# The difference in intrinsic motivation when completing a prioritization task in a standard and gamified interface

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**Abstract.** An early emphasis on time-management can help institutions to reduce student stress and aid in student retention. However, time-management is not a motivating task for students. One option to increase motivation is gamification, defined as the "*application of gaming metaphor to real life tasks to influence behavior, improve motivation and enhance engagement*"

A gamified time-management app has been designed with the intention of promoting effective time-management. The application aims to aid students in structuring their time, prioritizing important tasks, improving time-estimates, breaking up complex tasks and maintaining a structured routine. To increase intrinsic motivation, we are using a companion that incorporates the gamified elements of positive and negative reinforcement, progress, and. A pilot study was run using a scaled down companion focusing on one aspect of time-management: prioritization. Our research question was

*"What is the difference in intrinsic motivation when completing a prioritisation task in a gamified interface compared to a standard interface?"*

From the results of this study, participants intrinsic motivation was found to be significantly greater when using the gamified interface compared to the standard interface.

**Keywords:** Gamification, Intrinsic Motivation, Time-Management, Companion

## 1 Introduction

### 1.1 Time-management

At the beginning of the academic year, tertiary institutions may encourage new students to spend their initial time setting out a study plan [1]. However, while students enter college with the expectation that they will effectively manage their time, other academic pressures interfere and can deter them from investing their time into long-term planning [2].

Students rely on effective time-management when self-estimating study times, sufficiently planning for tests and deadlines, and learning how to set priorities [3], [4]. An ineffective use of time can lead to increased stress, low quality rushed work, missed deadlines and task avoidance [5]. An early emphasis on time-management by

institutions can reduce students' stress and aid in student retention, however these efforts can be hindered by a student's lack of motivation in managing their own time.

### 1.2 Motivation

Motivation describes the wants or needs that direct behavior towards a goal [6]. It is the need to behave or act in a way that will satisfy certain conditions, such as wishes, desires, or goals [7].

Extrinsic and intrinsic motivation are regarded as the external and internal reasons people have for completing an action [8]. For extrinsic motivation it is not the action or behavior that matters but the outcome, people that are extrinsically motivated seek out external tangible rewards [9]. Intrinsic motivation however is driven by the enjoyment of the activity itself, intrinsically motivated people seek internal rewards including happiness, sense of completion and personal achievement [9].

Time management however is not regarded as a motivating task, and students can be unwilling to invest their time into managing their time, a task they perceive as mundane, even if it benefits their long-term goals, [10]. To address this problem and make time-management more motivating we are investigating gamification, the use of game elements in non-game contexts [11].

### 1.3 Gamification

Games are by their nature engaging, and gamification the use of game elements in non-game contexts aims to capitalise on this engagement [11].

The last few years has seen educators utilising these elements and mechanics to aid students in their progression in areas such as studying, organization and teambuilding, by utilising game mechanics such as points, avatars, positive and negative reinforcement, challenge, leaderboards, onboarding, and feedback loops to motivate students [14], [15]. When done correctly, gamification can promote positive behaviour, increase cognition in learning and create a stronger connection between students and their education [13].

The implementation of gamification into a system can aid students in completing mundane tasks that are of benefit to them, tasks such as time-management [12]. Gamification is particularly suited to help in the area of time management in education as there is a noticeable delay between starting a task and receiving a reward for completing the task, which can reduce a student's motivation to start and complete the task [10]. Gamification can increase motivation for longer tasks by dividing the process into smaller pieces, providing a greater volume and frequency of positive reinforcements [15]. Students who receive constant positive feedback during the course of a project are less likely to procrastinate, as there is no delay in the reward [10].

When adding game elements into a time-management system intrinsic motivation must be taken into consideration, as it is necessary to include game mechanics that are intrinsically motivating to insure the continued use of the system and to improve the effort and quality users put into a task [23]. However the majority of current gamification systems rely on extrinsic game elements such as points and badges [12]. While

students' can be extrinsically motivated with the inclusion of these game elements [19], the overuse of extrinsic rewards can also negatively affect intrinsic motivation causing the over justification effect [20], which causes a decrease in intrinsic motivation as the user comes to expect an extrinsic reward and will lose motivation when none is offered [21]. While extrinsic rewards are effective in the short-term, over a long period they can negatively affect motivation to continue with an activity as the user will no longer continue without the expected reward [22]. In an area such as time-management that requires a long-term commitment, external rewards can thus prove to be detrimental [20].

Hamari et al [16] suggests that gamification can have a positive effect on intrinsic needs satisfaction, as long as educators consider the use of appropriate game mechanics for improving students' autonomy competency and relatedness [17]. By improving a student's self-determination educators can aid with time-management issues such as procrastination by making the task more intrinsically motivating [18].

For these reasons we are focusing on satisfying students' intrinsic needs by using intrinsically motivating game elements, in particular we are looking at the game element of adaptive companions.

### 1.4 Adaptive Companions

Companions are found in many role-playing games including Fallout [27] and Dragon-Age [25]. They are most often represented as animated non-playable characters (NPCs) that join and assist the player on their journey. Companions provide the player with help, feedback, narrative and quests. These companions adapt to the player, changing their behaviour based on the players actions or responses [26], providing the player with in-game gifts or information about themselves or becoming belligerent and chastising the player when they act in ways they don't approve.

Companions in most current gamified apps are primarily mascots, providing tutorials and hint tips, such as the owl in Duolingo [27]. While these companions provide basic feedback, there is little to no direct interaction between the player and the companion. To be intrinsically motivating there is a need for more personalized recognition and support in the given feedback [28]. As such adaptive companions are most suited in increasing immersion, with the companion reacting to the user and providing more personalized feedback [26].

However there is currently very little use of adaptive companions in gamified systems. We hypothesise the inclusion of an adaptive companion in a time-management system can aid in on-boarding while giving the user positive reinforcement and personalized feedback, providing them with recognition and support for goals met, thus increasing their intrinsic motivation while utilising the system.

## 2 Design Research

For the design section of this study User Centered Design (UCD) was used. This design process consists of five stages Empathy, Define, Ideate, Prototype and Test [29]. For the Empathy stage a self-report online survey was created to inform which features the proposed application would have and to identify concerns students may have regarding time-management, this was followed by a series of ten-minute intercept interviews.

51 students participated in the online questionnaire. In general respondents felt they needed better time-management with 68% of respondents answered, "I would like to manage my time more effectively". Time estimation was a problem for many respondents with only 30% feeling confident in their time estimates and 44% felt they could not estimate a task well if they had not completed it before. None of the respondents felt confident in breaking complex tasks down into achievable chunks.

Respondents used few tools to help in structuring their time. Over 58% of respondents had never used a study planner before with 31% never considering using one before now (Fig 1). A similar study by the University of Southampton found 29.9% of students used no time-management tools at all.

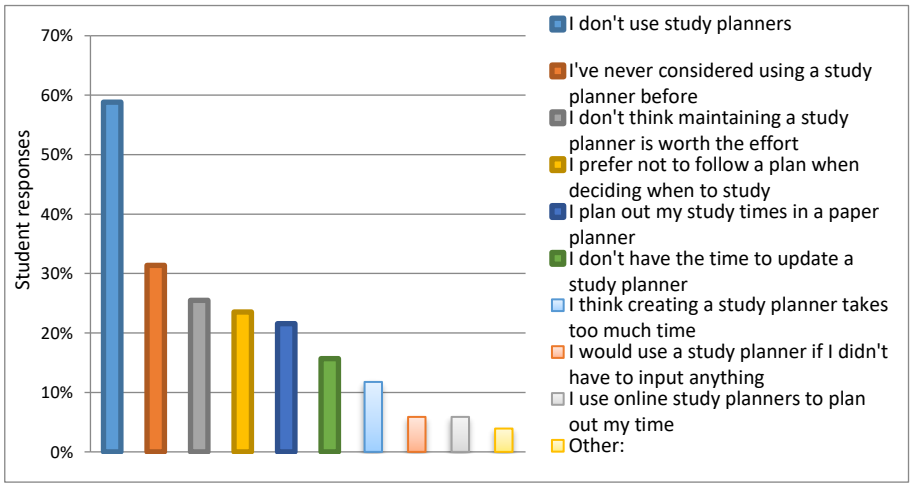


**Fig. 1.** Students attitude towards study planners.

From this a problem statement was defined.

> *"students find it difficult to estimate the time a task will take, and it can be very difficult to gauge the time a new task will take, lecturer estimates are not always accurate, and planning and setting priorities can be affected by fluctuating time-estimates and project deadlines. An uncertain and inefficient use of time by both students and lecturers can affect a student's health and engagement with their course".*

Once the problem was defined various solutions and features were considered during Ideation, including features suggested by the students during the empathizing stage. From Ideation, a study planner was deemed the most suitable tool in aiding students with their time-management and an initial prototype design was created. The aim of the prototype was to aid students in setting priorities, estimating time, managing tasks and increasing their understanding of how time-management can aid them.

## 2.1 MORT

To encourage users to continuously use the prototype we looked at incorporating gamification, to make the prototype more intrinsically motivating we designed MORT (Manager of Relocating Time) an adaptive companion who embodies the game mechanics of positive and negative reinforcement, on-boarding, and progress in the guise of an animated cartoon reaper.

*Positive and negative reinforcement;* reinforcement can promote behavioral change through rewards and warnings [30]. In gamification the use of immediate feedback in the form of both positive and negative reinforcement can help increase intrinsic motivation [14]. MORT provides positive reinforcement by encouraging users to complete a task and reassuring them if they are stressed (Fig 2.c) and gives negative reinforcement when addressing negative behaviors such as procrastinating.

*Onboarding;* the process of orienting new users to a system [31], and the management of complexity through scaffolding. Onboarding is extremely important, as initial confusion can lead to the abandonment of a system. MORT can help on-board and guide the user on how to use the system and what they need to complete their goals, through dialogue (Fig 2.a).

*Progress;* the visual representation of a user's journey. Students' who can visibly see their progress have a stronger perceived control of time and complete a greater percentage of work assigned to them [32]. Through dialogue with the user MORT can notify users of upcoming deadlines, help assign study hours and suggest time-estimates, and provide immediate feedback for the user on their progress. Progress can also be shown visually through progress bars (Fig 2.b, Fig 2.c).

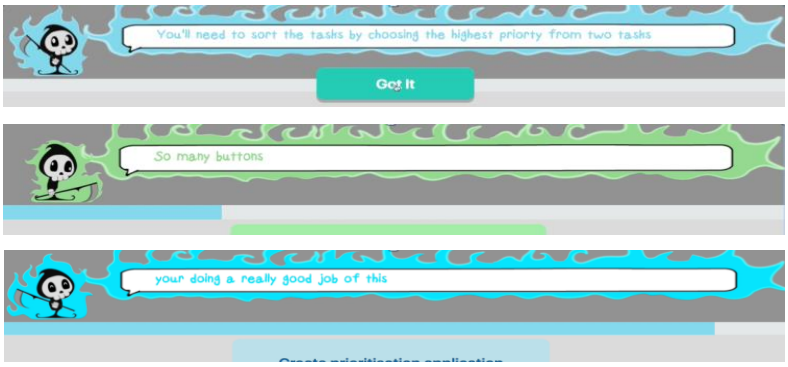


**Fig. 2.** MORT changes dialogue and animations as the user continues on.

## 3 Study

To test the use of MORT on a smaller scale we ran a pilot study focusing on just one aspect of time-management, prioritization.

### 3.1 Design

The study saw the creation of a prioritisation website, containing two different interfaces for the same prioritisation task, a standard interface and a gamified interface.

The standard interface contained a draggable priority list commonly used in to-do lists apps such as Trello [33] where users sort their tasks by dragging elements up and down a list as shown in Fig. 3, this design was based on current prioritization apps, Google tasks and todoist [34], [35].

The game mechanics for the gamified interface included animated tournament style priority sorting (Fig 3) and a simplified version of the interactive companion MORT, who reacts with different responses and animations (Fig 2).

For the elimination rounds, two tasks were presented and the user selected the task with the higher priority (Fig. 3), each selection was followed by a quick animated transition. Users continued to select from the next pair of tasks until all tasks were sorted through pairwise comparsion.


**Fig. 3**. In the standard interface users were asked to prioritize a standard list though drag and drop. In the gamified interface users selected one of two tasks too prioritise. This was followed by a quick transition animation after selecting a task

The simplified version of MORT was not adaptive due to the short build time. He is presented as an animated reaper and helped to on-board the user, responded to user input and encouraged the users to proceed throughout the task through different animations and dialogue (Fig 2). The gamifed interface also encouraged exploration with various Easter eggs (clicking directly on MORT will receive a response, waiting too long will result in an impatient MORT).

### 3.2 Research Question

To measure how gamification affects intrinsic motivation in time-management, we are looking on one aspect of time-management, prioritisation, and the difference in intrinsic motivation when prioritising using a standard interface and when using a gamified interface containing tournament style selection and an animated companion. To measure motivation we are looking at overall intrinsic motivation using the IMI [8] and also the individual subscales of enjoyment, effort and value.

In this study we are looking to answer the question *"What is the difference in intrinsic motivation when completing a prioritisation task in a gamified interface compared to a standard interface?"*

Through the study we aimed to gather evidence to determine if the following hypotheses were supported

*H1. Particpants experience a higher level of intrinsic motivation when prioritising with a gamified interface compared to a standard interface*

*H2. Particpants experience a higher level of enjoyment when prioritising with a gamified interface compared to a standard interface*

*H3. Particpants experience a higher level of effort when prioritising with a gamified interface compared to a standard interface*

*H4. Particpants experience a higher level of value when prioritising with a gamified interface compared to a standard interface*

### 3.3 Methodology

Volunteers were recruited through a mass email with a link to the online system, 28 participants responded. At the start of the system participants were prompted to enter seven tasks they needed to complete that day. Participants were then asked to prioritise their seven tasks using the two different interfaces. The study utilised a within-subject design with counterbalancing to control order effects, with (N=14) of participants using the standard interface first (Group A) and (N=14) using the gamified interface first (Group B).

Following the completion of each interface, participants filled out a 7 point Likert scale questionnaire on their intrinsic motivation while using the interface. The questionnaire contained items from the subscales of Value/Usefulness, Effort/Importance, and Interest/Enjoyment from the Intrinsic Motivation Inventory (IMI) [8].

### 3.4 Results

Using a one-tailed paired t-test, we measured the sub-scales of Value/Usefulness, Effort/Importance, and Interest/Enjoyment from the IMI. One-tailed was selected as we were only interested in seeing if the gamification elements increased intrinsic motivation.

We found there was a significantly greater level in the participants intrinsic motivation when using the gamified interface compared to the standard interface ( $t(27) = 2$ , $p=0.03$, $p < .05$) (Table 1), with the mean score for the gamified interface (M=4.45)

higher than the standard interface (M=4.02) (Fig 5, Table 1) This was mainly due to a higher level of enjoyment ( t(27) = 2.52, $p$=0.01, p<0.05), while using the gamified interface compared to the standard interface (Table 1). However, there was no significant statistical difference in the sub-scales of Value (t(27) = 1.5, $p$=0.07) and Effort (t(26) = 0.08 , $p$=0.47).

**Table 1.** Mean, standard deviation, and median and p-value for standard (S) and gamified (G) interfaces

| | MEAN | | SD | | MEDIAN | | P-VALUE |
|---|---|---|---|---|---|---|---|
| | **S** | **G** | **S** | **G** | **S** | **G** | |
| Intinsic Motivation | 4.02 | 4.45 | 1.09 | 0.94 | 4.08 | 4.46 | 0.03[a] |
| Value/Usefulness | 4.31 | 4.69 | 1.33 | 1.20 | 4.40 | 4.50 | 0.07 |
| Effort/Importance | 3.80 | 3.82 | 1.27 | 1.22 | 3.83 | 4.00 | 0.47 |
| Interest/Enjoyment | 3.88 | 4.60 | 1.26 | 0.99 | 4.00 | 4.70 | 0.01[a] |

[a.] p-value < 0.05.

[b.]

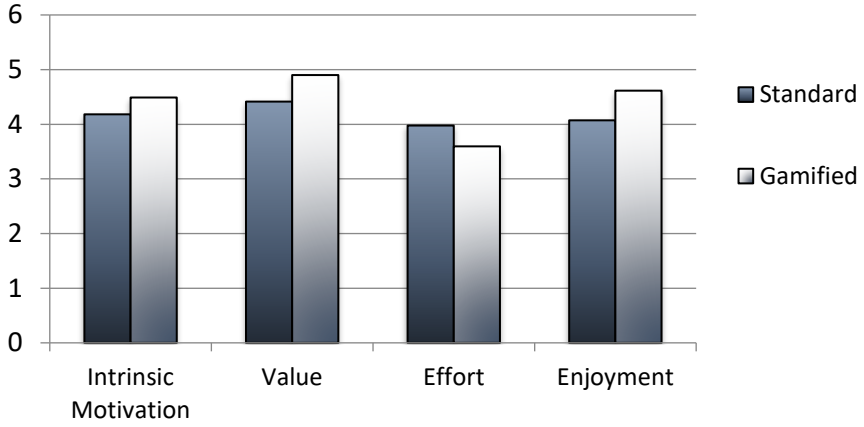


**Fig. 5.** The difference in the mean from the IMI responses for the standard and gamified interfaces

The Shapiro-Wilk test of normality distribution was used to verify the distribution of the data. However. as the sample size was less than 30 (N=28) a one-tailed Wilcoxon signed-rank test was also used to analyse the results; intrinsic motivation (z=-2.06, p=.019) and enjoyment (z=-2.578, p=.005) were significant at the 0.05 level.

### 3.5 Discussion

From the study there was a statistically greater level in intrinsic motivation and in the Interest/Enjoyment subscale for the gamified interface compared to the standard interface. Thus, some support for hypothesis H1 and H2 was attained. There was no significant difference for the subscales of Effort/Importance and Value/Usefulness, meaning support was not gathered for hypothesis H3 and H4. From the results of this study we can gather that the inclusion of an animated companion and tournament style in the gamified interface led to more enjoyment and overall intrinsic motivation while completing a prioritization task compared to a standard interface, without any significant change to value or effort.

The study however had some limitations. The sample size was small due to a low response rate. The study was also very short lasting roughly 15 minutes per participant, use over a longer duration may result in users re-prioritising and a change in motivation over time. The shorter duration may have also contributed to the low score in effort as the task required very little effort on the participant. Users also provided their only own tasks to prioritise, which could have potentially affected Effort/Importance, Value/Usefulness as they could enter inauthentic tasks.

Ordering may have also affected results, the group that used the standard interface first, Group A (N=14) saw a far greater difference in intrinsic motivation ($t(13)=2.7$, $p=0.01$) than group B who used the gamified interface first (N=14) ($t(13)=0.8$, $p=0.24$). This may be due to the gamified interface taking an average of 20 seconds longer to complete than the standard interface. One of the participants from group B said they felt the standard interface was much quicker to complete, after having used the gamified first.

Users were also asked in the questionnaire to estimate themselves how long they thought each task took them to complete (Fig 6). Participants estimated on average that the gamified task took 2 seconds more than it did and the standard task took them 8 seconds less than it did. Participants from group B however, estimated the standard interface took 17 seconds less than it did while group A thought it took 3 seconds longer, both groups were fairly accurate with their estimation of the gamified interface. The difference in how they groups perceived the task length was affected by whether they had the gamified interface first.

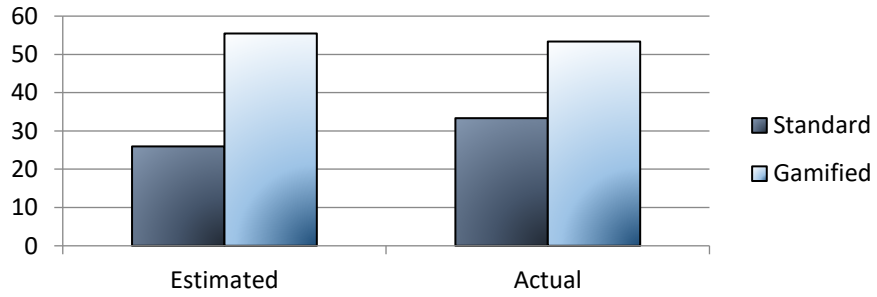


**Fig. 6.** The difference in estimated and actual times for completing the standard and gamified interfaces

## 4 Conclusion and future work

In this study we investigated the difference in intrinsic motivation when completing a prioritisation task in a gamified interface compared to a standard interface. To this end we created two interfaces for prioritising tasks, a standard interface containing a sortable to-do list and a gamified interface containing a single-elimination tournament selection and an animated companion. We asked participants to prioritise a set of tasks in both the standard and gamified interfaces and measured their intrinsic motivation, with the subscales of Interest/Enjoyment, Effort/Importance, and Value/Usefulness. From the results of this study there is some evidence to suggest that a gamified interface can positively affect intrinsic motivation particularly in Interest/Enjoyment. The response to the animated companion MORT was mainly positive, with participants liking his design, particularly younger participants. The single-elimination tournament questions however had a less positive effect on the participant's perception of time than the standard sorting and may not be suitable in a gamified interface for time-management.

This study was limited in size and length and for future work we hope to conduct a larger study utilising just one of the gamification elements used in this study, the companion MORT over a longer duration. We will also be looking at enhancing MORT by including more adaptive features to see if we can garner a larger difference in intrinsic motivation.

For our follow up study we are looking to answer the question *"To what degree does the inclusion of an adaptive companion affect intrinsic motivation when creating and maintaining a study plan."* We are looking at using MORT to increase intrinsic motivation for other aspects of time-management, including setting time estimates, procrastination and structuring time. It is hoped that through the use of MORT we will aid students in taking a more personal role in their time-management, help reduce stress and improve performance. From the results of this study we aim to fill the current gap of gamified time-management in academic literature and increase understanding of the effects of gamification in promoting effective time-management.

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