PERSONALIZATION OF GAMIFICATION IN EDUCATION

WHERE AUGMENTED INTELLIGENCE MEETS PLAYFULNESS

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Acknowledgement

TEAM

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Perspectives of AI to support gamification in Education
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TO AUTOMATE
Perspectives of AI to support gamification in Education

TO AUTOMATE

TO ASSIST
Focus on the assistive role of AI to ease almost any activity in our lives.
Vinton G. Cerf described **augmented intelligence** as:

An **extraordinary partnership** among **humans**, with their **curiosity** and **innovative intellect**, and **computers**, that bring their **speed** and ability to deal with **multidimensional data**.

https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=6596495
Many topics related to AI in Education: Learning Analytics, Intelligent Tutoring Systems, user modeling, personalized learning, virtual reality in education ...
BUT, most research and development on AI in Education still focuses on the **AUTOMATING ASPECTS**
We aim to pave the ground for a **symbiotic partnership** between humans and computers to enhance our capabilities to better design personalized playful experiences for learning.
Such a symbiotic partnership requires consideration of both technological and human perspectives.
Focus more on the human perspective
Let’s get started....
Let’s get started....
Let’s get started....

What is gamification?

Join at www.kahoot.it or with the Kahoot! app

Game PIN: 293 0771
Gamification is “the use of game design elements in non-game contexts”. [1]

Gamification in education is Using “game-based mechanics, aesthetics and game thinking to engage people, motivate action, promote learning, and solve problems”.[2]

Gamification

Ludus (Rule-based)

Serious games

Gamification

Digital games

Playful Design

Game as a whole

Game design elements

1. Photo (https://goo.gl/R4fAwA) by Serious-Game.fr/CC 2.0
2. Photo (https://goo.gl/aAHg1t) © pacmanhattan.com
3. Photo (https://flic.kr/p/51xSd1) by Chris Messina/CC BY-NC-SA 2.0

Game design elements

Gamification uses **game design elements** such as:

- Narrative,
- Aesthetics,
- Avatars,
- feedback,
- Reputation systems,
- Rankings,
- Competition rules,
- Challenges,
- Points,
- Badges,
- etc, ...
Game elements in Duolingo

What happened over time?

Source: https://blog.duolingo.com/shape-language-duolingo-art-style/
Game elements in Duolingo

Cleaner interface

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Game elements in Duolingo

Cleaner interface

Emphasis on game elements
- Aesthetics
- Levels
- Points
- context
- Social components

Source: https://blog.duolingo.com/shape-language-duolingos-art-style/
Why does research on gamification in education matter?
Motivation crisis

In learning settings

Particularly in Developing Countries (e.g., Global South)
Enjoyment of Science (2006-2015)

Several inadequate behaviors are associated with the lack of engagement and motivation for learning in Brazil:

- Dropout
- Truancy
- Cheating
- Incomplete homework
- Age-grade distortion
- Etc
Used properly, gamification can reduce the problems of lack of engagement/motivation and its negative effects on learning.
Does gamification increase engagement with online programs? A systematic review

Jemma Looyestyn¹, Jocelyn Kernot¹, Kobie Boshoff¹, Jillian Ryan², Sarah Edney², Carol Maher²*

Results

1017 studies were identified from database searches following the removal of duplicates, of which 15 met the inclusion criteria. The studies involved a total of 10,499 participants, and were commonly undertaken in tertiary education contexts. Engagement metrics included time spent (n = 5), volume of contributions (n = 11) and occasions visited to the software (n = 4); as well as downstream behaviours such as performance (n = 4) and healthy behaviours (n = 1). Effect sizes typically ranged from medium to large in direct engagement and downstream behaviours, with 12 out of 15 studies finding positive significant effects in favour of gamification.
Does gamification increase engagement with

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The Gamification of Learning: a Meta-analysis

Michael Sailer¹ • Lisa Homner¹

Abstract

This meta-analysis was conducted to systematically synthesize research findings on effects of gamification on cognitive, motivational, and behavioral learning outcomes. Results from random effects models showed significant small effects of gamification on cognitive ($g = .49$, 95% CI [0.30, 0.69], $k = 19$, $N = 1686$), motivational ($g = .36$, 95% CI [0.18, 0.54], $k = 16$, $N = 2246$), and behavioral learning outcomes ($g = .25$, 95% CI [0.04, 0.46], $k = 9$, $N = 951$).
Gamification

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Does gamification improve student learning outcome? Evidence from a meta-analysis and synthesis of qualitative data in educational contexts

Shurui Bai, Khee Foon Hew, Biyun Huang

Highlights

- Gamification can increase student learning performance (effect size of 0.504).
- Shorter gamified interventions have greater average effect sizes.
- Participants report four main reasons why they enjoy gamification.
- Participants report two main reasons why they dislike gamification.
- Two main unresolved questions in gamification research are highlighted.
ABSTRACT

Despite the buzz around gamification as an exciting new method to engage students, evidence of its ability to enhance learning is mixed. In fact, gamification has attracted considerable controversy ("gamification is bullshit") and some derogatory labels such as "exploitationware." Therefore, in order to make the case for or against gamification in education, it is important to examine the effects (if any) of gamification on student learning achievements. This study is a meta-analysis of 30 independent interventions (3,202 participants) drawn from 24 quantitative studies that have examined the effects of gamification on student academic performance in various educational settings. The results show an overall significant medium effect size in favor of gamification over learning without gamification (Hedges’ g = 0.504, 95% CI [0.284–0.723], p < 0.001). No publication bias is detected. An analysis of 32 qualitative studies reveals four reasons for learners’ enjoyment of gamification: (a) gamification can foster enthusiasm; (b) gamification can provide feedback on performance; (c) gamification can fulfill learners’ needs for recognition; and (d) gamification can promote goal setting, and two reasons for their dislike of gamification: (a) gamification does not bring additional utility and (b) gamification can cause anxiety or jealousy. We conclude by highlighting two unresolved questions, and suggesting several future research directions concerning gamification in educational contexts.
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Despite the buzz around gamification as an exciting new method to engage students, evidence of its ability to enhance learning is mixed. In fact, gamification has attracted considerable controversy ("gamification is bullshit") and some derogatory labels such as "exploitationware." Therefore, in order to make the case for or against gamification in education, it is important to examine the effects (if any) of gamification on student learning achievements. This study is a meta-analysis of 30 independent interventions (3,202 participants) drawn from 24 quantitative studies that have examined the effects of gamification on student academic performance in various educational settings. The results show an overall significant medium effect size in favor of gamification over learning without gamification (Hedges’ g = 0.504, 95% CI [0.284–0.723], p < 0.001). No publication bias is detected. An analysis of 32 qualitative studies reveals four reasons for learners’ enjoyment of gamification: (a) gamification can foster enthusiasm; (b) gamification can provide feedback on performance; (c) gamification can fulfill learners’ needs for recognition; and (d) gamification can promote goal setting, and two reasons for their dislike of gamification: (a) gamification does not bring additional utility and (b) gamification can cause anxiety or jealousy. We conclude by highlighting two unresolved questions, and suggesting several future research directions concerning gamification in educational contexts.
Based on our results, we found out that the game design may lead to a negative impact. For instance, Leaderboards are strongly associated to many negative effects mapped in this work. This result is corroborated by the psychology literature regarding ranking systems within learning environments. We believe our work may be useful to guide gamification instructors and specialists to avoid those negative effects in education contexts, by avoiding some game design elements settings.
<table>
<thead>
<tr>
<th>Negative Effect</th>
<th># of Elements</th>
<th>Elements</th>
<th>Most Impacting Element</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indifference</td>
<td>8</td>
<td>Leaderboard, Badge, Level, Leaderboard and Badge Progression, Social Status, Point, Instant Feedback, Challenge</td>
<td></td>
</tr>
<tr>
<td>Loss of Performance</td>
<td>11</td>
<td>Leaderboard, Badge, Level, Social Status, Social Interaction, Point, Avatar, Progression, Instant Feedback, Challenge, Economy</td>
<td>Leaderboard, Badge and Point</td>
</tr>
<tr>
<td>Undesired Behavior</td>
<td>11</td>
<td>Leaderboard, Badge, Point, Badge and Leaderboard Level, Instant Feedback, Progression, Social Status, Social Interaction, Avatar, Economy, Narrative</td>
<td></td>
</tr>
<tr>
<td>Declining Effects</td>
<td>4</td>
<td>Leaderboard, Badge, Point, Leaderboard and Point Level</td>
<td></td>
</tr>
<tr>
<td>Negative Effect</td>
<td># of Elements</td>
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<td>Leaderboard and Point Level</td>
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</tbody>
</table>
“Inserting game elements such as Points, Badges, and Leaderboards (PBL Approach), *without proper design*, will *not ensure the positive desired outcomes*” (Toda, Valle, Isotani, 2018)
To augment the capabilities of teachers to design gamification scenarios for education, my group has worked in the past 10+ years:

- Gamification Taxonomy
- Gamification Design Framework
- Personalization of Gamification
To do so, we need to understand how gamification works and why.
Theoretical landscape: Relationships of theoretical foundations in research on gamification

Flow Theory
Nakamura, & Csikszentmihályi (2001)


Flow Theory


https://farm2.static.flickr.com/1228/1385806571_c7a6bf2006.jpg
Understanding the impact of gamification over time on Students’ behavior

Understanding the impact of gamification over time on Students’ behavior


Goal: understand the impact of a gamification design, featuring fictional and competitive-collaborative elements

Participants: CS1 courses taken by STEM students (N = 756; 62.3% males and 37.7% females)

Settings: 14-week period of time in an ecological setting (7 analysis)

Experiment: quasi-experimental design, where Brazilian students completed assignments in either a gamified or non-gamified version of the same system
Enunciado
Meu primeiro programa
Escribe um programa que imprima na tela do computador a seguinte mensagem:

Universidade Federal do Amazonas

Dicas
Use a função `print()`, que exibe mensagens na tela do computador.

# Leandro
# 31 / 05 /2016
# Lab 0, Ex 1

print("Universidade Federal do Amazonas")
Objetivos da disciplina

https://uspdigital.usp.br/jupiterweb/obterDisciplina?sgldis=S5C0600

Emblemas da gamificação

Você pertence ao grupo Bronze, representado pelo emblema abaixo. Existem três grupos: Ouro, Prata e Bronze. O seu grupo é determinado pela quantidade de pontos de experiência (Exp) que você adquiriu dentro do ambiente da gamificação.

Os emblemas abaixo representam o seu desempenho nas atividades da disciplina de programação. Os emblemas podem ser de Ouro, Prata ou Bronze. O primeiro emblema, de Ouro, representa a sua média nas avaliações (10) feitas até então; o segundo, de Bronze, representa a sua média nas listas de exercícios (0); e o terceiro emblema, de Bronze, representa a frequência com que você acessa o CodeBench.

Progresso Individual

<table>
<thead>
<tr>
<th>TOTAL DE PONTOS GANHOS</th>
<th>10.0%</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRABALHOS COM 10.0</td>
<td>10.0%</td>
</tr>
<tr>
<td>MENSAGENS LIDAS</td>
<td>0.0%</td>
</tr>
<tr>
<td>MATERIAIS BAIXADOS</td>
<td>0.0%</td>
</tr>
</tbody>
</table>
Que sucesso! Você ajudou a liberar a ponte que liga a vila Freiheit e a cidade Kalayaan. Isso ajudou muito os dois povoados, pois Kalayaan é rica em comerciais. Entretanto, as demais partes do Reino de Midgard continuam inacessíveis. Um ladrão da Químera, chamado Staurk, é o culpado por manter as duas vilas isoladas. Staurk está sendo protegido pelo sacerdote. Você precisa encontrar o sacerdote que está no templo trancado a oito cadeados. Só tem uma forma de você abrir o templo: "destrancar os oito cadeados na porta do templo". Para destrancar os cadeados você precisa unir aos outros aprendizes e juntos resolverem os exercícios de programação no CodeBench. Após cada resolução de exercícios serão sorteadas cartas de recompensa. Faça exercícios até destrancar todos os cadeados. Após abrir o templo, você percorrerá o seu subterrâneo, passará por provações em uma escuridão assustadora, encontrará enigmas e lutará com o terrível Staurk. Corra! Ajude a libertar os povoados!

Nesta cidade você também pode se divertir e ganhar recompensas através de opcionalmente: explorar a cidade; entrevistar cidadãos; encontrar uma entrada para a terra das Fadas Valiosas; realizar compras nas lojas da vila; ou até mesmo ouvir uma música especial no bar sem álcool.

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**Guerreiros e Guerreiras — Grupo Bronze**

**Gustavo Antonio de Paula Santos**

- **Nível 3**
- **Experiência 110**
- **Vida 340/340**
- **Energia 48/48**

**Lua Gabriella Gonçalves Maia**

- **Nível 2**
- **Experiência 86**
- **Vida 295/320**
- **Energia 44/44**

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**Definições de termos**

**CARTAS DE RECOMPENSA (CARTAS DE THORIEL)**

São as cartas sorteadas para um aluno quando um exercício é resolvido corretamente. As recompensas são: moedas, pontos de experiência, abertura de novos locais exploráveis e progressão nos capítulos. Também conhecidas como cartas de Thoriel.

**EXPERIÊNCIA**

Pontos de experiência (EXP) podem ser sorteados ao fim da resolução de exercícios, encontrados explorando os mapas e realizando missões.
Most interesting result:

A statistically significant interaction between the effects of gamification and system usage, IDE usage and number of attempts.
Most interesting result

We found empirical evidence supporting that gamification **likely suffers from the novelty effect** but also **benefits from the familiarization effect**, contributing to an overall **positive impact on students**.


How to select game design elements to support learning?
We collected data from specialists to identify the most relevant game elements that can be used in educational contexts to improve participation, motivation and engagement.
Taxonomy of game design elements that are commonly utilized in learning environments

2nd part

Augmented intelligence

Focus more on the technological perspective
How to design gamification systems and activities to support learning?
Personalization matters ....


Towards a framework to support personalized gamification designs in education
Design of a Gamification Framework

4 Pillars:

(1) The Hero's Journey (Vlogler, 2017)

(2) Bloom's Taxonomy (Anderson et al. 2001)

(3) Gamification Taxonomy (Toda et al., 2019)

(4) ADDIE Model (Morrison, 2010)


Student’s Journey and Experience + Learning Goals

Student’s Journey and Experience + Learning Goals + Gaminfication elements

Step by Step

Act 1: Call to Action

- Purpose and Meaning
- Immersion
- Autonomy and Creativity
Example of use

Personal Dimension
Step by Step

Act 2: Crisis (Conflict)

take the student out of their 'comfort zone', and challenge them to grow.

- Ownership and Rewards
- Scarcity
- Challenge and Competence
Step by Step

Performance Dimension
How to assign teachers to use our tools and augment their capabilities to design gamification scenarios?
GARFIELD

Gamification Automatic Recommender for Interactive Education and Learning Domains
• Data collected from 361 individuals from 19 different countries

• We investigate how to semi-automatically tailor gamification designs to users considering their geographic location, learning activity types (according to Bloom’s taxonomy and gamification preferences/experience)

Fig. 1. Conditional decision tree for participants most preferred game element. Codes refer to preferred game genre (PGG), learning activity type (LAT), and experience researching gamification (ERG).
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Data-driven
GARFIELD - Gamification Automatic Recommender for Interactive Education and Learning Domains

Intrinsic Motivation Level
- Age
- Gender: Female
- Highest degree: High school
- Preferred Game Genre: Action
- Preferred Playing Setting: Multiplayer
- Weekly Playing Time (hours): 5

Data-driven
Multidimensional
GARFIELD - Gamification Automatic Recommender for Interactive Education and Learning Domains

Data-driven
Multidimensional
Transparent
Challenges

How to maximize the benefits of gamification, so that students are simultaneously engaged in playing but also focused on learning?

How to better design augmented technologies to accurately guides teachers during to design and apply gamification in education?

How can we use data-driven gamification designs to promote equity and equality in education?
