinsic motivation positively predicts performance quality	Supported
$H1_B$	A behavioural measure of intrinsic motivation positively predicts performance quality	Supported
$H2_A$	The perceived competence sub-construct of intrinsic motivation positively predicts performance quality	Supported
$H3_A$	Points, levels and leaderboards increase the users perceived level of competence	Not supported
$H4_A$	Points, levels and leaderboards increase the users performance quality	Supported -Only in levels condition
$H5_A$	Points, levels and leaderboards increase the flow state	Not supported

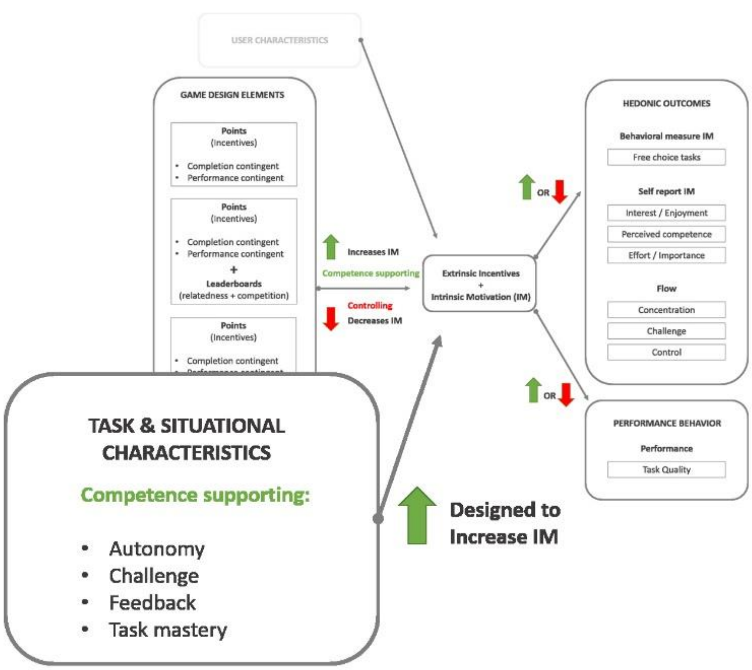
CHAPTER 6: DISCUSSION OF RESULTS

This chapter looks at the experimental results in more detail, examining them against the relevant hypotheses in chapter three in the context of the reviewed literature and theory in chapter two. Key elements from each of the preceding chapters are brought together to better contextualise the discussion and interpretation of the results. Through this process the validity of the hypotheses will be confirmed and additional insights added, which are relevant to the research question.

6.1 Experimental task design

Figure 10 in chapter two was created, based on the reviewed literature, as a framework for the study. It was used to aid in answering the primary research question, can the individual gamification elements, points, levels and leaderboards, be used to drive performance quality behaviours by means of enhancing intrinsic motivation in meeting the user's psychological needs of autonomy and competence?

Figure 22 – Task and situational characteristics



From chapter 5.5.1 it can be seen that for both the pilot and final experiment, the IM scores in the control conditions were 65% and 64% positive respectively, showing that the respondents were intrinsically motivated by the tasks, regardless of the gamification elements. Deterding (2015) recommended that a feedback loop be created to allow users to master the challenges presented by the system. CET states that events, such as feedback that is conducive toward feelings of competence, and enhances intrinsic motivation, by supporting the psychological need for competence (Edward L Deci & Ryan, 1985; M. R. Ryan & Deci, 2000), further to this, overcoming challenge is what leads to a sense of mastery and control. This supports current literature and shows that the design of the tasks was intrinsically motivating.

6.2 Hypothesis 1 and 2

Hypothesis one and two sought to determine whether intrinsic motivation and perceived competence, positively predicted the performance quality for this experiment, given the specific tasks and situation. As established in 6.1.1 the tasks were designed to be intrinsically motivating by using feedback and challenge to enhance competence.

The literature review revealed that intrinsic motivation leads to cognitive and behavioural outcomes, based on the task, situational and personality determinants (Carbonneau et al., 2012). Furthermore, Cerasoli & Ford (2014) found that mastery goals are what mediate the effect of intrinsic motivation on performance, where mastery goals and intrinsic motivation have a reciprocal effect on each other. Mastery goals enhance intrinsic motivation by enhancing the perception of competence, which is achieved by allowing the user to overcome challenges (Deterding, 2015). Intrinsic motivation is positively associated with engagement in performance behaviours, increasing the duration, persistence and the intensity (effort) of the behaviour, whilst mastery goals focus ones effort and drive cognitions to competence, rather than merely being satisfaction relevant (Cerasoli et al., 2014). They also found that intrinsic motivation was a moderately strong predictor of both quality and quantity performance behaviours, but was necessary for quality performance.

- **$H1_A$:** Self-reported intrinsic motivation positively predicts performance quality
- **$H1_B$:** A behavioural measure of intrinsic motivation positively predicts performance quality
- **$H2_A$:** The perceived competence sub-construct of intrinsic motivation positively predicts performance quality

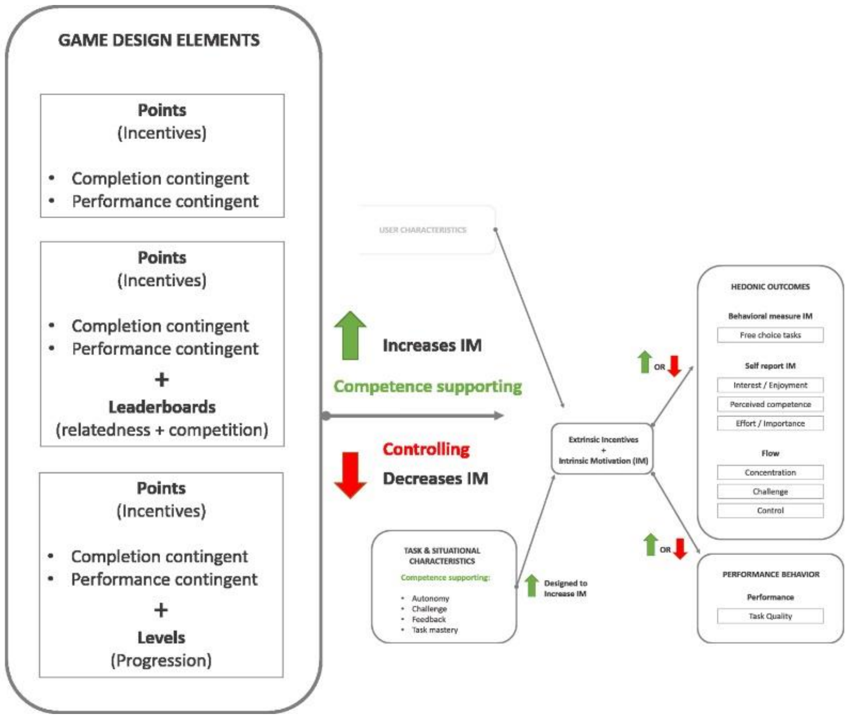
The results of the regression analysis performed in 5.5.2 and 5.5.3 showed that intrinsic motivation, and the respondent's level of education were significant in predicting the final score obtained during the experiment, where the final score was used as a measure of performance quality. Given the design of the task, it can be understood how education level might predict the score obtained, but the results showed that the intrinsic motivation had a Beta coefficient with a much higher value (.778) when compared to education level (.253). This shows that education level is not as strong of a predictor as intrinsic motivation on the score obtained. The behavioural measure of intrinsic motivation and the perceived competence construct of intrinsic motivation, were significant for a one-tailed test, and as both hypotheses are directional, it was deemed a significant result. Therefore in all three cases the null hypothesis could be rejected in favour of the hypothesis.

The results support the current literature showing that intrinsic motivation and competence predict quality performance for this experiment. As perceived competence was the only measure of intrinsic motivation (the other two being IM-IE and IM-EI) to significantly predict the score, it can be said that these findings support the literature, in that mastery goals (competence) are what mediate the effect of intrinsic motivation on performance.

6.3 Hypothesis 3

This hypothesis sought to test if the individual mechanics; points, levels and leaderboards increase the users perceived level of competence.

Figure 23 – Game design elements



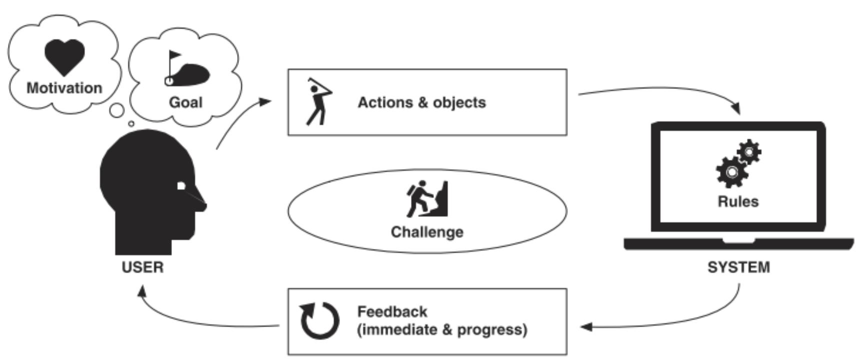
If mechanics are perceived as informative, non-controlling, and competence boosting, they may increase intrinsic motivation by increasing a sense of competence (R. M. Ryan et al., 2006). If mechanics are perceived as controlling, they decrease intrinsic motivation. Positive feedback, perceived competition and enhanced opportunities for the user to be optimally challenged are other ways to improve competence (Francisco et al., 2012). In the case of this experiment the gamification incentives were not the primary feedback mechanism. Direct informative feedback was given (Appendix E), which delivered the competence boosting message. In this case the mechanics sought to further increase the user's sense of competence, by providing additional measures for performance standards. Levels showed progression and leaderboards added a dimension of relatedness and competition.

The results of the ANOVA analysis conducted in 5.5.4 revealed that IM-PC, the perceived competence measure of intrinsic motivation, was not significant between the different groups of the experiment. Therefore the null hypothesis could not be rejected and thus the hypothesis was found to be untrue.

An interesting finding within the analysis was that one specific measure in the perceived competence construct was found to be significant between the control and levels condition. The measure was question 12, “After working at this task for a while, I felt pretty competent”, what makes this interesting, is that when compared to the other measures within this construct; “I am satisfied with my performance at this task”, “I was pretty skilled at this task”, and “I think I am pretty good at this task” one notices that this is the only measure that speaks to improving competence over time. The other measures all speak to an absolute level of skill for the overall experiment.

Deterding (2015) recommends designing gamification using feedback loops called skill atoms seen in figure 9, and repeated below in figure 24:

Figure 24 – Schematic of a skill atom (Deterding, 2015)



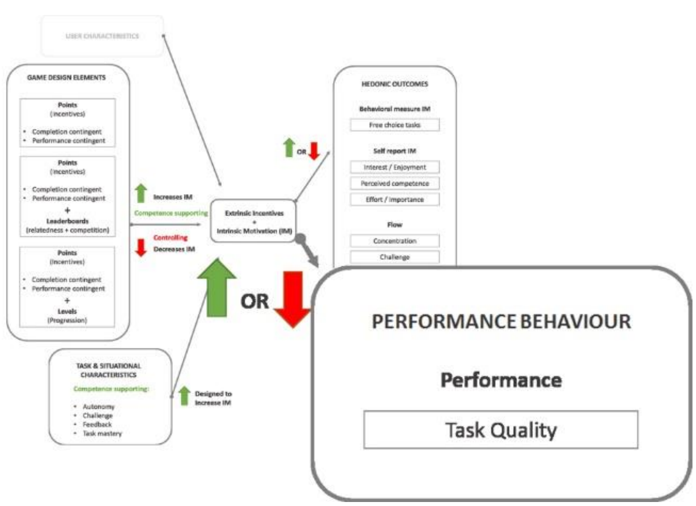
This is relevant, because it requires the user to repeatedly run through the atom, and in doing so, they obtain task mastery (competence) by overcoming the emerging challenges that are presented. This speaks to an improving level of competence over time, and as such relates to question 12. Further to this, achievement motivation and intrinsic challenge are where people derive pleasure from, ***improving*** their level of competence (Carbonneau et al., 2012; Francisco et al., 2012). This again speaks to question 12. From this one might consider that the perceived competence construct of intrinsic motivation, from the established intrinsic motivation inventory tool (Edward L Deci & Ryan, 1985; McAuley et al., 1989), might not be the best measure of competence for this sort of research, and that perhaps other options should be explored and developed.

What should also be noted is that although the mechanics (points) were applied as directly salient, performance and completion contingent incentives, they were not perceived as controlling. This can be said, as they did not reduce intrinsic motivation. Cerasoli, Nicklin & Ford (2014) stated that controlling incentives reduce but supporting incentives enhance intrinsic motivation. From this is it can be argued that the game mechanics acted in support of the feedback given.

6.4 Hypothesis 4

This hypothesis sought to test if the individual mechanics; points, levels and leaderboards increase the users performance quality.

Figure 25 – Performance behaviour



The performance type (quality or quantity) and the incentive contingency (directly or indirectly performance salient) are factors that should be considered, as they change the relationship between intrinsic motivation, incentives and performance (Cerasoli et al., 2014). The literature suggests that when quantity type behaviours are required (such as an increase in the frequency of a behaviour) extrinsic incentives should be used, as they focus attention and direct behaviour (Cerasoli et al., 2014). When quality performance behaviours are required, such as the completion of complex tasks or tasks requiring overall quality of completion, intrinsic motivation should be used.

As established above, the mechanics sought to increase the user's sense of competence, and thus intrinsic motivation, to improve the overall quality of the participant's performance.

6.4.1 Points condition

The ANOVA analysis conducted in 5.5.4 showed that there was no statistically significant difference between the control condition and the point's condition in terms of the scores achieved by the respondents. As points alone do not add any additional measures of performance feedback, comparison or competition, they do not enhance competence and intrinsic motivation.

6.4.2 Levels condition

Based on the results of the ANOVA analysis conducted in 5.5.4, using the participants' scores as a measure of performance, it can be seen that there was a statistically significant difference (p=0.002) in the scores obtained between the different groups. A Tukey HSD post-hoc analysis revealed that the levels condition had a significantly higher score than the control condition (p=0.026). As already established by the literature and in **$H1_B$** and **$H2_A$**, intrinsic motivation and the perceived competence sub-construct of intrinsic motivation positively predict performance quality. Intrinsic motivation has been found to be a medium to strong predictor of performance Cerasoli & Ford (2014)

It would therefore follow that when compared to the control condition, the levels condition increased the participant's level of perceived competence and thus intrinsic motivation, by adding progression as an additional measure of performance feedback.

If only question 12 was used as the measure of competence, as argued above in 6.1.3, it would have verified this, by showing a statistically significant (p=.029), increased level in competence, when compared to the control condition. This adds to the argument, that the perceived competence construct used above should be further explored.

6.4.3 Leaderboard condition

Interestingly, the levels condition had significantly higher scores than the leaderboard condition (p=0.001). This could possibly be explained by the literature reviewed on achievement goal theory. This speaks to two kinds of goals, performance goals and mastery goals. Performance goals are an ambition to perform better than others. Orientating people to compare their competence to others is likely to promote performance goals, which leads to poorer performance, and lower intrinsic motivation than mastery goals (Benita et al., 2014). The result also contradicts Francisco et al., (2012) who stated that perceived competition could be used to enhance a sense of competence. As discussed above the mechanics were implemented in an attempt to aid with task mastery, and improve competence. This result could suggest a possible unintended negative consequence, whereby the leaderboard condition did not transfer the same motivational affordances as expected from a play context (Deterding, 2011).

6.5 Hypothesis 5

The results showed that when compared to the control condition, none of the gamification elements significantly increased the flow state. Flow is measured by intrinsic interest and concentration, so a possible reason for this result, is due to the design of the tasks within the experiment. As discussed above, the experiment was intrinsically motivating irrespective of the game elements. The challenges and feedback within the design would have led to increased concentration, as the respondent attempted task mastery. This shows that the inclusion of the elements did not further enhance the respondent’s concentration and level of intrinsic interest. Perhaps a better way to have measured the flow state would have been to compare it to a control condition without any performance feedback.

CHAPTER 7: CONCLUSION

This chapter summarises the findings of the research.

7.1 Key considerations for the research design

What is important to note is that previous studies, such as a study by Mekler et al.,(2015) on the use of individual game elements, have used the game mechanics as primary feedback mechanisms. This is due to the fact that feedback which is conducive toward feelings of competence, enhances intrinsic motivation, by supporting the psychological need for competence (Edward L Deci & Ryan, 1985; M. R. Ryan & Deci, 2000). This particular study found that the mechanics acted as extrinsic motivators and increased performance quantity (the frequency of the behaviour) instead of acting as intrinsic motivators as intended. Deterding (2015) suggests that the design of the actual task should allow for improved levels of competence (control, mastery, etc.) by creating well-balanced challenges, as this in turn creates an intrinsically motivating task (with or without the gamification incentives). Further to this the literature suggests that a feedback loop should be created to allow users to master the challenges presented by the system.

Based on the above, the experiment was designed to challenge the participants, and direct performance feedback as given (appendix E). The feedback told the participants whether they had correctly completed each task. It also gave the correct answers to tasks that were incorrectly answered. This aided with task mastery and thus increased the participant's feelings of competence. From the reviewed literature, it was also important to note that a sense of competence will not increase intrinsic motivation unless the person experiences autonomy. That is that the person believes their behaviour is self-determined and not controlled by the extrinsic rewards (Edward L Deci et al., 1999). For this reason, a measure of perceived choice was used to filter out respondents who believed that they did not have a choice in partaking in this experiment.

The level of the participant's intrinsic motivation was measured for the control condition (the condition without gamification elements) and it was found that the mean intrinsic motivation for this condition was positive at 64%. This showed that the design of the task was successful in enhancing intrinsic motivation.

Whilst the gamification mechanics *could* have been used to deliver the primary performance feedback described above, it was decided that they would rather be used in an attempt to further increase the user's sense of competence by providing additional measures for performance feedback. The levels were used to show progression and the leaderboards added a dimension of relatedness and competition. In this case *if* the mechanics were used to deliver the primary performance feedback, it could be argued that the sense of competence gained from progression, relatedness and competition, would be difficult to measure.

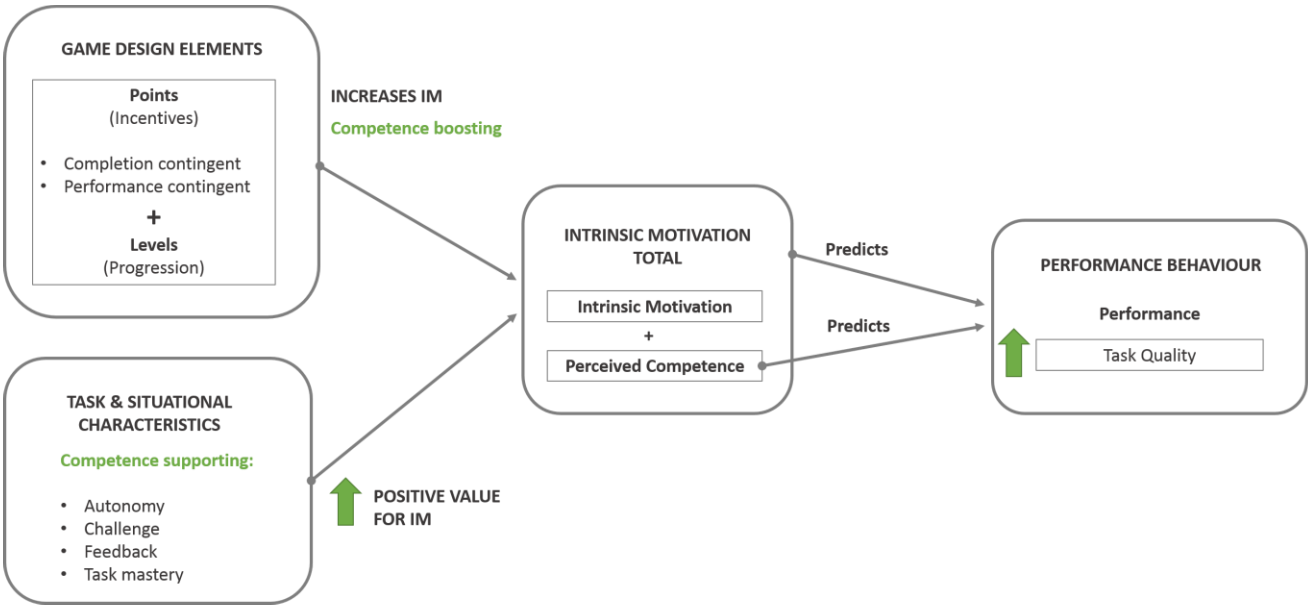
For example; in the leaderboard condition, if the performance feedback was delivered by the leaderboard and this feedback led to a significant gain in perceived competence (compared to a control condition with *no* feedback), but the perceived competition from the leaderboard led to a non-significant loss of perceived competence (compared to a control condition with *no* feedback), the net effect of this might not have shown the loss of competence due to relatedness and competition. The leaderboard condition in this case, might have still shown a significant level of increased competence when compared to the control condition with no performance feedback.

This consideration was thus important when considering the design of the experiment to answer the primary research question; can the individual gamification elements, points, levels and leaderboards, be used to drive performance quality behaviours by means of enhancing intrinsic motivation in meeting the user's psychological needs of autonomy and competence?

7.2 Summary of research findings

The framework developed from the literature review was illustrated in figure 10, and is adapted in figure 25 to highlight the research findings.

Figure 25 – Research findings



Based on literature reviewed and the results of the statistical analysis conducted in this paper, the following could be concluded;

1. The reviewed literature suggested that creating tasks that offers challenge and feedback, which allows for task mastery, under the condition of autonomy, leads to increased intrinsic motivation. The tasks used in this experiment proved to have a positive level of intrinsic motivation.
2. Intrinsic motivation and the perceived competence sub-construct of intrinsic motivation both predict performance quality (measured by the score obtained by the participants during the experiment).
3. The levels condition, which added feedback on progression, led to a significant increase in performance quality, when compared to the control condition.

Table 26 summarised the findings relating to the hypotheses that were tested:

Table 26 – Summary of results

$H1_A$	Self-reported intrinsic motivation positively predicts performance quality	Supported
$H1_B$	A behavioural measure of intrinsic motivation positively predicts performance quality	Supported
$H2_A$	The perceived competence sub-construct of intrinsic motivation positively predicts performance quality	Supported
$H3_A$	Points, levels and leaderboards increase the users perceived level of competence	Not supported
$H4_A$	Points, levels and leaderboards increase the users performance quality	Supported -Only in levels condition
$H5_A$	Points, levels and leaderboards increase the flow state	Not supported

Other key findings include;

1. The leaderboard condition showed no significant increase in performance quality, when compared to the control condition. It did however show a significant *decrease* in performance quality, when compared to the levels condition.
2. One specific measure of "perceived competence" showed a significant difference between the levels and control condition. This could possibly explain the significant increase in performance quality obtained by the levels condition.

7.3 Managerial implications

This research has shown that giving the user points as directly salient, performance and completion contingent incentives, and using levels to show progression as the user accumulates these points, can support performance quality by relaying a competence-boosting message. The literature suggests that intrinsic motivation predicts "quality performance" type behaviours and extrinsic motivation predicts "quantity type" performance behaviours, therefore complex tasks or tasks that require overall quality and focus should be motivated intrinsically (Cerasoli & Ford, 2014).

The leaderboard condition in this research had a significantly lower performance quality than the levels condition. Benita et al., (2014), suggests that orientating people to compare their competence to others is likely to promote performance goals, which leads to poorer performance, and lower intrinsic motivation than mastery goals. Deterding, (2011) also warned that using game elements in different contexts, might not transfer the same motivational affordances from 'play' contexts, as participation in the gamified system might not be voluntary or free of consequence. This needs to be considered when implementing gamification within an organisational context, and specific care should be taken when using leaderboards which add competition and comparison elements. From the findings in this paper, it is suggested that leaderboards should not be used to drive performance *quality* behaviours. However, this research only tested one specific task. This conclusion may not be the case for other task types.

7.4 Academic implications

The results of this study have shown that extrinsic incentives (points and levels) can be used to support intrinsic motivation and its associated performance behaviours, where intrinsic motivation predicts "quality performance" type behaviours and extrinsic motivation predicts "quantity type" performance behaviours.

It has been suggested that extrinsic incentives crowd-out intrinsic motivation for interesting tasks due to "the undermining effect", Cognitive evaluation theory states that how someone perceives the extrinsic rewards or incentives, mediates the undermining effect (Edward L Deci & Ryan, 1985; M. R. Ryan & Deci, 2000). If they are perceived as controlling, intrinsic motivation will be reduced, however if incentives are perceived as informative, non-controlling, and competence boosting, they may increase intrinsic motivation, by increasing a sense of competence (R. M. Ryan et al., 2006).

Incentive contingency describes how incentives are predicted on performance. Completion and performance contingent incentives tend to be directly performance salient, that is, they provide a clear, immediate and unambiguous link between the incentive and the performance. Directly salient incentives have two factors necessary for controlling behaviour, namely; immediacy and salience. These incentives give a direct and clear link between behaviour and reward, and thus create a strong extrinsic incentive to perform. Indirectly salient incentives are less controlling (Cerasoli et al., 2014).

This study contradicts what was said by Cerasoli et al., (2014), in that it showed that directly performance salient, completion and performance contingent incentives (points awarded for completing tasks and correct answers) were not perceived as controlling. They did not thwart intrinsic motivation as they led to an increase in performance quality which is predicted by intrinsic motivation.

7.5 Limitations and suggestions for future research

- The nature of the tasks employed during the online experiment were specific in nature, in that they were graphical perception tasks. The participant's subjective experience of the subject matter for this experiment may have impacted the results. For instance, if a particular participant had a negative outlook on such tasks, it may have impacted their subsequent motivation levels. Deterding (2015) reccomeds that challenges should be identified, which already exist in the users persuit of their goals, and that these should be used within the gamified systerm, by structuring them in a motivating manor. As this experiement was not applied to specific, already exisiting challenges, the results may differ if applied in such a way. It is therefore recommended that further studies be conducted using real world example of user challenges.
- The participants interacted with the experiment for a short period of time. The results of which may differ if the engagement elements were to run for an extended period. Testing the long-term effects of gamification elements on engagement and performance would be beneficial.
- As discussed in 6.3, the perceived competence measure of intrinsic motivation, from the intrinsic motivation inventory, might not be the best suited measure of competence for this sort of research. Future studies could investigate exploring and developing more suitable measures.

7.6 Conclusion

This research contributed to the body of knowledge by showing the individual game elements can be used to enhance performance quality behaviours which are predicted by the users feeling of competence and intrinsic motivation. Intrinsically motivated experiences are associated with positive outcomes, such as enjoyment and quality of engagement. The findings add to the understanding of how gamification elements can be added to organisational and other contexts.

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APPENDICES

Appendix A: Demographic questionnaire

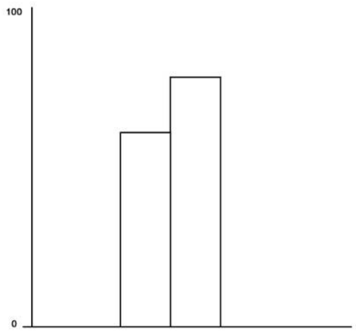
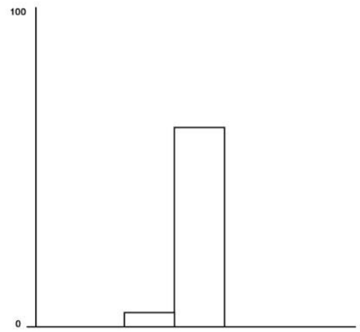
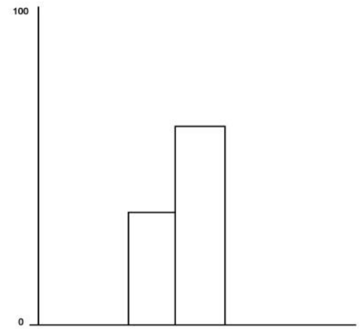
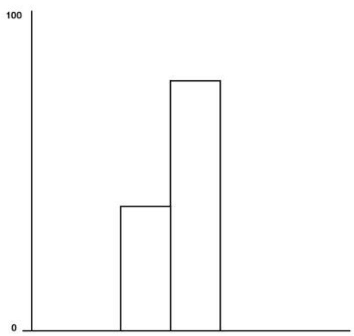
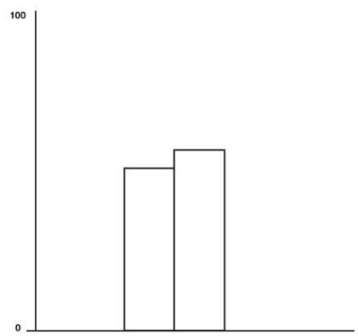
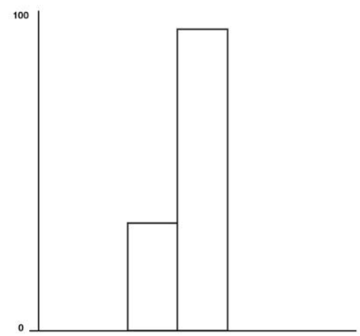
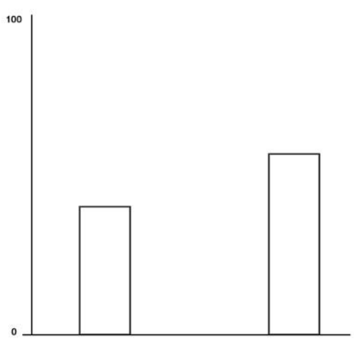
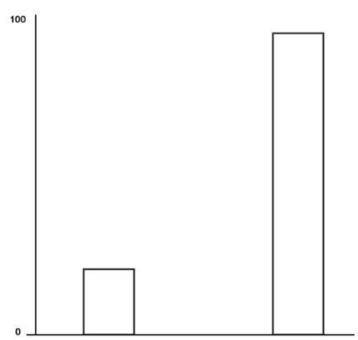
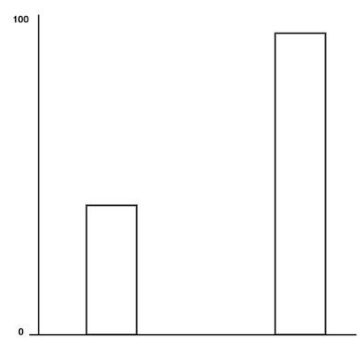
1. Pilot

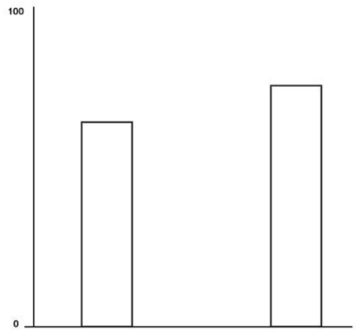
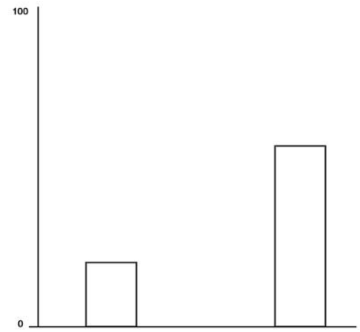
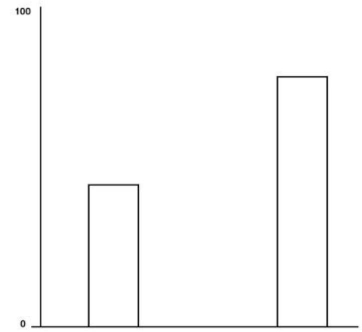
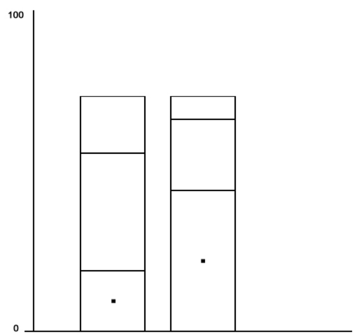
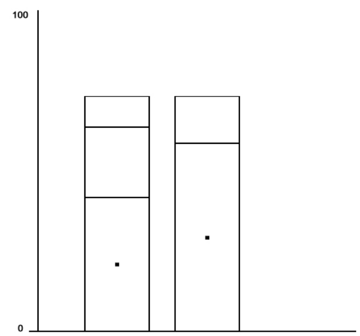
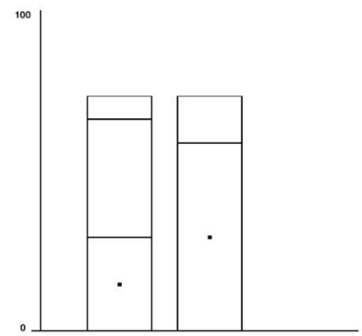
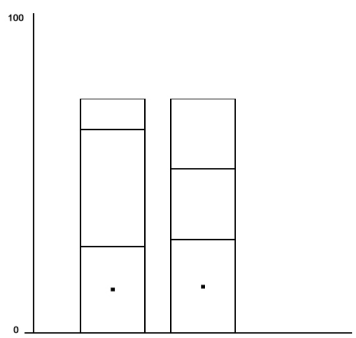
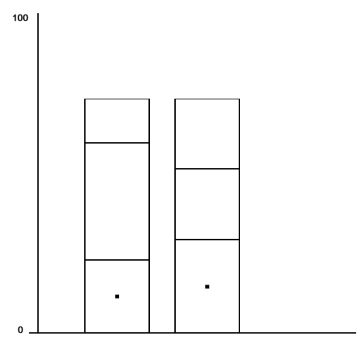
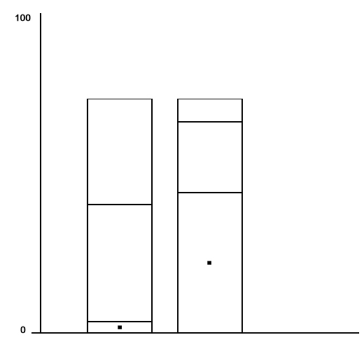
Question	Scale			
Please select your gender?	Male	Female		
What is your age in years?	Under 18	19-24	25-34	35-44
	45-54	55-64	65-74	75 and older
What is your highest qualification level?	High school	Matric	Certificate	Some college credit no degree
	Bachelor's degree	Honors degree	Master's degree	Doctorate
	Other			
How often do you use a computer?	Daily	Weekly	Monthly	Seldom
How did you come across this experiment?	Social media	A crowdsourcing platform	A UX or gamification related forum	Other
What is your country of origin?	List of countries			

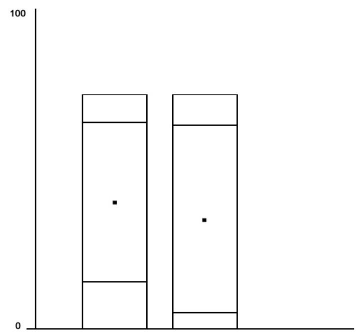
2. Final Experiment

Question	Scale			
Please select your gender?	Male	Female		
What is your age in years?	Under 18	19-24	25-34	35-44
	45-54	55-64	65-74	75 and older
What is your highest qualification level?	High school	Matric	Certificate	Some college credit no degree
	Bachelor's degree	Honors degree	Master's degree	Doctorate
	Other			

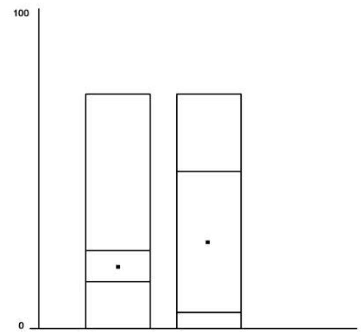
Appendix B: Experiment tasks

First 30 tasks		
		
Task 1: Answer 78%	Task 2: Answer 8%	Task 3: Answer 57%
		
Task 4: Answer 50%	Task 5: Answer 92%	Task 6: Answer 36%
		
Task 7: Answer 71%	Task 8: Answer 22%	Task 9: Answer 43%

		
Task 10: Answer 85%	Task 11: Answer 36%	Task 12: Answer 57%
		
Task 13: Answer 43%	Task 14: Answer 71%	Task 15: Answer 50%
		
Task 16: Answer 92%	Task 17: Answer 78%	Task 18: Answer 8%



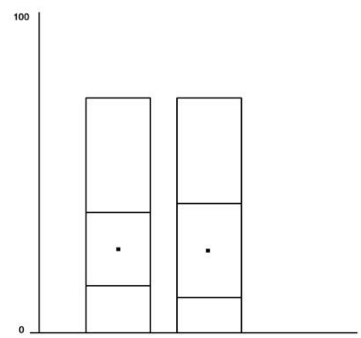
Task 19: Answer 85%



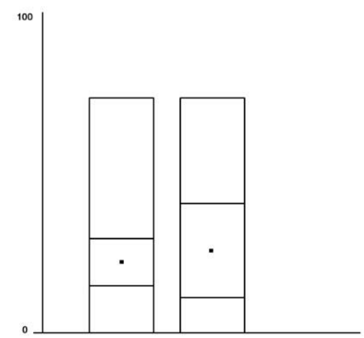
Task 20: Answer 22%

Task 21: Answer 36%

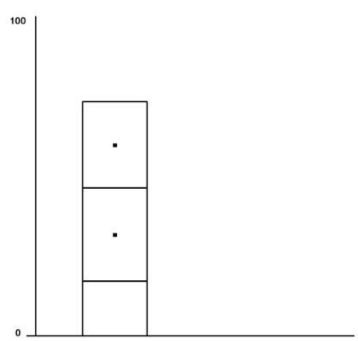
Task 22: Answer 57%



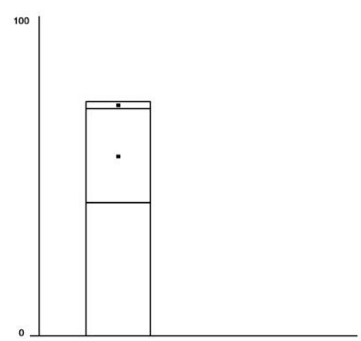
Task 23: Answer 78%



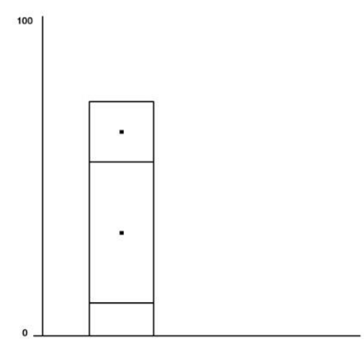
Task 24: Answer 50%



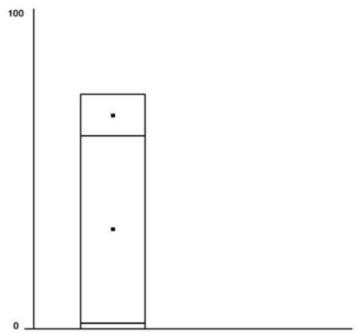
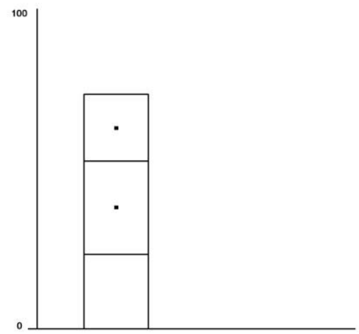
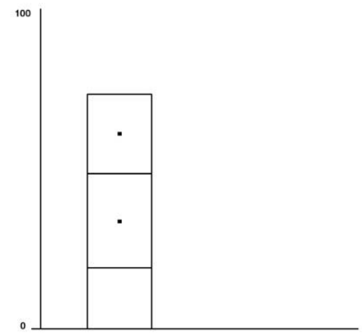
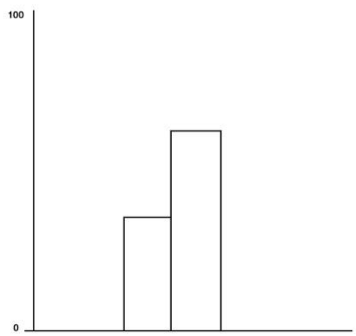
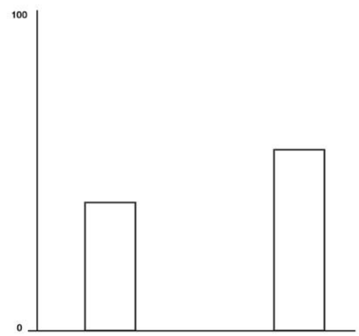
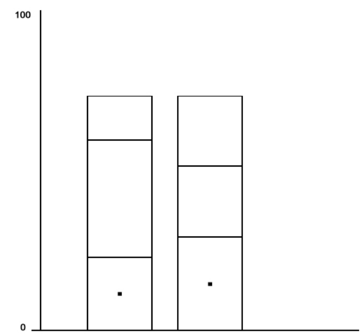
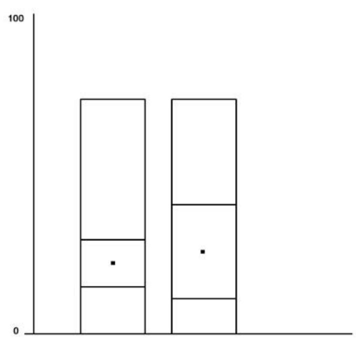
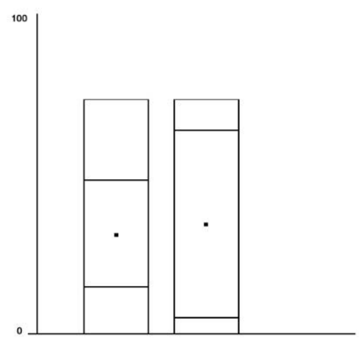
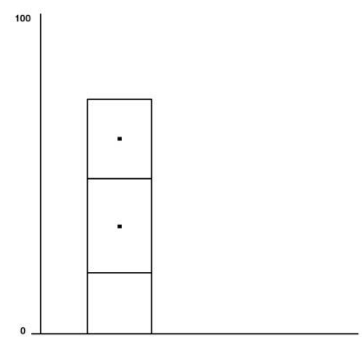
Task 25: Answer 92%



Task 26: Answer 8%



Task 27: Answer 43%

		
Task 28: Answer 22%	Task 29: Answer 71%	Task 30: Answer 85%
Free choice tasks		
		
Task 31: Answer 43%	Task 32: Answer 71%	Task 33: Answer 78%
		
Task 34: Answer 50%	Task 35: Answer 57%	Task 36: Answer 92%

Appendix C: Experiment conditions

1. Control condition

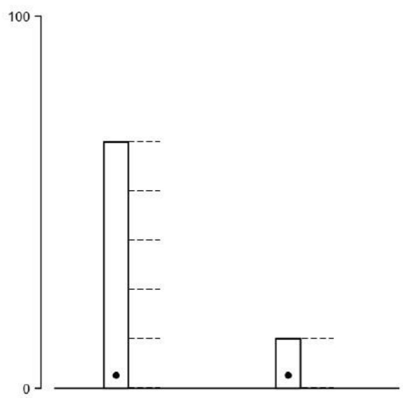
Instructions

On each screen there will be a bar graph. Please estimate the height of the shorter bar as a percent of the height of the taller bar. In some cases dots mark the bars that should be compared. Your answer should be between 0% and 100%.

There is no time limit, but you should target an average of 7-9 seconds per response.

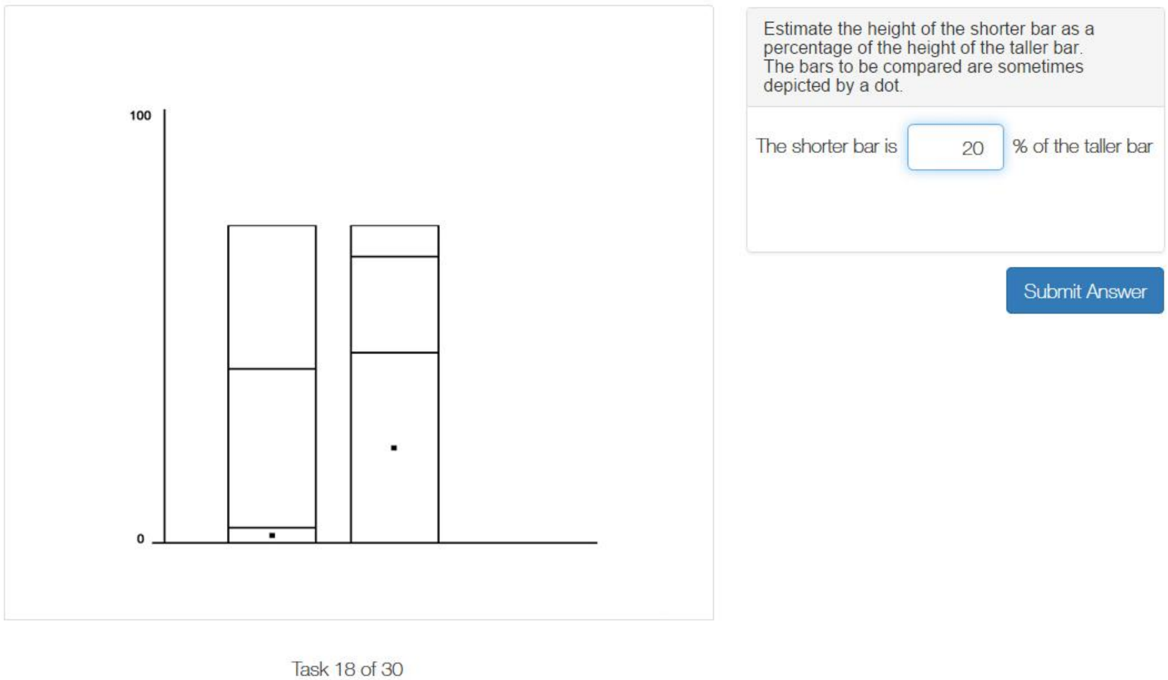
Please complete the exercise by giving your best estimation to all 30 bar graph tasks.

Example:



The shorter bar marked with a dot is 20% of the taller bar marked with a dot

Sample of exercise screen:



2. Point's condition

On each screen there will be a bar graph. Please estimate the height of the shorter bar as a percent of the height of the taller bar. In some cases dots mark the bars that should be compared. Your answer should be between 0% and 100%.

There is no time limit, but you should target an average of 7-9 seconds per response.

Please complete the exercise by giving your best estimation to all 30 bar graph tasks.

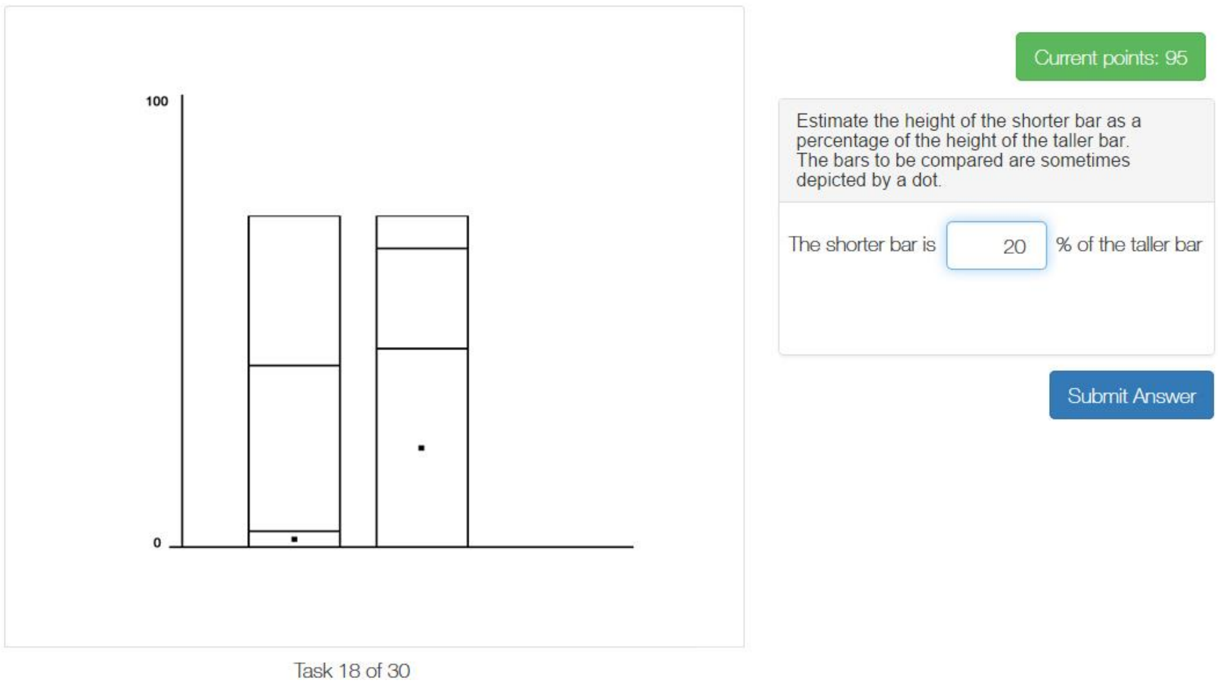
You will receive 5 points for each estimate you make.

You will receive 10 points if your estimation is within 5% of the correct percentage.

You will receive 25 points for correct estimates.

(Same Example as above)

Sample of exercise screen:



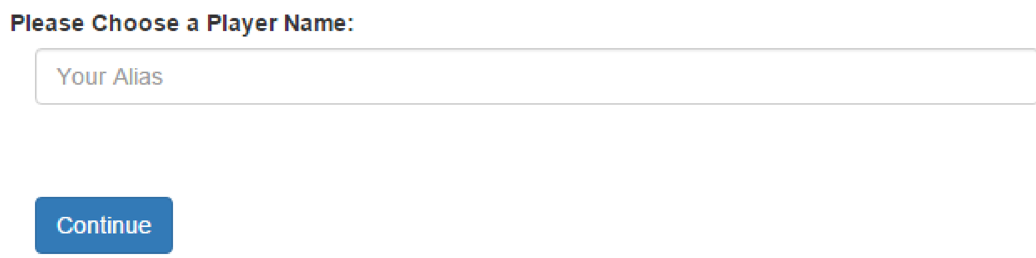
3. Levels condition (Pilot)

(Same Instructions as above)

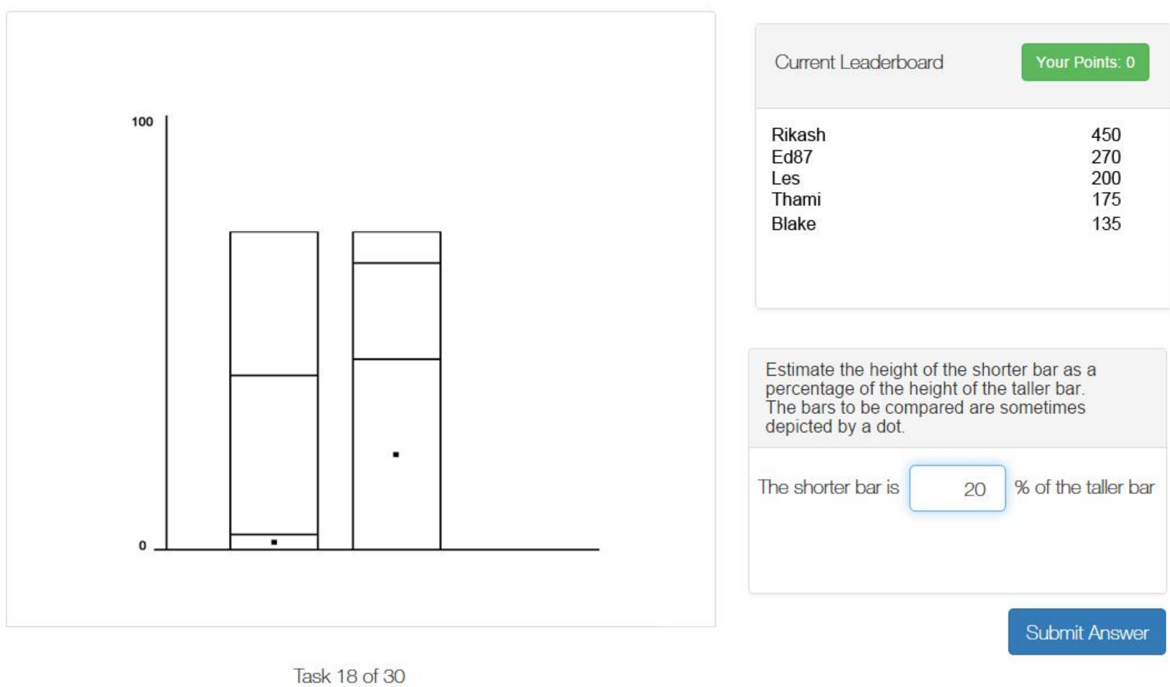
Sample of exercise screen:

4. *Leaderboard condition (Pilot)*

(Same Instructions as above)

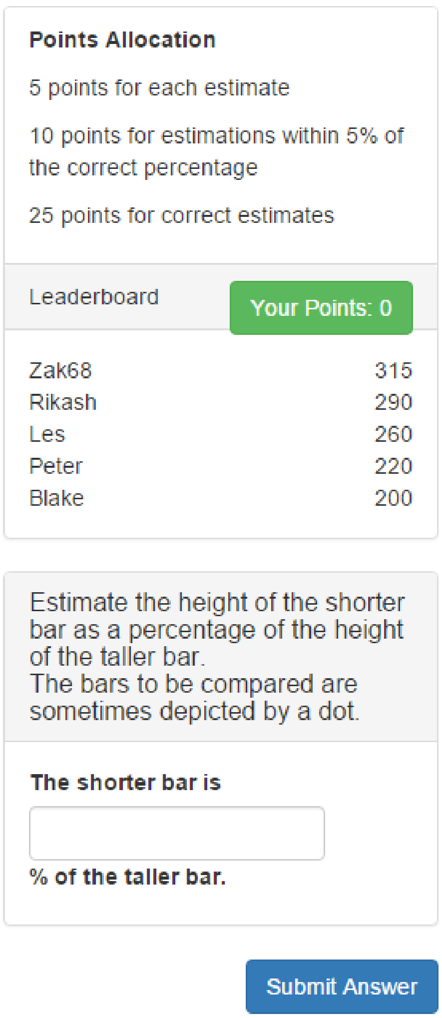


Sample of exercise screen:

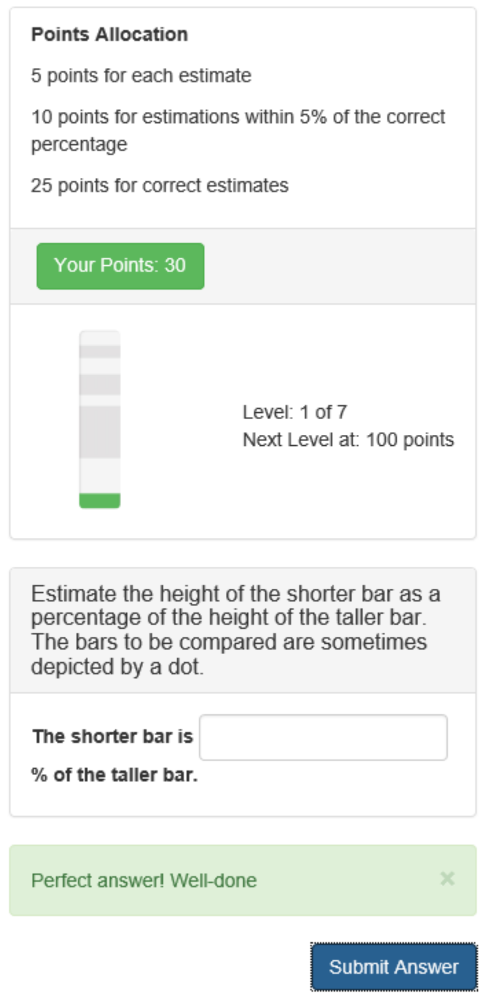


Appendix D: Final experiment conditions

1. ***Leaderboard condition (Final Experiment)***



2. ***Levels condition (Final Experiment)***



Appendix E: Experiment feedback

Answer	Feedback mechanism
Correct answer given	Perfect answer! Well-done ×
Answer given was within 5% of the correct answer	Almost, the correct answer is 50 ×
Incorrect answer given	The correct answer is 8. ×

Appendix F: Survey

1. *Intrinsic motivation questionnaire: Pilot*

Question Number	Question (Scale: 1 = not at all true 7 = very true)
Interest / Enjoyment Construct	
1	Doing the tasks was fun
5 (R)	I thought the task was very boring (R)
8	I thought the tasks was very interesting
14	I would describe the task as very enjoyable
17	While I was working on the task I was thinking about how much I enjoyed it
18 (R)	This activity did not hold my attention at all (R)
20	I enjoyed doing the task very much
Perceived Competence Construct	
4	I am satisfied with my performance at this task
6	I was pretty skilled at this task
16	After working at this task for a while, I felt pretty competent
21 (R)	This was an activity that I couldn't do very well (R)
26	I think I am pretty good at this task
Effort / Importance Construct	
7	I tried very hard on this activity
13 (R)	I didn't try very hard to do well at this activity (R)
22	I put a lot of effort into this

23 (R)	I didn't put much energy into this (R)
Perceived Choice	
2	I believe I had a choice about doing this activity
19	I did this activity because I wanted to

2. Flow questionnaire: Pilot

Question Number	Question (Scale: 1 = not at all true 7 = very true)
Concentration	
9	I was deeply engrossed in the activity
24	My attention was focused on the tasks, while I was busy with them
25	I was absorbed intensely in this activity
27	I concentrated fully on the activity
Challenge	
12	This activity challenged me
15	This activity challenged me to perform to the best of my ability
28	This activity stretched my capabilities to the limits
Control	
3	I felt in control
10 (R)	I felt frustrated (R)
11 (R)	I felt confused (R)

3. Final Experiment Questionnaire

Construct	Questions
IM Interest / Enjoyment	Doing the tasks was fun I thought the tasks was very interesting I was deeply engrossed in the activity I would describe the task as very enjoyable This activity challenged me to perform to the best of my ability While I was working on the task I was thinking about how much I enjoyed it I enjoyed doing the task very much
IM Effort / Importance	I tried very hard on this activity I didn't try very hard to do well at this activity (R) I put a lot of effort into this
IM Perceived Competence	I am satisfied with my performance at this task I was pretty skilled at this task After working at this task for a while, I felt pretty competent I think I am pretty good at this task
Flow - Concentration	My attention was focused on the tasks, while I was busy with them I was absorbed intensely in this activity I concentrated fully on the activity
IM Perceived Choice (filtering questions)	I believe I had a choice about doing this activity I felt in control

Appendix G: Results from analytical techniques

1. Test for normality

Pilot:

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
IM-Total	.061	216	.052	.985	216	.020
Flow-Total	.059	216	.064	.981	216	.006

a. Lilliefors Significance Correction

Final Experiment:

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
IM-Total	.060	83	.200*	.980	83	.238
Flow-Total	.093	83	.071	.967	83	.031

*. This is a lower bound of the true significance. a. Lilliefors Significance Correction

2. Descriptive Statistics

a. Demographic Data: Pilot

GENDER

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	126	58.3	58.3	58.3
	Female	90	41.7	41.7	100.0
	Total	216	100.0	100.0	

AGE

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	19 - 24	8	3.7	3.7	3.7
	25 - 34	118	54.6	54.6	58.3
	35 - 44	50	23.1	23.1	81.5
	45 - 54	21	9.7	9.7	91.2
	55 - 64	15	6.9	6.9	98.1
	65 - 74	4	1.9	1.9	100.0
	Total	216	100.0	100.0	

EDUCATION

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	High school	4	1.9	1.9	1.9
	Matric	12	5.6	5.6	7.4
	Some college credit but no degree	24	11.1	11.1	18.5
	Certificate	10	4.6	4.6	23.1
	Bachelors degree	72	33.3	33.3	56.5
	Masters degree	40	18.5	18.5	75.0
	Honors degree	41	19.0	19.0	94.0
	Doctorate	5	2.3	2.3	96.3
	Other	8	3.7	3.7	100.0
	Total	216	100.0	100.0	

COUNTRY

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	South Africa	160	74.1	74.1	74.1
	India	19	8.8	8.8	82.9
	Zimbabwe	3	1.4	1.4	84.3
	United Kingdom	6	2.8	2.8	87.0
	United States	12	5.6	5.6	92.6
	Mozambique	1	.5	.5	93.1

	Sri Lanka	1	.5	.5	93.5
	South Korea	1	.5	.5	94.0
	Nigeria	2	.9	.9	94.9
	Zambia	2	.9	.9	95.8
	Germany	2	.9	.9	96.8
	Canada	2	.9	.9	97.7
	Ghana	1	.5	.5	98.1
	Turkey	1	.5	.5	98.6
	Norway	1	.5	.5	99.1
	Australia	1	.5	.5	99.5
	South Sudan	1	.5	.5	100.0
	Total	216	100.0	100.0	

EXPERIMENT

		Frequency	Percent	Valid Percent	Cumulative
Valid	Control Condition	48	22.2	22.2	22.2
	Points Condition	54	25.0	25.0	47.2
	Levels Condition	57	26.4	26.4	73.6
	Leaderboard Condition	57	26.4	26.4	100.0
	Total	216	100.0	100.0	

BM

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Required tasks only	171	79.2	79.2	79.2
	Additional free choice	45	20.8	20.8	100.0
	Total	216	100.0	100.0	

b. Individual constructs: Cronbach's Alpha

Intrinsic Motivation – interest, enjoyment construct

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.914	.917	6

Intrinsic Motivation – effort, importance construct

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.756	.759	3

Intrinsic Motivation – perceived competence construct

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.813	.817	4

Flow – concentration construct

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.849	.849	3

c. Descriptives final experiment

Descriptives

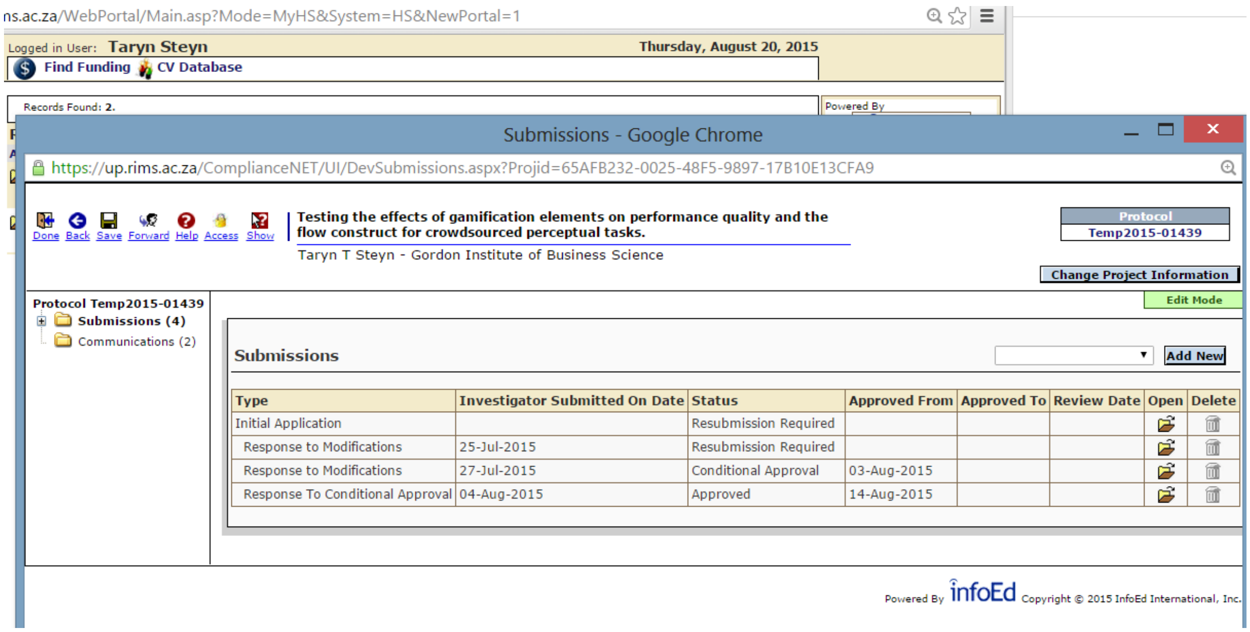
			N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum	Between-Component Variance
IM-IE	1.0		19	27.632	5.7078	1.3095	24.881	30.383	19.0	40.0	
	2.0		24	30.458	7.5641	1.5440	27.264	33.652	10.0	41.0	
	3.0		20	30.100	7.9532	1.7784	26.378	33.822	7.0	38.0	
	4.0		20	28.650	9.5712	2.1402	24.171	33.129	6.0	42.0	
	Total		83	29.289	7.7704	.8529	27.592	30.986	6.0	42.0	
	Model	Fixed Effects			7.8311	.8596	27.578	31.000			
		Random Effects				.8596[a]	26.554[a]	32.025[a]			-1.2509
IM-PC	1.0		19	18.368	3.4994	.8028	16.682	20.055	10.0	24.0	
	2.0		24	20.208	4.4719	.9128	18.320	22.097	9.0	28.0	
	3.0		20	20.950	2.6253	.5870	19.721	22.179	16.0	27.0	
	4.0		20	18.850	5.6594	1.2655	16.201	21.499	7.0	27.0	
	Total		83	19.639	4.2843	.4703	18.703	20.574	7.0	28.0	
	Model	Fixed Effects			4.2395	.4653	18.712	20.565			
		Random Effects				.5864	17.772	21.505			.5052
IM-EI	1.0		19	12.368	3.8903	.8925	10.493	14.243	5.0	18.0	
	2.0		24	13.708	3.7588	.7673	12.121	15.296	6.0	21.0	
	3.0		20	14.150	4.3076	.9632	12.134	16.166	4.0	21.0	
	4.0		20	13.500	4.3589	.9747	11.460	15.540	6.0	21.0	

	Total		83	13.458	4.0494	.4445	12.574	14.342	4.0	21.0	
	Model	Fixed Effects			4.0736	.4471	12.568	14.348			
		Random Effects				.4471[a]	12.035[a]	14.881[a]			-.2595
F-CH	1.0		19	11.526	2.4578	.5639	10.342	12.711	5.0	14.0	
	2.0		24	12.375	1.6369	.3341	11.684	13.066	9.0	14.0	
	3.0		20	12.750	1.2927	.2891	12.145	13.355	9.0	14.0	
	4.0		20	12.600	1.2732	.2847	12.004	13.196	11.0	14.0	
	Total		83	12.325	1.7468	.1917	11.944	12.707	5.0	14.0	
	Model	Fixed Effects			1.7170	.1885	11.950	12.700			
		Random Effects				.2644	11.484	13.167			.1363
FL-CON	1.0		19	13.947	3.4877	.8001	12.266	15.628	7.0	20.0	
	2.0		24	15.000	4.4526	.9089	13.120	16.880	4.0	21.0	
	3.0		20	14.850	3.9640	.8864	12.995	16.705	6.0	21.0	
	4.0		20	15.150	4.9127	1.0985	12.851	17.449	3.0	21.0	
	Total		83	14.759	4.2039	.4614	13.841	15.677	3.0	21.0	
	Model	Fixed Effects			4.2576	.4673	13.829	15.689			
		Random Effects				.4673[a]	13.272[a]	16.246[a]			-.6001
IM-Total	1.0		19	58.368	10.3559	2.3758	53.377	63.360	41.0	76.0	
	2.0		24	64.375	12.8700	2.6271	58.940	69.810	35.0	89.0	
	3.0		20	65.200	12.6141	2.8206	59.296	71.104	31.0	80.0	
	4.0		20	61.000	17.1126	3.8265	52.991	69.009	20.0	84.0	
	Total		83	62.386	13.4915	1.4809	59.440	65.331	20.0	89.0	
	Model	Fixed Effects			13.4669	1.4782	59.443	65.328			
		Random Effects				1.5511	57.449	67.322			.8755
Flow-Total	1.0		19	41.579	8.5265	1.9561	37.469	45.689	27.0	57.0	
	2.0		24	45.458	11.0019	2.2458	40.813	50.104	15.0	62.0	
	3.0		20	44.950	11.4178	2.5531	39.606	50.294	13.0	58.0	
	4.0		20	43.800	12.4207	2.7774	37.987	49.613	20.0	63.0	
	Total		83	44.048	10.8660	1.1927	41.676	46.421	13.0	63.0	
	Model	Fixed Effects			10.9664	1.2037	41.652	46.444			
		Random Effects				1.2037[a]	40.217[a]	47.879[a]			-2.8953
12	1.0		19	3.74	1.408	.323	3.06	4.42	2	6	
	2.0		24	4.83	1.129	.231	4.36	5.31	2	7	
	3.0		20	5.00	1.338	.299	4.37	5.63	1	7	
	4.0		20	4.90	1.683	.376	4.11	5.69	1	7	
	Total		83	4.64	1.453	.160	4.32	4.96	1	7	
	Model	Fixed Effects			1.391	.153	4.33	4.94			
		Random Effects				.287	3.73	5.55			.234
score	1.0		19	288.158	39.5534	9.0742	269.094	307.222	195.0	365.0	
	2.0		24	303.125	39.4476	8.0522	286.468	319.782	215.0	390.0	
	3.0		20	324.250	40.8229	9.1283	305.144	343.356	275.0	455.0	
	4.0		20	276.250	36.6662	8.1988	259.090	293.410	185.0	340.0	
	Total		83	298.313	42.3205	4.6453	289.072	307.554	185.0	455.0	
	Model	Fixed Effects			39.1619	4.2986	289.757	306.869			
		Random Effects				10.2081	265.827	330.800			339.9946
BM	1.0		19	1.053	.2294	.0526	.942	1.163	1.0	2.0	

	2.0		24	1.208	.4149	.0847	1.033	1.384	1.0	2.0	
	3.0		20	1.100	.3078	.0688	.956	1.244	1.0	2.0	
	4.0		20	1.050	.2236	.0500	.945	1.155	1.0	2.0	
	Total		83	1.108	.3128	.0343	1.040	1.177	1.0	2.0	
	Model	Fixed Effects			.3113	.0342	1.040	1.176			
		Random Effects				.0385	.986	1.231			.0013

a. Warning: Between-component variance is negative. It was replaced by 0.0 in computing this random effects measure.

Appendix H: Ethical clearance



ns.ac.za/WebPortal/Main.asp?Mode=MyHS&System=HS&NewPortal=1

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Testing the effects of gamification elements on performance quality and the flow construct for crowdsourced perceptual tasks.

Taryn T Steyn - Gordon Institute of Business Science

Protocol Temp2015-01439

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Submissions (4)
Communications (2)

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Submissions   Add New

Type	Investigator Submitted On Date	Status	Approved From	Approved To	Review Date	Open	Delete
Initial Application		Resubmission Required					
Response to Modifications	25-Jul-2015	Resubmission Required					
Response to Modifications	27-Jul-2015	Conditional Approval	03-Aug-2015				
Response To Conditional Approval	04-Aug-2015	Approved	14-Aug-2015				

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