

**Levelling up Learning: Exploring the Effectiveness of Gamification Elements on Learning and Motivation**

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### **Abstract**

Digital learning platforms like Duolingo, Babbel, Mimo, and many others received increasing attention from the public during the last decade. A key concept they all use is called gamification. Literature shows that the use of gamification elements can enhance learning performance and motivation when applied correctly. Thus, this research deals with the effectiveness of specific gamification elements on the learning performance and motivation of participants. To test that, the participants were divided into two groups. In total, the data from 36 participants was used. One group had to do a language learning task in a gamified learning environment and the other one used a learning environment with almost no gamification elements. Moreover, intrinsic motivation was tested before and after the learning task. It was hypothesized that the group with the gamification elements will experience higher test scores and increased motivation. Moreover, it was tested whether motivation has a moderating effect on the effect of the gamification elements. After data collection and analysis, it came to light that the results show no indication that the hypotheses can be confirmed. Thus, it can be said that in this particular case, the use of gamification elements has no significant effect on learning performance and motivation. In conclusion, it can be said that this research can provide a broad overview of the topic with different implications for future research.

## Introduction

Acquiring new skills, knowledge, or competencies is a complex process that involves many different factors such as motivation, environment, and feedback. Experts and scientists from diverse fields have explored the topic of learning for many years, with research spanning a range of disciplines including psychology, education, neuroscience, and others. One field that has received raising attention in the last decade is the domain of game-based learning (GBL). Game-based learning describes an educational approach that utilizes different game design principles and mechanics to improve the learning process of individuals. Game-based learning takes place most of the time with the assistance of video games or simulations. One method that is similar to game-based learning is gamification. Gamification describes the use of game elements in non-gaming environments intending to achieve a better user experience (Nand et al., 2019). Hence, GBL and gamification are not the same. While GBL describes the whole field of learning by focusing on video games or simulations as primary teaching tools, gamification is only the application of game elements outside of a pure game scenario. In this study, the use of gamification elements in existing learning environments will be examined.

The rapid rise of e-learning platforms in higher educational institutions in response to the COVID-19 pandemic has further accelerated the trend of digital learning environments. It is to mention, that the use of digital learning platforms leads to higher dropout and lower completion rates among students (Khaldi et al., 2023). This is a consequence of the low motivation and engagement of the students, combined with a missing feeling of obligation to finish the tasks because of reduced social pressure. Gamification can be used to solve this problem and enhance the engagement and motivation of students (Khaldi et al.,2023; Thomas & Baral, 2023). To achieve this, it is important to identify gamification elements that are most

effective in a certain context. This research aims to investigate the effects of gamification elements on the learning process and motivation of students.

### **Gamification Taxonomy**

According to Toda et al., (2019), gamification elements can be classified into five different categories: *performance, ecological, social, personal, and fictional*. The *Performance* category is related to providing feedback to learners on their progress and performance in a digital environment. The elements in this dimension are Progression, Point, Level, Stats, and Acknowledgement. Point is the most basic element, and it can be found in most applications it provides extrinsic feedback to users' actions by giving scores, experience- or skill points. Progression relates to elements such as progression bars or steps in order to provide information about how advanced the user is, while level is an extrinsic hierarchical layer that provides the user new advantages as they advance. Stats are the visual information provided by the environment to the learner (extrinsic), and acknowledgment is a kind of extrinsic feedback that rewards the players for specific actions by giving them e.g. badges, medals, trophies, and achievements.

The *Ecological* category relates to the environment where gamification is being implemented. The elements in this dimension are Chance, Imposed Choice, Economy, Rarity, and Time Pressure. Chance describes the random property of a certain event or outcome, while Imposed Choice occurs when the player faces an explicit decision that they must make to progress within the environment. An economy involves any transaction that takes place within the environment, and Rarity is linked to the scarcity of resources, which leads to the motivation of learners to achieve a specific goal. Lastly, Time Pressure is related to the use of time elements like countdowns to motivate learners to finish a specific task. Nevertheless,

this element can be perceived as one of the least important ones, because it can lead to disengagement of the learner.

The *Social* dimension of gamification deals with the interaction between users within an environment. The elements in this dimension are Competition, Cooperation, Reputation, and Social Pressure. Competition is an intrinsic concept that involves challenging other users to achieve a common goal, which is often displayed in leaderboards or scoreboards. Cooperation is an intrinsic concept that requires users to work together on a shared goal and Reputation is related to the accumulation of titles or achievements within the environment and it serves as an intrinsic motivator. Lastly, Social Pressure is related to the effect of social relations on the player. Nevertheless, the effect of social pressure is neglectable in most situations.

The Personal dimension of gamification focuses on the individual and on five intrinsic elements that contribute to their experience. The first element Novelty involves regular updates with the aim to prevent boredom and disengagement. Objectives provide learners intending to work on and give them a purpose to continue. Puzzles or cognitive tasks challenge the learner and promote learning. Challenging the learner is important to prevent boredom. Renovation provides learners with the opportunity to retry a task or event. In combination with a challenge, this is an element that makes a game fun. Lastly, Sensation refers to the use of visual or auditory stimulation, such as gameful interfaces, virtual reality, or augmented reality.

Fictional is the last dimension of gamification and it deals with the narrative and storytelling elements that connect the user to the environment. Narrative refers to the order of events and how they unfold based on the user's choices. Storytelling is the way the environment's story is conveyed, whether it be through text, voice, or sensory resources.

Without these fictional elements, the user experience may suffer from a lack of meaning and context which impacts the overall quality of the environment.

This taxonomy is important to identify the most important elements that can be implemented in an experiment to test the effectiveness of gamification in education. Another work by Toda et al. (2019b) deals with the relevance of each element in education. The results are based on a survey with experts in this domain. It shows that the most effective game elements are Objectives, Level, and Progression and the least effective ones are Choice, Renovation, and Social Pressure (Figure 1). Hence, these are elements that can be considered to be implemented in the experiment.

**Figure 1**

*Relevance of each Gamification Element*

Game element	Likert Scale					Mean	SD
	1	2	3	4	5		
Objectives	0%	0%	0%	23%	77%	4.77	0.44
Level	0%	0%	8%	31%	62%	4.54	0.66
Progression	0%	0%	15%	23%	62%	4.46	0.78
Acknowledgement	0%	0%	15%	62%	23%	4.08	0.86
Point	0%	8%	8%	54%	31%	4.08	0.64
Competition	0%	0%	23%	54%	23%	4.00	0.71
Novelty	0%	0%	15%	69%	15%	4.00	0.58
Data	0%	0%	31%	46%	23%	3.92	0.71
Puzzle	0%	8%	23%	38%	31%	3.92	0.95
Classification	0%	8%	8%	77%	8%	3.85	0.76
Scarcity	0%	8%	23%	46%	23%	3.85	0.9
Sensation	0%	15%	15%	38%	31%	3.85	1.07
Cooperation	0%	0%	31%	62%	8%	3.77	0.69
Time pressure	0%	8%	23%	54%	15%	3.77	0.6
Chance	0%	8%	31%	46%	15%	3.69	0.83
Economy	0%	0%	54%	31%	15%	3.62	0.85
Choice	0%	7%	50%	36%	7%	3.43	0.77
Renovation	8%	15%	15%	54%	8%	3.38	1.12
Social pressure	8%	15%	38%	38%	0%	3.08	0.95

## Gamification and Motivation

The literature indicates that one way how gamification elements can enhance learning performance is by increasing the motivation and engagement of the learner (Buckley & Doyle, 2016; Hamari et al., 2014). Consequently, it can be assumed that the effect of gamification on motivation can partly explain the general effect of gamification on learning. It is important to state the importance of motivation in learning environments in general. Literature suggests, that increased intrinsic and extrinsic motivation has a positive effect on

the educational performance and learning outcomes of students (Tokan & Imakualta, 2019; Arian, 2016). It can be also seen as a predictor of academic performance (Kusukar et al., 2013). Moreover, motivation is perceived as an enhancing factor in the process of skill acquisition and other cognitive abilities (Kanfer & Ackerman, 1989). A majority of gamification elements aim at least partly to increase the motivational level of the learner. Most literature found positive effects of gamification on motivation rather than a negative or no effect (Hamari et al., 2014).

To understand what effect gamification has on motivation, it is important to explore the effect of specific gamification elements on psychological need satisfaction. One theory that found application in research is the self-determination theory (STD). This theory was applied in the context of games, and it also considers the role of the environment (Sailer et al., 2017). The self-determination theory posits that three basic psychological needs drive intrinsic motivation: autonomy, competence, and relatedness (Deci & Ryan, 2012). Autonomy in this case refers to the need to have control over one's own life and decisions, to act in accordance with one's values, and to experience a sense of choice in one's actions. Competence refers to the need to feel effective and capable of achieving one's goals. Lastly, relatedness refers to the need to experience a sense of belonging to others and being understood and valued by significant others. According to the STD, when these three psychological needs are met, intrinsic motivation is promoted. Hence, people engage in an activity for its own sake. In contrast, when these needs are not met, individuals experience extrinsic motivation, which means that they engage in an activity because of pressure or external rewards. These psychological needs should be considered when selecting gamification elements. According to Sailer et al. (2017), the need for competence is met by points, leaderboards, badges, and performance graphs. Moreover, the need for autonomy includes the two aspects of the experience of decision freedom and the experience of task meaningfulness. The first one

(decision freedom) can be met by including the gamification element of choosing avatars because they offer players freedom of choice. The second one (task meaningfulness) can be fulfilled by creating stories that give the user the feeling that their actions and decisions are meaningful. Lastly, the need for social relatedness can be met by providing teammates to collaborate with and providing a shared goal which can also be told within a meaningful story. The needs, connected with the gamification elements and their underlying mechanisms can be found in Table 1 (Sailer et al. 2017). In this experiment, the main focus will be on meeting the need for competence because it can be appealed to more easily in a gamification environment with a focus on testing short-term learning effects.

**Table 1**

*Psychological Needs and Their Connected Gamification Elements*

<b>Psychological need</b>	<b>Game design element</b>
Need for competence	Points
	Performance graphs
	Badges
	Leaderboards
Need for autonomy (decision freedom)	Avatars
Need for autonomy (task meaningfulness)	Meaningful stories
Need for social relatedness	Teammates
	Meaningful stories

A literature review by Hamari et al. (2014) suggests that gamification elements can enhance the motivation of learners. Nevertheless, the effect is not universal and can depend on several variables such as the context and the target group. The underlying cause for the effect of gamification is still not clear. Some studies have suggested that the effect may be driven by a novelty effect, while other factors such as the participant group or content to be



learned can also influence the outcomes. Moreover, different gamification elements can have changing effects in non-identical contexts. For instance, leaderboards can enhance learners' motivation by providing social competition. However, the effect can change into being demotivating for some participants, when the participant finds themselves at the bottom of the leaderboard (Sailer et al., 2017). Therefore, it is important to consider variables like context and target group when designing gamification applications and interpreting the results of studies. By doing so, it can be ensured that the findings of the study can be applied more specifically and contribute to the development of effective gamification tools. The selection of gamification elements is context-dependent and should be done carefully with consideration of previous literature. Hence, this study is mainly focused on the following elements: levels, points, leader boards, objectives, and progression. They are selected because of their high effectiveness in previous studies (see Figure 1). It is to mention that these elements apply to the need for competence which could be an underlying mechanism that causes an effect.

## **Hypotheses**

Based on the theoretical framework, it is investigated whether the use of gamification elements in learning can lead to better results than a traditional learning approach. Moreover, the role of intrinsic motivation as an enhancing factor and as a moderator variable for the effectiveness of gamification will be assessed. Hence, the following hypotheses will be tested in the experiment:

H1: Participants that used a digital learning environment containing gamification elements such as points, leader board, levels, and objectives, will score higher in a learning assessment test compared to participants that used a digital learning environment with only limited gamification elements.

H2: Participants in the gamification group will report a higher change of intrinsic motivation from the pre- to the post-measurement, compared to the control group.

H3: The positive correlation between motivation and learning will be stronger in the gamification group than in the traditional learning group, indicating that intrinsic motivation may be a moderator variable that enhances the effect of using gamification elements on learning outcomes.

## Methods

### Participants

In total 36 individuals participated in the experiment and finished it with sufficient data. Over 60 participants were not included because they did not finish the survey and one person was excluded because of prior experience with the learning objective. The participants had a mean age of 23.22 (SD = 3.53). Moreover, 25 were male (70%) and 11 (30%) female. Lastly, 27 of the participants had German nationality (75%), 1 was Dutch (8%) and 7 were from elsewhere (19%), including Poland, Austria, Taiwan, Portugal, and Brazil. It can be observed that 23 participants (62%), did not use a digital learning platform before and 13 participants (35%) used it. One participant was not sure. Of the participants that used a digital learning platform before, 1 indicated that he uses it less than once a week, 8 indicated they use it once a week, and 4 used it daily.

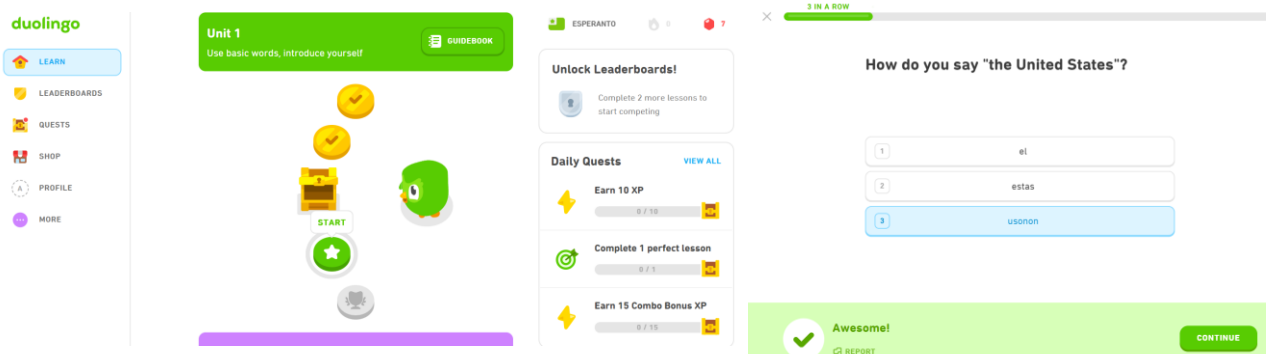
For this study, a convenience sample was used to select participants. Participants were recruited through various methods, including the University of Twente Sona platform, WhatsApp groups, and other online platforms. Interested participants above the age of 18 and without knowledge of Esperanto were invited to participate in the study. Given the study's nature, which aims to identify important gamification elements in virtual learning platforms accessible to a broad variety of individuals, the target population is not limited to a specific group or demographic. Due to the use of a convenience sample, results may be less representative of a deviating population. Furthermore, informed consent was obtained from every participant at the beginning of the study. Participants were also able to demand a complete deletion of their data.

### Materials

The experiment was performed on the online survey platform "Qualtrics". The survey was divided into different parts. The main part took place in Qualtrics. Participants received

informed consent in the beginning (Appendix 3). Moreover, their intrinsic motivation was tested by a set of questions from the Intrinsic Motivation Inventory (IMI). For this task, a set of eight questions from four different dimensions relevant to the research topic were used (namely: Interest/Enjoyment, Perceived Competence, Effort/Importance, and Value/Usefulness). These dimensions were chosen based on their connection to the gamification elements and learning tasks. The dimensions of Pressure, Perceived Choice, and Relatedness were excluded from the questionnaire because the context did not allow the measurement of these dimensions.

Participants were equally divided into two conditions by randomization. One Qualtrics survey was used for each condition. Both surveys were equal except for the instruction page for the online learning platform. In the middle of the survey participants received instructions to perform a set of tasks on an online learning platform. The first platform that was used is called Duolingo (Figure 2) and for the experiment, the *Duolingo for schools* version was used, (<https://schools.duolingo.com/>) which includes additional features that are useful for the experiment. Additional features include no advertisements for the participants, management of account data, creation of dummy accounts by the researcher, and insights into the study progress of the participants. Participants in the Duolingo condition received individual account log-in data before the experiment.

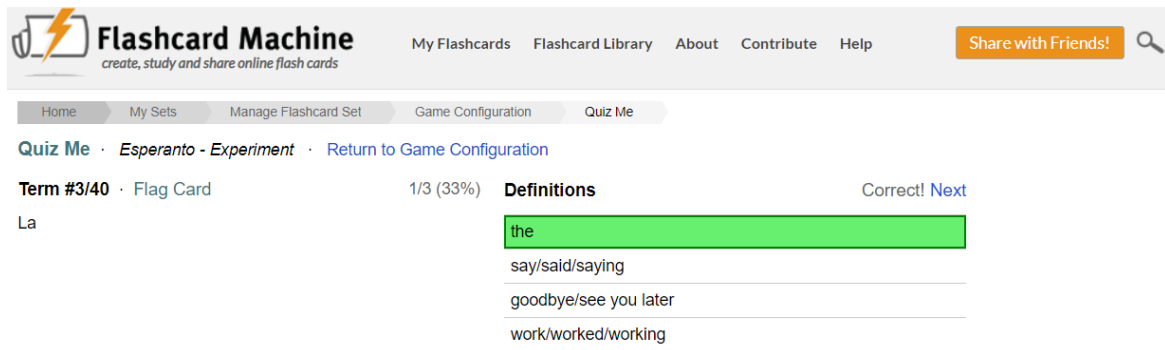
**Figure 2***Example Pictures of the Learning Environment “Duolingo”*

*Notes: The left picture shows the main menu of Duolingo. The user can access the lessons there. In addition to that, there is also access to other parts of the application like leaderboards, shop, and quests. The right picture shows an example of a task from the first unit.*

The second platform is called Flashcard Machine (FM). FM is a flashcard platform with different interactive functions such as the “Play a Game”. With this function, it is possible to study the flashcards by receiving multiple-choice questions with feedback (see Figure 3). Before the experiment, a set of flashcards was created which includes all 39 words that were used in the first two Duolingo lessons (See Appendix 2). This set was then imported into FM to use the same vocabulary for both conditions. Lastly, an assessment test was created in Qualtrics. This test included 15 words from the vocabulary list with multiple-choice options (See Appendix 3).

**Figure 3**

*Example Pictures of the Learning Environment “Flashcard Machine”*



*Notes: In the picture, you can see the Quiz Me mode which was also used for the experiment.*

There are multiple differences in the use of gamification elements between Duolingo and FM. While FM is primarily focusing on multiple-choice tasks with flashcards, it also makes use of the gamification elements points and progress. Contrary to that, Duolingo offers a whole environment with different gamification elements. The lessons are structured on a clear progression part (see Figure 2). Gamification elements like levels and progression are covered with that. Moreover, the user receives points and rewards like Lingots (in-game currency) when he finishes a lesson. In addition to that, there are several social elements like connecting to friends and competing on a leaderboard. Lastly, different learning techniques like listening tasks or speaking exercises are used within the lessons.

### **Procedure**

Firstly, the participants received an email or private message with instructions for the experiment. The condition which they are placed into is already determined by a randomization tool beforehand. Half of the participants received instructions with Duolingo account data, and the other half did not receive instructions regarding the online platform. Furthermore, participants received a link to the survey for the condition they were in. Until the page with the instructions for the online learning platform, both surveys did not differ from each other. The survey began with informed consent. Afterwards, participants received a

unique participant number which they could refer to when they want to demand an anonymous deletion of their data. Next, basic demographic data were retrieved from the participants, such as age, gender, and nationality. Furthermore, they were asked whether they already have experience with the language Esperanto (which was an exclusion criterion if they had) and whether they had prior experience with digital language learning platforms.

In the next part, participants had to answer 8 statements from the IMI on how much they agreed with them on a scale from 1-5. After they were done with the questionnaire the part with the different conditions started. In the first condition, participants received instructions and a link to a Duolingo classroom. They are instructed to finish the first two levels of the basic Esperanto program. The levels consist of four lectures each. In total 39 new vocabulary were learned here with the use of different methods such as multiple-choice questions and filling in the blank task. The duration of this task was approximately 20-25 minutes. When they were done, participants were instructed to go back to the original survey where they had to indicate that they are finished. In the other condition, people received similar instruction, but they were linked to a set of flashcards on FM. They were directed to a learning mode where they studied the same set of vocabulary as the Duolingo condition. The FM learning mode is similar to Duolingo but it did not make use of gamification elements. After they were finished with all vocabulary, participants came back to the original survey.

After the participants were done with the learning task, they received the same IMI questionnaire as they did earlier to test the change in their motivational level. Then, their knowledge of the learned vocabulary was assessed with a test in Qualtrics. The test consisted of 15 multiple-choice questions with random vocabulary from the list. Lastly, participants were debriefed by receiving information about the purpose of the study.

## Data Analysis

To analyse the collected data and test the hypothesis, the results of the study were imported into the statistical software R. Then they were analysed using descriptive and inferential statistical methods. Descriptive statistics particularly means, standard deviations, and frequencies were computed to give a general overview of the data and characteristics of the participants. In order to test the first hypothesis, an independent samples t-test was conducted to examine whether there are significant differences in the test scores between both groups. Moreover, Welch's two-sample t-test was conducted in order to test the second hypothesis. Welch's test was chosen because the assumption of equal variances could not be confirmed. The test was done to compare the changes in intrinsic motivation before and after the learning phase between the two groups. Lastly, a linear regression analysis was performed to test for a moderating effect of intrinsic motivation before the test on the relationship between groups and test scores. In order to test for the effect, a linear regression model with the following equation was created:

$$\text{Score} = \beta_0 + \beta_1(\text{Group}) + \beta_2(\text{IM\_before}) + \beta_3(\text{Group} * \text{IM\_before})$$



## Results

To begin with, for the descriptive statistics, the most important data of the main variables were analysed. Particularly, the means and standard deviations for the variables for each group were gathered (Table 2).

**Table 2**

*Descriptive Statistics of Main Variables*

	<i>n</i>	Test Scores	IM Pre	IM Post	IM Change
FM Group	19	12.26 (2.70)	3.23 (0.62)	3.40 (0.69)	0.16 (0.22)
Duolingo Group	18	12.35 (3.89)	3.13 (0.75)	3.16 (0.73)	0.02 (0.46)
Total	37	12.31 (2.75)	3.19 (0.67)	3.28 (0.67)	0.10 (0.36)

*Notes: The displayed numbers are the mean scores of the variables with their standard deviations in brackets. The scores for Intrinsic Motivation (IM) were measured on a scale from 1-5. 1 represents the lowest level of motivation and 5 represents the highest. FM (Flashcard Machine) Represents the control condition and Duo is the test group (Duolingo).*

For the first hypothesis, the differences in test scores between the control group ( $M = 12.26$ ,  $SD = 2.70$ ) and the gamification group ( $M = 12.35$ ,  $SD = 3.89$ ) were examined by using an independent samples t-test. No significant difference in test scores between the gamification and control group could be found,  $t(32.91) = -0.10$ ,  $p = .924$ ,  $CI [-1.99, 1.81]$ .

To test the second hypothesis a Welch's t-test was conducted to compare the change of measured intrinsic motivation between the groups. A new variable that represents the change in intrinsic motivation was created by subtracting the score of the pre-measurement from the post-measurement. The t-test showed the differences in the intrinsic motivation change scores of the gamification group ( $M = 0.88$ ,  $SD = 0.39$ ) and the control group ( $M = 0.16$ ,  $SD = 0.22$ ). According to the test statistics  $t(24.64) = 0.697$ ,  $p = .492$ , 95%  $CI [-0.14,$

0.30], the results are not significant because the p-value is higher than .05 and the confidence interval includes 0. Moreover, the t-test was also conducted with every dimension of intrinsic motivation. For the single dimensions, no significant difference in the mean scores between the groups could be found.

To test whether intrinsic motivation functions as a moderating variable in the relationship between groups and test scores (Hypothesis 3), the linear regression model was analysed and the results showed an intercept of 9.71, and slopes of 3.29 (Group), 0.78 (Intrinsic Motivation), and -1 (Group \* Intrinsic Motivation). It can be said that the model is not statistically significant according to the test statistics and p-value ( $F(3, 32) = 0.196$ ,  $p = .899$ ). This indicates that the predictors' *Group* and *Intrinsic Motivation Before* did not explain the variance in the test scores. In addition to that, the moderator effect of intrinsic motivation on the test score did not show a significant effect either. Moreover, every single dimension of intrinsic motivation was measured and none of the variables had a significant effect on the dependent variable *Score*. Lastly, the adjusted R Square is -0.073, which indicates that the model is not a good fit for the data.

## Discussion

The effect of gamification on learning performance and motivation in digital learning environments was investigated. To test for the effects, three hypotheses were stated. The first hypothesis deals with the group differences in the measured learning performance, while the second hypothesis investigates the effect of gamification on the change in intrinsic motivation toward learning. Lastly, the third hypothesis states that there is an interaction effect between intrinsic motivation and the use of gamification, which means that higher intrinsic motivation in combination with the use of gamification leads to the best learning outcomes in this case.

After investigating the results of the experiment, it came to light, that the outcomes provided no support for the hypotheses. No significant main effect of the variable *Group* on the test scores could be found, which means that the use of gamification elements did not lead to improved performance among participants in this study compared to the control group. The null hypothesis that there is no significant difference in test scores between the two groups, can not be rejected, since the p-value is greater than 5% and the confidence interval includes 0. Furthermore, no main effect of *Group* on intrinsic motivation could be proven significantly. Isolating the dimensions of intrinsic motivation showed no significant effect either. This indicates that there is no significant effect of gamification elements on intrinsic motivation in this setting. Lastly, the interaction effect of intrinsic motivation on the group did not show a significant slope in the linear regression model, which indicates that the relationship between the group and test score did not change based on the level of intrinsic motivation.

These results show that the use of gamification elements has no significant effect on learning performance and motivation in short-term language learning. Hence, there are other factors in this experiment that affect the performance of the participants significantly. Consequently, other instructional and environmental factors should be considered in addition to gamification to measure the effect on learning more accurately. Even though the results do not support any of the hypotheses, it does not mean that gamification can not affect learning at all. Especially, because other studies already suggested that there can be indeed an enhancing effect on performance and motivation when using gamification elements (Buckley & Doyle, 2016; Hamari et al., 2014).

Some studies found limited or mixed effects of gamification on learning performance and motivation (Sailer & Homner, 2020; Koivisto & Hamari, 2020). They argue that research on gamification is complicated and the effectiveness of it is factor dependent. Particularly the

choice of gamification elements and the correct implementation in the environment is crucial (Zainuddin et al., 2020). This should be kept in mind when interpreting the results of this study because the missing significance of the results may be a consequence of the study's limitations. Other studies have found improvement in learning performance and motivation when gamification elements were implemented in learning environments which is contrary to the results of this study. Zainuddin et al. (2020) review different studies that deal with the effect of gamification on learning, instruction, and motivation. The main findings include positive effects on learning motivation through competition and challenge, increased intrinsic motivation, increased learning engagement, and positive effects regarding behaviour, emotion, and cognition. Even though the literature is mixed on this topic, the majority suggests the positive effects of gamification elements. Differences in the findings may be caused by different instructional approaches, learning settings, selection of elements, and target groups.

Several limitations of this study should be mentioned. Firstly, the execution of the experimental design might have caused inaccuracies in the measurement of the constructs. Particularly the measurement of performance was a single outcome measure that does not consider other indicators of learning. Furthermore, the experiment only measured the very short-term effect of these elements. Participants had only 20-30 minutes to study and there were only 39 vocabularies. This could be an explanation for the varying results of other experiments that concentrated on long-term effects. Hence it might be probably the effect of gamification on learning and motivation is only measurable in long-term experiments. In this experiment, other factors than the implementation of gamification elements had a stronger impact on individual performance and motivation. In addition to that, the assessment test included only 15 elements and participants had very high average scores, with only a small standard deviation. This makes it particularly hard to measure differences among the

participants. Furthermore, other studies may also have deviating results because the learning topic differs from vocabulary learning. It might be that learning vocabulary has different interactions with gamification elements than other learning topics. Lastly, the potential presence of the attrition bias might have affected the results since the experiment had a very high dropout rate (60%). The decision to not finish the study might have been caused by a lack of motivation. Hence, it is possible that the general level of intrinsic motivation among the people that finished the study was higher than the general level of intrinsic motivation among the whole population. Moreover, the remaining participants might also be more interested in language learning or digital learning environments, which could be an alternative explanation for the high test scores.

Future research should put more emphasis on long-term experiments with more-dimensional measurements for performance such as accuracy, time, and different tests. Furthermore, motivation might be more affected in long-term studies than in very short-term studies. There was only little change in intrinsic motivation during the study, hence conducting a study with a measurement over multiple days or even weeks, could show a higher change of motivation. In addition to that, different environments that use a variation of gamification elements to enhance learning performance could be implemented to test for the effect of specific elements or combinations of elements. Some elements could be tested isolated as well. Lastly, focusing on specific groups of learners such as adolescents or children in school settings, and testing the impact of gamification elements on them could bring more concise results for this target population.

Overall, the research already gives good insight into the different facets of gamification and motivation. The insignificance of the findings shows that it is important to consider different factors that can affect the measured variables. This means that the variables are vulnerable to design errors and hence, should be measured very accurately. These insights

should be considered in future research on this topic. This study shows that there is no measurable short-term effect of gamification elements on learning performance and intrinsic motivation.

To conclude, it can be said that the use of gamification elements is considered a useful contribution to learning environments by different researchers. Moreover, the rise of gamified digital environments shows that there is vast interest in this field of research, and it will be an important topic in the future as well. Even though the tested hypotheses were not supported by the found data, important implications for future research could be found. Additionally, it could be observed that the implementation of gamification elements is not a universal tool that can be used in every situation but should be carefully adapted to the context.

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## Appendix

### Appendix 1

#### *R*Codes

```
library(dplyr)
```

```
library(tidyverse)
```

```
library(haven)
```

```
library(tidyverse)
```

```
library(foreign)
```

```
library(janitor)
```

```
library(CTT)
```

```
library(mirt)
```

```
library(psych)
```

```
library(dplyr)
```

```
library(car)
```

```
library(broom)
```

```
library(readxl)
```

```
DataCombined <- read_excel("C:/Users/Alex/OneDrive - Universiteit Twente/DataCombined.xlsx")
```

```
View(DataCombined)
```

```
#Descriptive statistics#
```

```
DataCombined %>% select(1:19) %>% summary()
```

```
DataCombined %>% tabyl(Nationality)
```

```
DataCombined %>% tabyl(Gender)
```

```
DataCombined %>% tabyl(platform_use)
```

```
DataCombined %>% tabyl(platform_use_frequency)
```

```
Descriptive <- DataCombined %>%
```

```
  data.frame(
```

```
    score = DataCombined$Score,
```

```
    age = DataCombined$Age,
```

```
    Gender = DataCombined$Gender,
```

```
    intrinsic_motivation_before = DataCombined$IM_pre,
```

```

Intrinsic_motivation_after = DataCombined$IM_Post)

desc_stats <- describe(Descriptive)

print(desc_stats)

#Means and SD of variables by Group#
mean_group0 = mean(DataCombined$Score[DataCombined$Group == 0])
mean_group1 = mean(DataCombined$Score[DataCombined$Group == 1])

sd_group0 <- sd(DataCombined$Score[DataCombined$Group == 0])
sd_group1 <- sd(DataCombined$Score[DataCombined$Group == 1])

mean_group0 = mean(DataCombined$IM_pre[DataCombined$Group == 0])
mean_group1 = mean(DataCombined$IM_pre[DataCombined$Group == 1])

sd_group0 <- sd(DataCombined$IM_pre[DataCombined$Group == 0])
sd_group1 <- sd(DataCombined$IM_pre[DataCombined$Group == 1])

mean_group0 = mean(DataCombined$IM_Post[DataCombined$Group == 0])
mean_group1 = mean(DataCombined$IM_Post[DataCombined$Group == 1])

sd_group0 <- sd(DataCombined$IM_Post[DataCombined$Group == 0])
sd_group1 <- sd(DataCombined$IM_Post[DataCombined$Group == 1])

#First Hypothesis - T-test#
DataCombined %>%
  t.test(formula = Score ~ Group)

t.test(DataCombined$Score ~ DataCombined$Group, data = DataCombined)

#Second Hypothesis: T-Test with Change variable##

##Create new Variable for change of IM##
DataCombined$IM_change <- DataCombined$IM_Post - DataCombined$IM_pre

```

```
DataCombined$Interest_Change <- DataCombined$Interest_post - DataCombined$Interest_pre
```

```
DataCombined$Effort_change <- DataCombined$Effort_post - DataCombined$Effort_pre
```

```
DataCombined$Competence_change <- DataCombined$Competence_post - DataCombined$Competence_Pre
```

```
DataCombined$Value_change <- DataCombined$Value_post - DataCombined$Value_Pre
```

```
##T-test##
```

```
#Assumptions#
```

```
hist(DataCombined$IM_change)
```

```
qqnorm(DataCombined$IM_change)
```

```
qqline(DataCombined$IM_change)
```

```
shapiro.test(DataCombined$IM_change)
```

```
#Test#
```

```
t.test(DataCombined$IM_change ~ DataCombined$Group, data = DataCombined)
```

```
#SD#
```

```
tapply(DataCombined$IM_change, DataCombined$Group, sd)
```

```
#T-Test with all dimensions
```

```
t.test(DataCombined$Interest_Change ~ DataCombined$Group, data = DataCombined)
```

```
t.test(DataCombined$Effort_change ~ DataCombined$Group, data = DataCombined)
```

```
t.test(DataCombined$Value_change ~ DataCombined$Group, data = DataCombined)
```

```
t.test(DataCombined$Competence_change ~ DataCombined$Group, data = DataCombined)
```

```
#Third Hypothesis: Linear regression model#
```

```
model <- lm(DataCombined$Score ~ DataCombined$Group * DataCombined$IM_pre, data = DataCombined)
```

```
model %>% summary()
```

```
model_all <- lm(DataCombined$Score ~ DataCombined$Group * DataCombined$Interest_pre +
DataCombined$Group * DataCombined$Competence_Pre + DataCombined$Group *
DataCombined$Effort_pre + DataCombined$Group * DataCombined$Value_Pre, data = DataCombined)
```

```
summary(model_all)
```

```
df <- tidy(model_all)
```

```
ft <- flextable(df)
```

```
save_as_docx(ft, path = "regression_table.docx")
```

## Appendix 2

### *Vocabulary List*

Esperanto	English
mi	I
estas	am/are/is
adamo	Adam
Sofia	Sophia
laboras	work/worked/working
Kaj	and
saluton	hello/greetings
Viro	man
La	the
Ne	not

virino	woman
dormas	sleep/slept/sleeping
multe	much/many/a lot
Kun	with
oficejo	office
usono	USA
Loĝas	live/lives/living
venas	come/comes/coming
El	from
En	in
londono	London
dankon	thank you
Jes	yes
bonvenon	welcome
bonan matenon	good morning
gratulon	congratulations
kiel vi fartas?	how are you?
Bone	well/good
Kiu	who

fartas	am/are/is
Kiel	how
Diras	say/said/saying
nedankinde	you're welcome
komencanto	beginner
bonan nokton	good night
bonan tagon	good day
ĝis la revido	goodbye/see you later
bonan vesperon	good evening
pardonu	sorry/excuse me
bonvolu	please

### Appendix 3

#### *Qualtrics Survey*

##### (1) Bachelor Thesis - FM

---

#### Start of Block: Informed Consent

Welcome to the research study!

We are conducting a study to investigate the impact of various learning environments on language acquisition. As a participant, you will be asked to learn a specific set of foreign language vocabulary. Both before and after the study, you will be asked to complete a questionnaire, and a small test will be administered to evaluate how many words you can recall. Please complete the study with honesty and refrain from cheating. The study is expected to take approximately 30 minutes to complete. Participation in this research is voluntary, and you have the right to withdraw at any time during the study. If you have any questions or concerns, please contact the Principal Investigator of this study at:

a.rudolf@student.utwente.nl

By clicking the button below, you acknowledge:

Your participation in the study is **voluntary**. You are at least **18 years** of age. You are aware that you may choose to terminate your participation at any time for any reason. Data retrieved from your responses will be used for analysis

I consent, begin the study

End of Block: Informed Consent

---

Start of Block: Participant ID

(The following information is only relevant in case you want to withdraw from the participation and demand a deletion all your data)

As mentioned, you can withdraw from the experiment at any point, even after completion. If you wish that your data will be deleted, please contact the researcher (contact details can be found on the previous page) and indicate your participant ID. Your participant ID is:  $\{e://Field/Random\%20ID\}$

Please remember your number or write it down.

Are you done?

Yes

End of Block: Participant ID

---

Start of Block: Participant Questionnaire

What is your age?

---

---



What Gender do you identify yourself with?

- Male
- Female
- Non-binary / third gender
- Prefer not to say
- 

What is your nationality?

- Dutch
- German
- Other: \_\_\_\_\_

**End of Block: Participant Questionnaire**

---

**Start of Block: Previous Experience with Language and environments**

If yes, do you have prior experience with learning *Esperanto*?

- Yes
- No
- 

Do you use a digital language learning platform on a regular basis (Duolingo, Babbel, etc.)?

- Yes
- No
- Not sure
-

How often do you use digital language learning platforms?

- Less than once a week
- Once a week
- 2-3 times a week
- 4-6 times a week
- Daily

**End of Block: Previous Experience with Language and environments**

---

**Start of Block: Intrinsic motivation - Before**

In the following, indicate on a scale from 1 (lowest) to 5 (highest), how much you agree with the statement.

-----

I really enjoy learning new vocabulary.

- 1
- 2
- 3
- 4
- 5

-----

I have problems holding my attention when learning a new language.

1

2

3

4

5

---

I think that I am good at learning a new language.

1

2

3

4

5

---

I think I am good at language learning compared to other students.

1

2

3

4

5

---

It is important for me to learn a new language.

1

2

3

4

5

---

I usually put a lot of effort in the process of language learning.

1

2

3

4

5

---

I feel a sense of personal growth and development by learning a new language.

1

2

3

4

5

---

I feel that learning a new language is important to my future goals and aspirations.

- 1
- 2
- 3
- 4
- 5

End of Block: Intrinsic motivation - Before

---

Start of Block: FM con

Now you are going to practice some basic vocabulary in the language Esperanto. For that, you will use the Flashcard application Flashcard Machine. You will play a quiz game where you are asked to guess the correct words. By playing this game for two rounds, you will learn some vocabulary. It is not necessary that you know all of the vocabulary by heart after the game.

After you have clicked on the link, click on the button "Play a game" and then choose the first game "Quiz me". Then you can start the game. Play this game for two rounds, so you practice all vocabulary at least twice. This should take around 20 minutes in total. When you are done, please come back to this Survey. Here is the link to the Website, please open it in a new tab: <https://www.flashcardmachine.com/3830654/g38u>

---

Are you done?

- Yes

End of Block: FM con

**In the other Survey, the following text was used:**

Start of Block: Duolingo Con

Q31 Now you are going to practice some basic vocabulary in the language Esperanto. For that, you will make use of the language learning platform Duolingo. In the following I give you an invite link to my Duolingo Classroom which you should open in a new Tab: [www.duolingo.com/classroom/tpdxdk](http://www.duolingo.com/classroom/tpdxdk) Log in with the account data that was provided to you in the email or message you received or create a new account (the login button is on the upper right corner).

Now, please complete the first two levels, namely: "*Use basic words*" and "*introduce yourself*". Each level has 4 lessons and altogether it will take approximately 25 minutes. If you are finished, the level path should look like in the picture below. After you are finished please come back to this document.

---

**Start of Block: Intrinsic motivation- After**

In the following, indicate on a scale from 1 (lowest) to 5 (highest), how much you agree with the statement.

---

I really enjoy learning new vocabulary.

1

2

3

4

5

---

I have problems holding my attention when learning a new language.

1

2

3

4

5

---

I think that I am good at learning a new language.

1

2

3

4

5

---

I think I am good at language learning compared to other students.

1

2

3

4

5

---

It is important for me to learn a new language.

1

2

3

4

5

---

I usually put a lot of effort in the process of language learning.

1

2

3

4

5

---

I feel a sense of personal growth and development by learning a new language.

1

2

3

4

5

---

I feel that learning a new language is important to my future goals and aspirations.

1

2

3

4

5

---

End of Block: Intrinsic motivation- After

Start of Block: Assessment Test



Before we finish the survey, we would like to test your knowledge on the vocabulary related to the topic. The test will consist of a few multiple-choice questions, and there are correct and incorrect answers. Please select the best answer for each question. The purpose of this test is to help us understand your understanding of the topic better. Please answer the questions to the best of your ability.

---

What does "mi" mean in English?

- Hello
  - Goodbye
  - No
  - I
- 

What does "laboras" mean in English?

- Sleep
  - Work
  - Goodbye
  - Welcome
- 

What does "bonvolu" mean in English?

- Good day
  - Goodbye/see you later
  - Please
  - Excuse me/Sorry
-

What does "Loğas" mean in English?

- Come/comes/coming
  - Sleep/slept/sleeping
  - Live/lives/living
  - Office
- 

What does "venas" mean in English?

- Come/comes/coming
  - Work
  - Thank you
  - Sleep/slept/sleeping
- 

What does "kun" mean in English?

- With
  - Without
  - For
  - Against
-

What does "multe" mean in English?

- Little/Few
  - Much/Many/A lot
  - Big/Large
  - Small/Little
- 

What does "usono" mean in English?

- Use
  - With
  - Man
  - United States
- 

What does "kiel vi fartas?" mean in English?

- How far is it?
  - How are you?
  - Good morning
  - Good evening
- 



What does "komencanto" mean in English?

- to comment
  - Excuse me
  - Beginner
  - Please
- 

What does "viro" mean in English?

- Woman
  - Man
  - Child
  - Dog
- 

What does "bonan vesperon" mean in English?

- Good afternoon
  - Good night
  - Good morning
  - Good evening
-

What does "Kaj" mean in English?

- The
  - Who
  - And
  - Not
- 

What does "dormas" mean in English?

- Home
  - come/comes/coming
  - sleep/slept/sleeping
  - Man
- 

What does "La" mean in English?

- The
- And
- Woman
- I

**End of Block: Assessment Test**

---

**Start of Block: Debriefing**

Thank you for participating in this study! Our aim in this research is to explore the effectiveness of different gamification elements in the process of (language) learning. Specifically, we are interested in comparing the effectiveness of different learning environments in terms of learning achievements and motivation. We will be using the data collected during the study to analyze the impact of different gamification elements on these outcomes. Please note that all data collected during this study will be kept confidential and your privacy will be protected. If you have any questions about the study or would like to receive more information, please feel free

to contact the researcher. Thank you again for your participation and contribution to this research!

**End of Block: Debriefing**

---