PERSONALIZED GAMIFICATION EXPERIENCES IN EDUCATION

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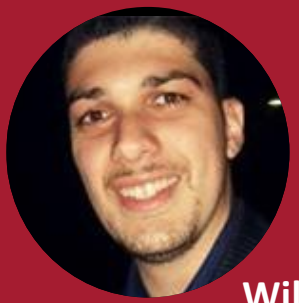

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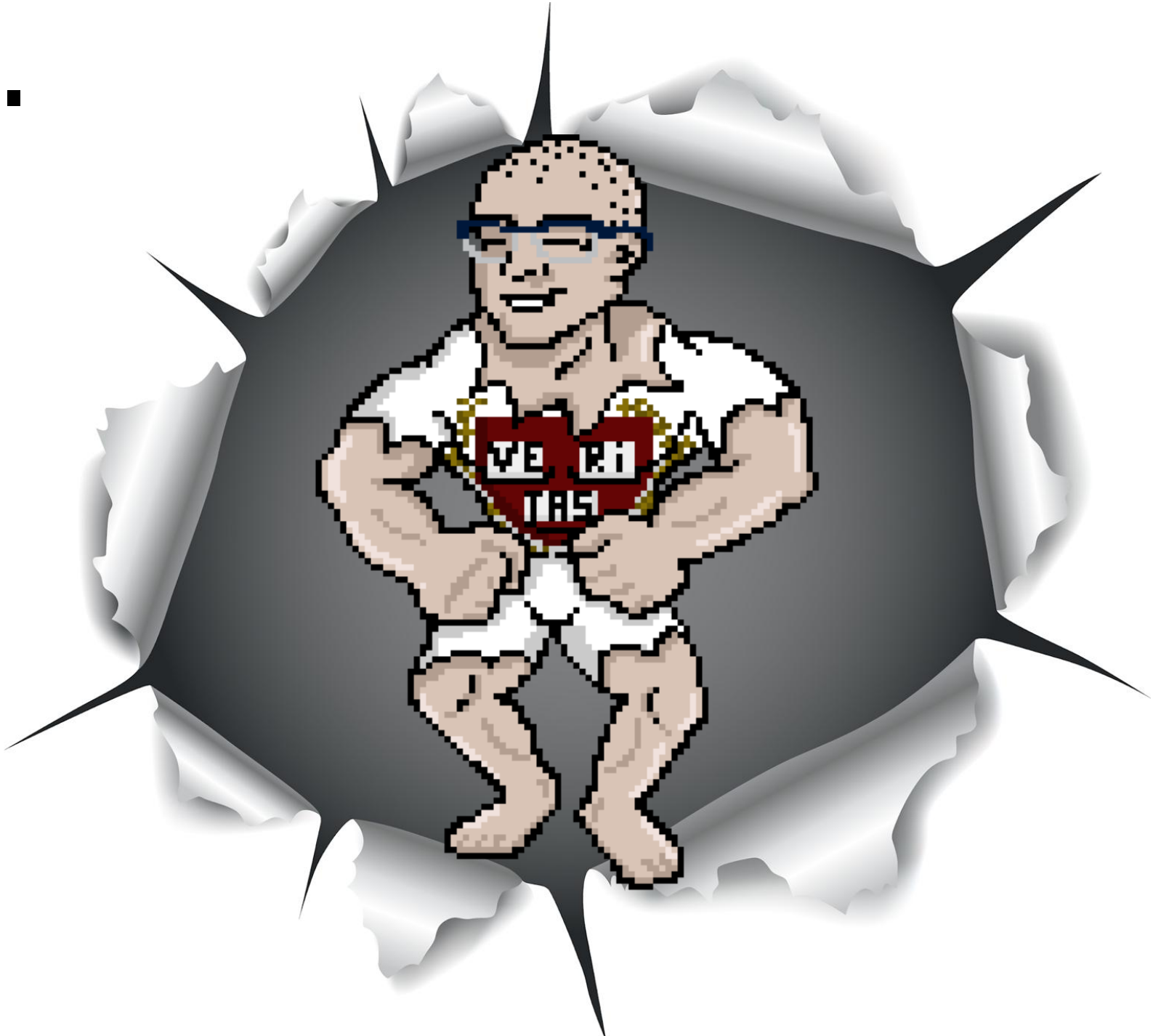
Team Work!

Let's get started....

Let's get started....



Gamification is

“the use of game design elements in non-game contexts” .[1]

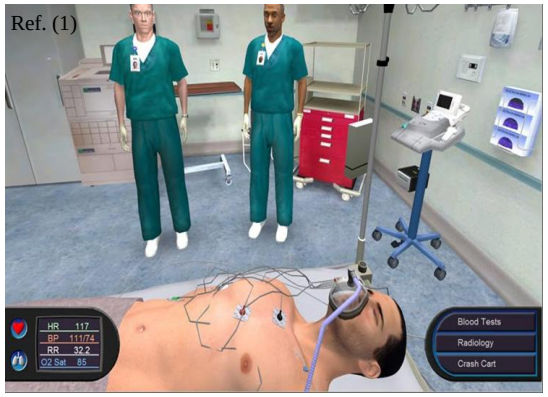
[1] Deterding, S. et al.: From game design elements to gamefulness: defining gamification. In: Proc. of the 15th International Academic MindTrek Conf.: pp. 9–15 (2011).

Gamificatio
n

Gaming (Rule-based)

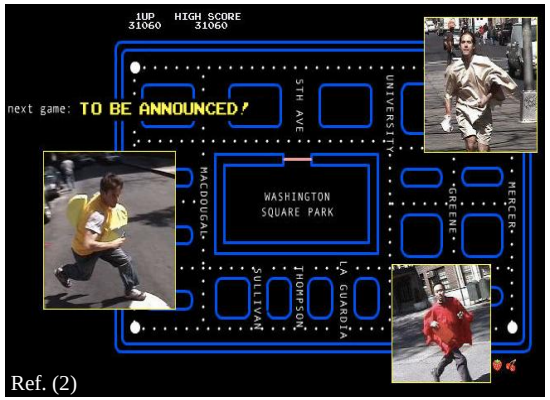
Serious games

Gamification



Game as a whole

Game design elements



Digital games

Playful Design

Playing (Freedom)

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

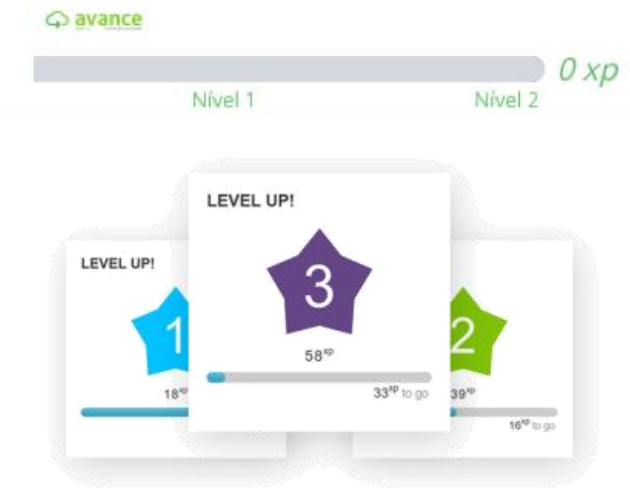
Borges, S., Durelli, V. H., Reis, H. M., & Isotani, S. (2014). A systematic mapping on gamification applied to education. In *Proc. of the 29th annual ACM symposium on applied computing* (pp. 216-222).

Game design elements

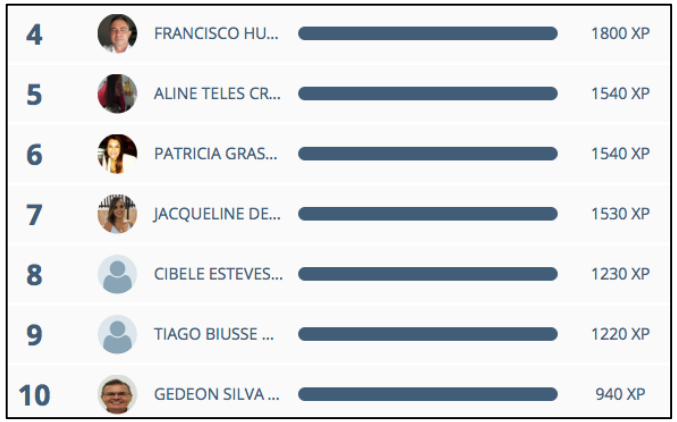
Gamification uses **game design elements** such as:

- Narrative,
- Aesthetics,
- Avatars,
- feedback,
- Reputation systems,
- Rankings,
- Competition rules,
- Challenges,
- **Points,**
- **Badges,**
- **Leaderboards,**
- etc, ...

Badges



Levels



Rankings

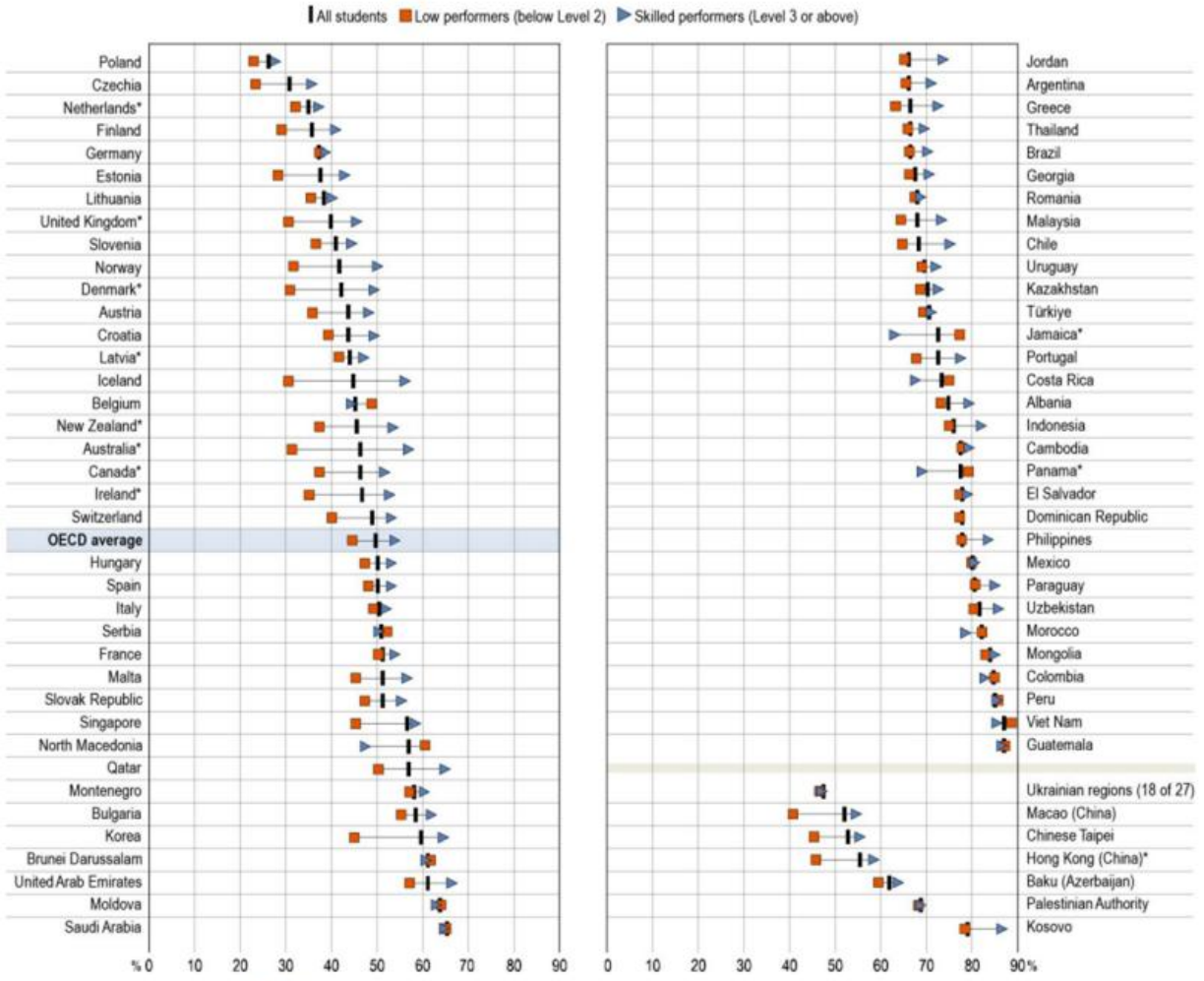
Why does research on gamification in education matter?


Motivation crisis
In traditional learning settings

Motivation like enjoying learning new things in school, **consistently predicts the uptake of learning strategies.**

However, **less than half of students in OECD countries reported (intrinsic and instrumental*) motivation to learn**

Percentage of students who agree or strongly agree that they love new things in school



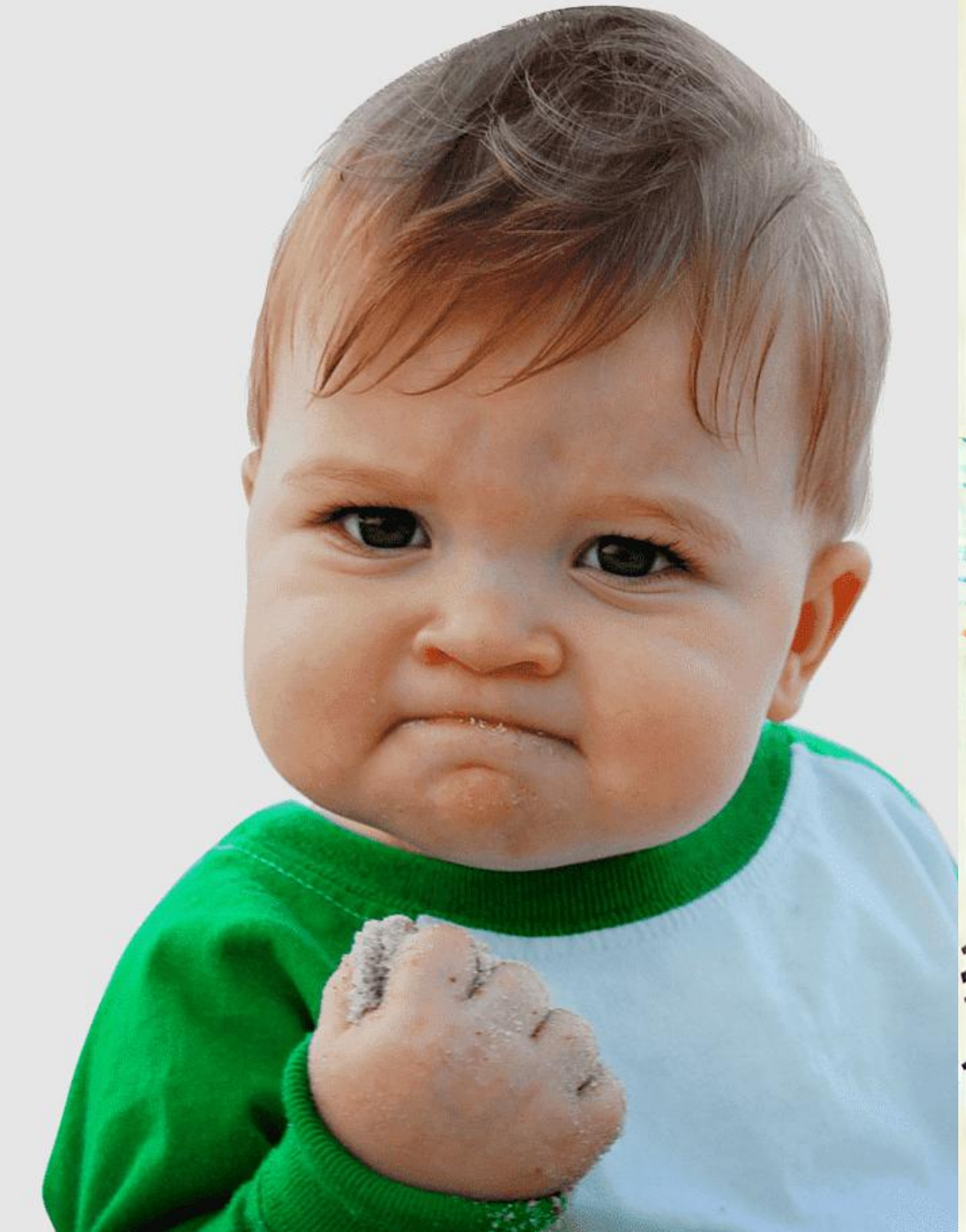
Countries and economies are ranked in ascending order of the percentage of all students.
Source: OECD, PISA 2022 Database, Table V.B1.3.4.
See Table V.3.1 for StatLink at the end of this chapter.

*Instrumental Motivation= learning for a purpose

Source: PISA 2022

Some may feel ambivalent about fostering intrinsic motivation through the use of extrinsic motivators

BUT ....




IT WORKS BABY!

Game elements in Duolingo

What happened over time?

Source: https://blog.duolingo.com/shape-language-duolingos-art-style/

Game elements in Duolingo

Cleaner interface

Source: https://blog.duolingo.com/shape-language-duolingos-art-style/

Game elements in Duolingo

Cleaner interface

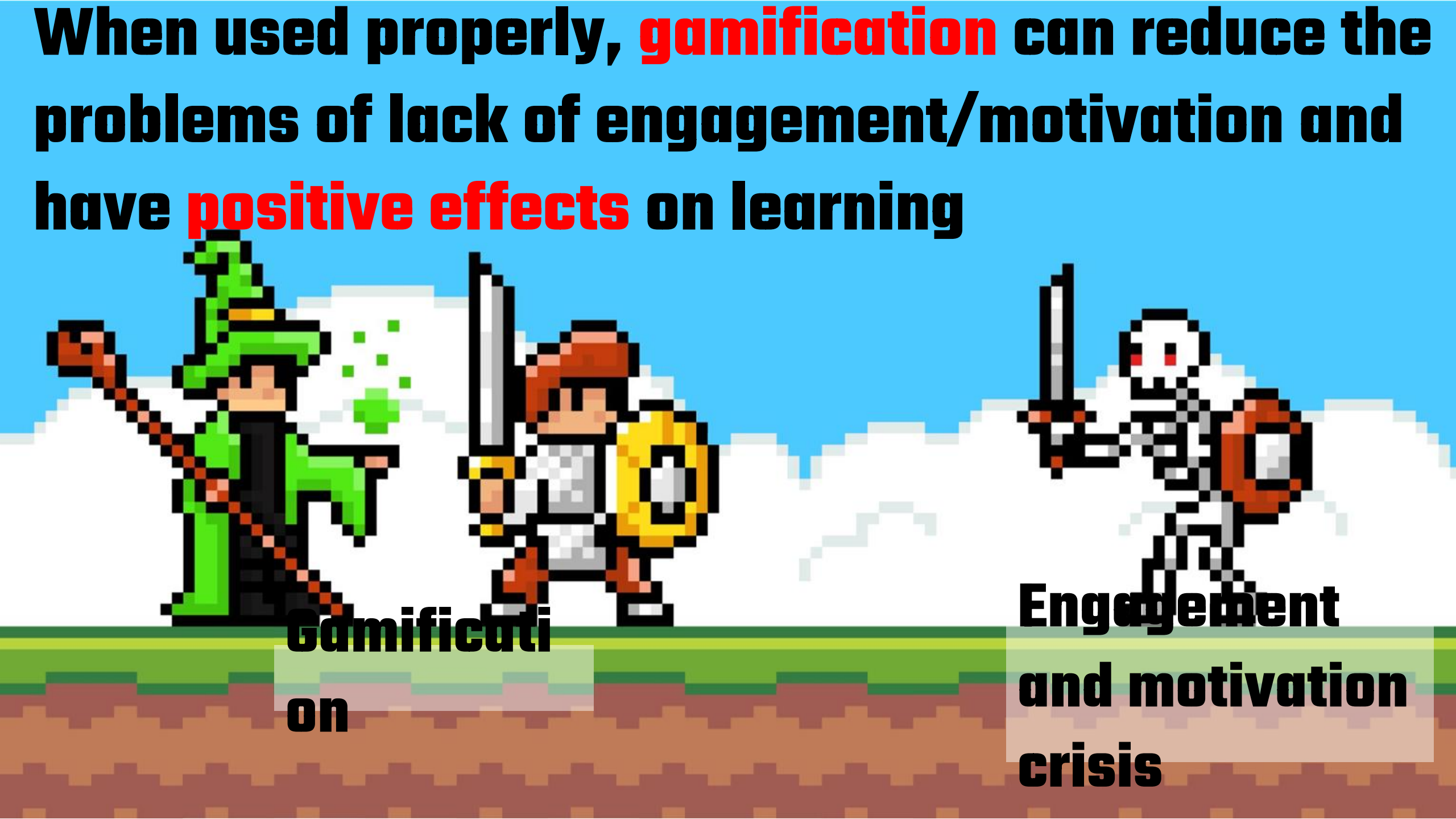
Emphasis on game elements

- Aesthetics
- Levels
- Points
- context
- Social componentes

- **Streak!!!**

Source: https://blog.duolingo.com/shape-language-duolingos-art-style/

When used properly, gamification can reduce the problems of lack of engagement/motivation and have positive effects on learning



Educational Psychology Review (2020) 32:77–112
https://doi.org/10.1007/s10648-019-09498-w

META-ANALYSIS

The Gamification of Learning: a Meta-analysis

Michael Sailer[1] · Lisa Homner[1]

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 Benefits

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], $k = 9$, $N = 951$). Whereas the effect of gamification on cognitive learning outcomes was stable in a subsplit analysis of studies employing high methodological rigor, effects on motivational and behavioral outcomes were less stable. Given the heterogeneity of effect sizes, moderator analyses were conducted to examine *inclusion of game fiction*, *social interaction*, *learning arrangement of the comparison group*, as well as situational, contextual, and *design* characteristics. Results indicated that effects of competition augmented with collaboration might also be valid for motivational learning outcomes. The results suggest that gamification as it is currently operationalized in empirical studies is an effective method for instruction, even though factors contributing to successful gamification are still somewhat unresolved, especially for cognitive learning outcomes.

valid for motivational learning outcomes. The results suggest that gamification as it is currently operationalized in empirical studies is an effective method for instruction, even though factors contributing to successful gamification are still somewhat unresolved, especially for cognitive learning outcomes.

To proper design game-like experiences, we need to understand how gamification works and why

To do that we need ...

Acknolwledge the Dark Side

A. I. Cristea et al. (Eds.): HEFA 2017, CCIS 832, pp. 143–156, 2018.
https://doi.org/10.1007/978-3-319-97934-2_9

The Dark Side of Gamification: An Overview of Negative Effects of Gamification in Education

Armando M. Toda(✉), Pedro H. D. Valle, and Seiji Isotani

comes. 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 3. Negative effects and their respective gamified designs

Negative Effect	# of Elements	Elements	Most Impacting Element
Indifference	8	Leaderboard, Badge, Level, Progression, Social Status, Point, Instant Feedback, Challenge	Leaderboard and Badge
Loss of Performance	11	Leaderboard, Badge, Level, Social Status, Social Interaction, Point, Avatar, Progression, Instant Feedback, Challenge, Economy	Leaderboard, Badge and Point
Undesired Behavior	11	Leaderboard, Badge, Point, Level, Instant Feedback, Progression, Social Status, Social Interaction, Avatar, Economy, Narrative	Badge and Leaderboard
Declining Effects	4	Leaderboard, Badge, Point, Level	Leaderboard and Point

Table 3. Negative effects and their respective gamified designs

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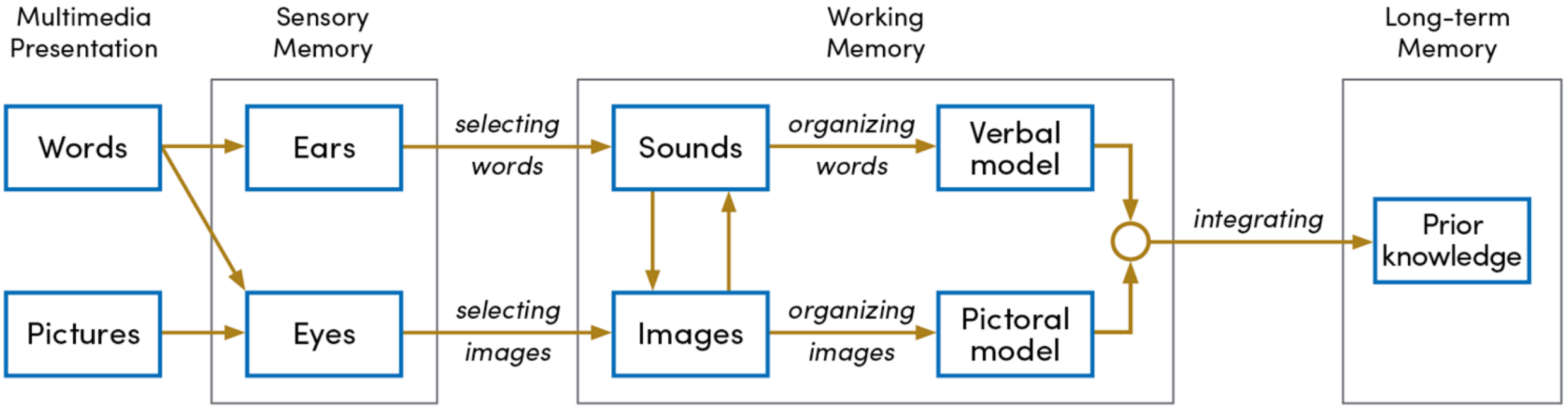
Declining Effects	4	Leaderboard, Badge, Point, Level	Leaderboard and Point

"Inserting game elements such as Points, Badges, and Leaderboards, without proper personalized design, will not ensure the positive desired outcomes" (Toda, Valle, Isotani, 2018)

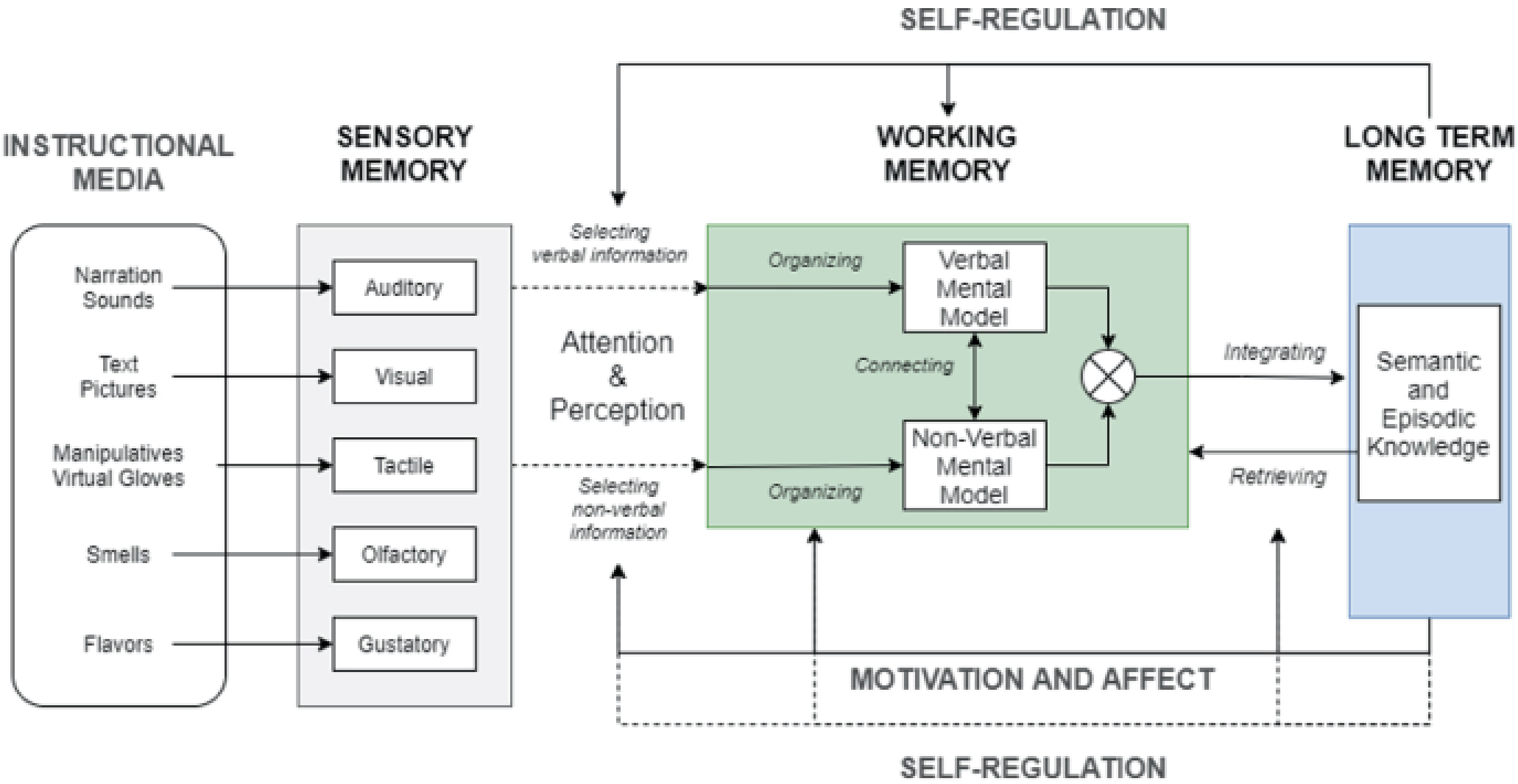
Then, we need to consider a framework of thought to design personalized gamification experiences

Cognitive Theory of Multimedia



Source: From Mayer, 2005, Cognitive Theory of Multimedia Learning.https://www.buffalo.edu/catt/develop/theory/multimedia-learning.html

Cognitive-Affective Theory of Learning with Media

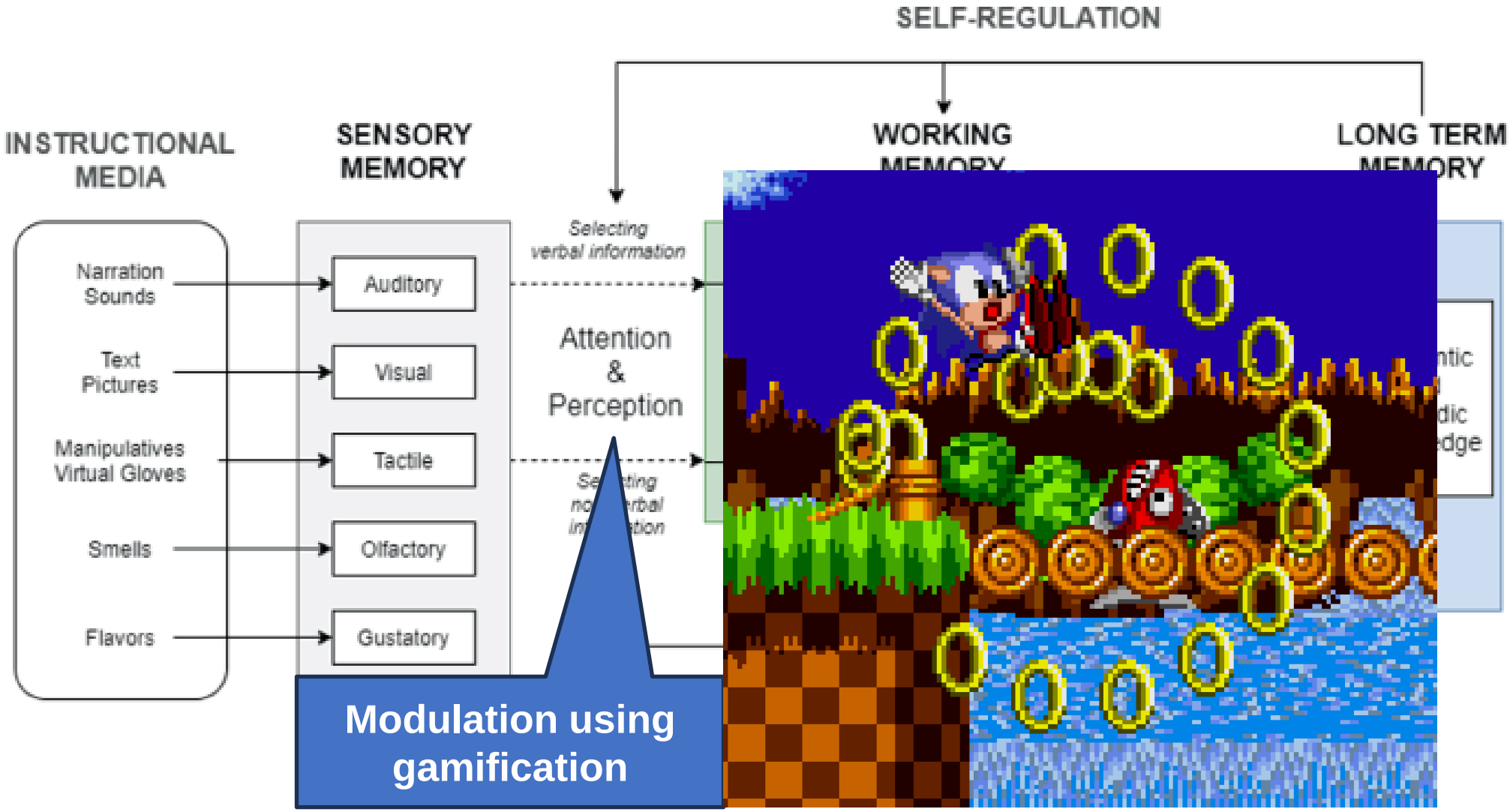


Source:

Moreno, R. (2006). Does the modality principle hold for different media? A test of the method-affects-learning hypothesis. Journal of Computer Assisted Learning, 22(3), 149-158.

Natucci, G. C., & Borges, M. A. (2020) Balancing Game Elements, Learning, and Emotions in Game Design. Communications in Computer and Information Science, vol 1702. Springer, Cham. https://doi.org/10.1007/978-3-031-27639-2_5

Cognitive Affective Theory of Learning with Media



Source:
Mullins, J. K., & Sabherwal, R. (2020). Gamification: A cognitive-emotional view. Journal of Business Research, 106, 304-314.
Natucci, G. C., & Borges, M. A. (2020) Balancing Game Elements, Learning, and Emotions in Game Design. Communications in Computer and Information Science, vol 1702. Springer, Cham. https://doi.org/10.1007/978-3-031-27639-2_5

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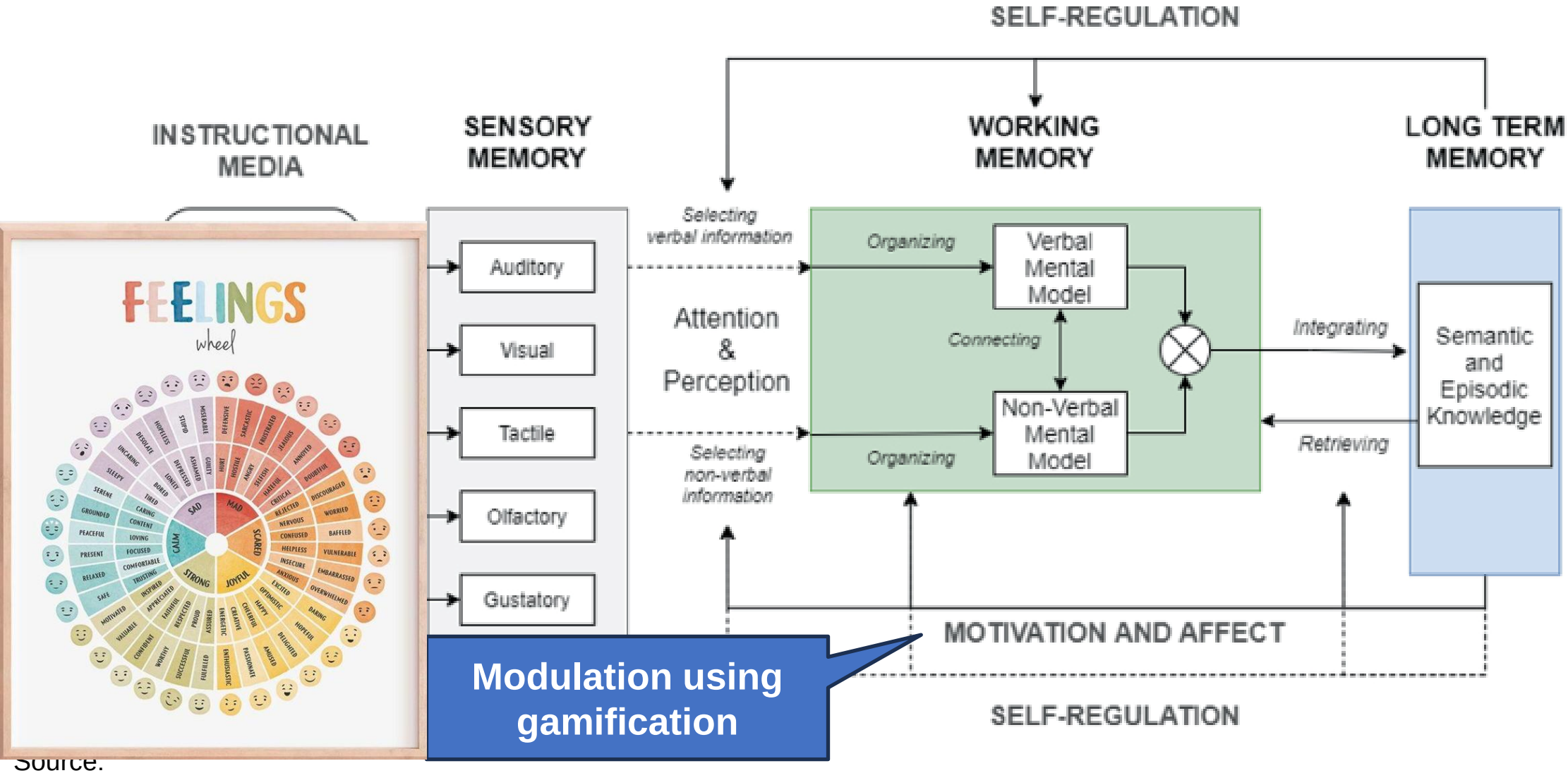

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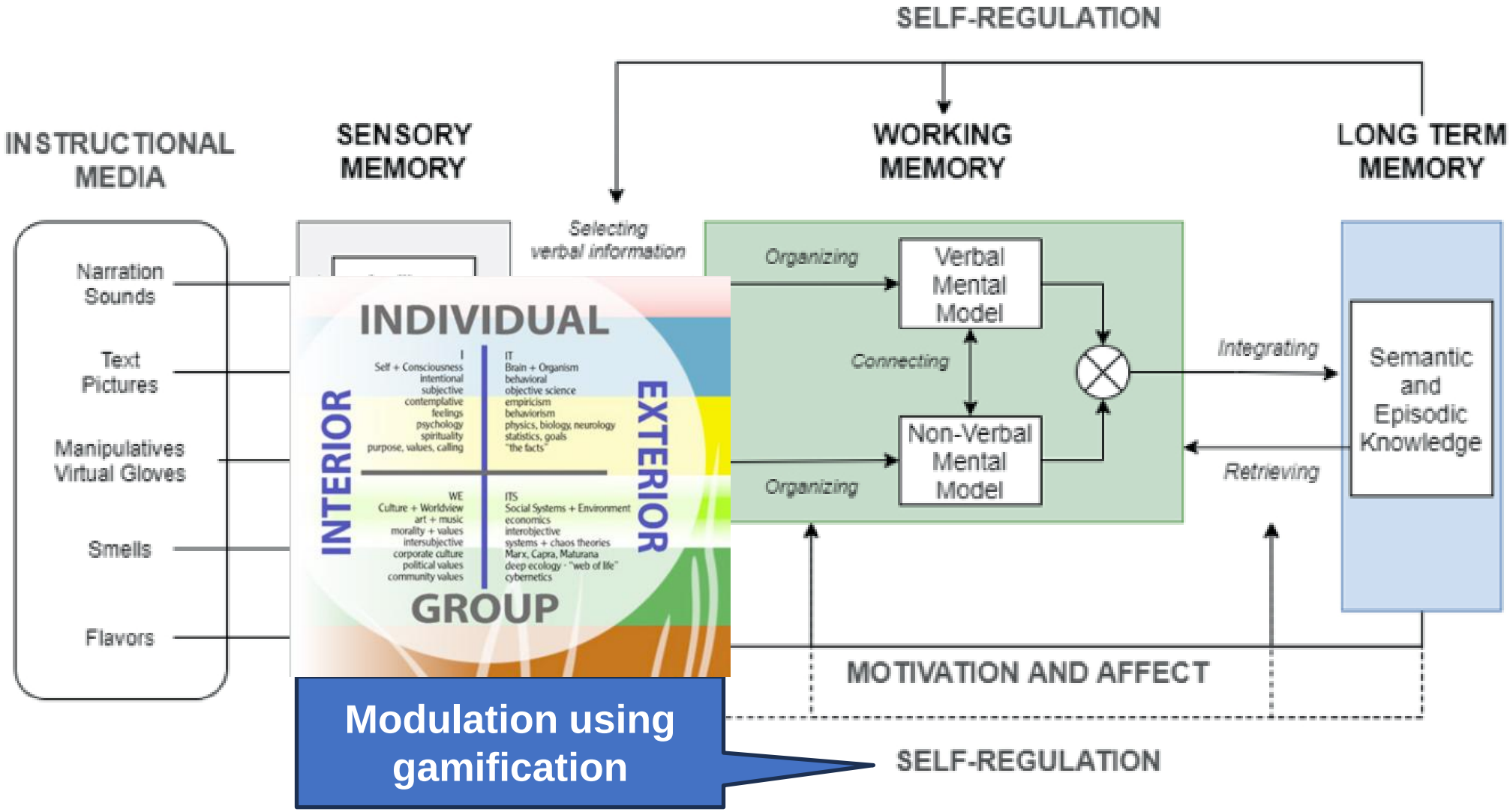

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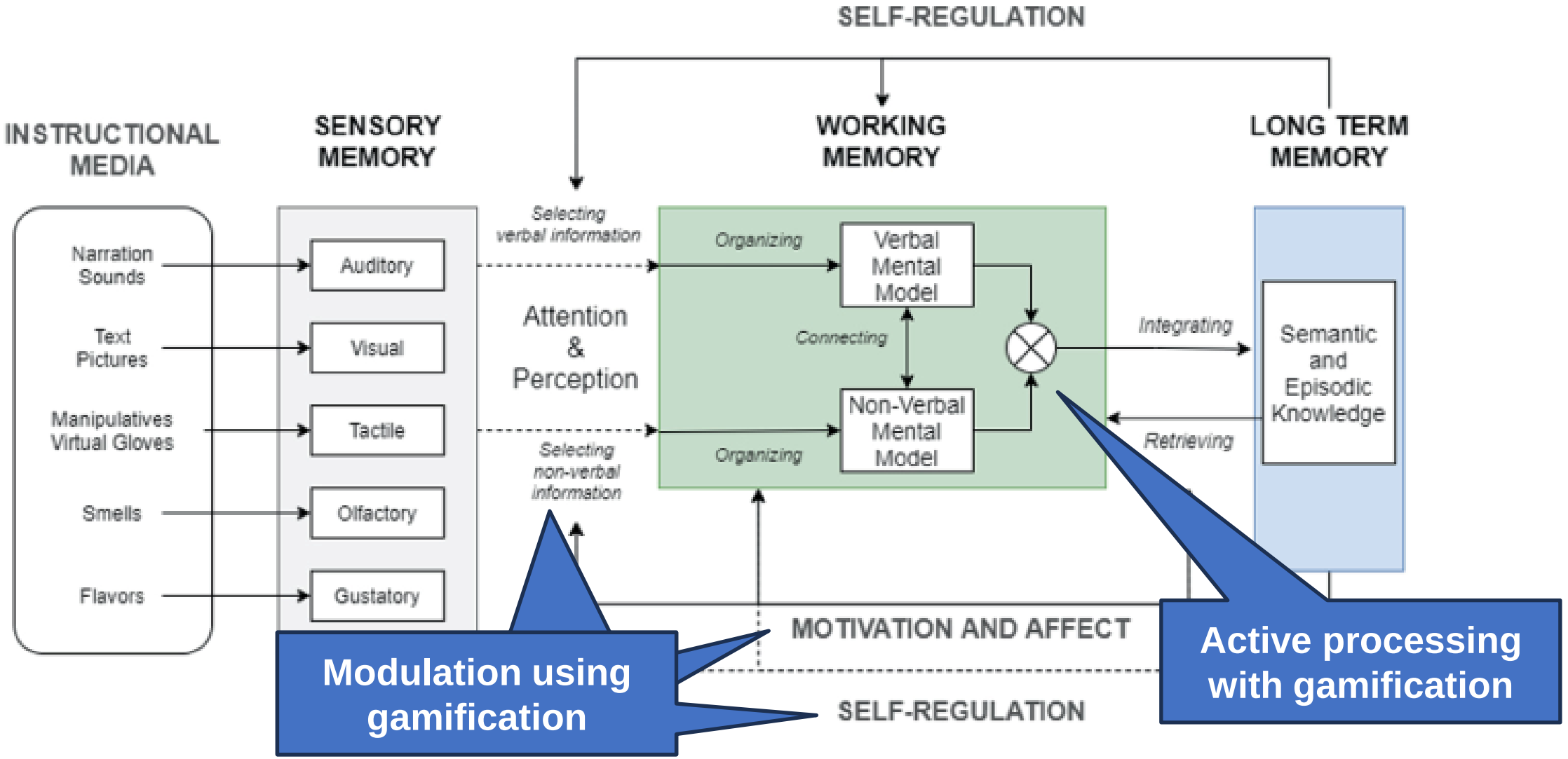

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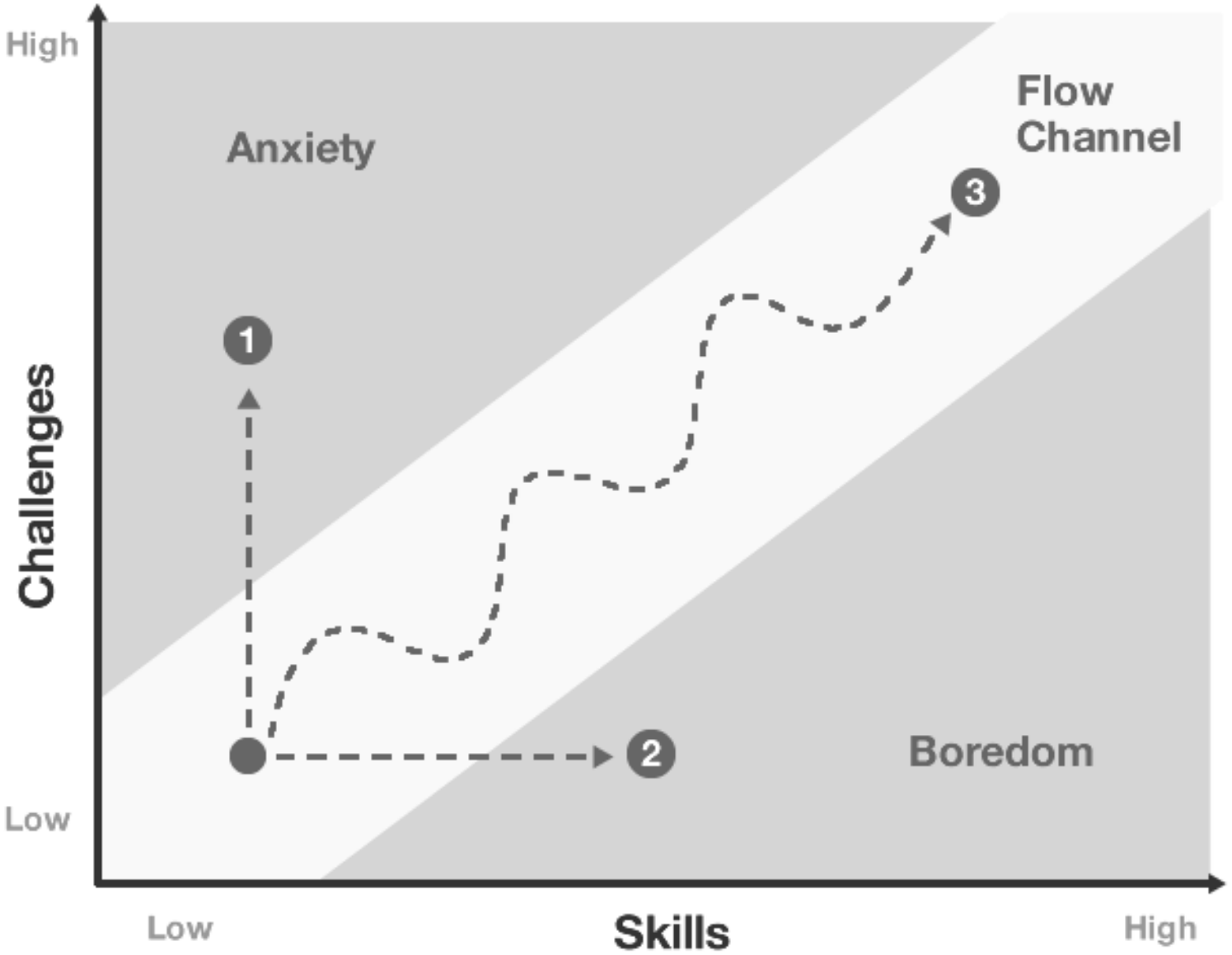
Modulating Gamification with Flow Theory

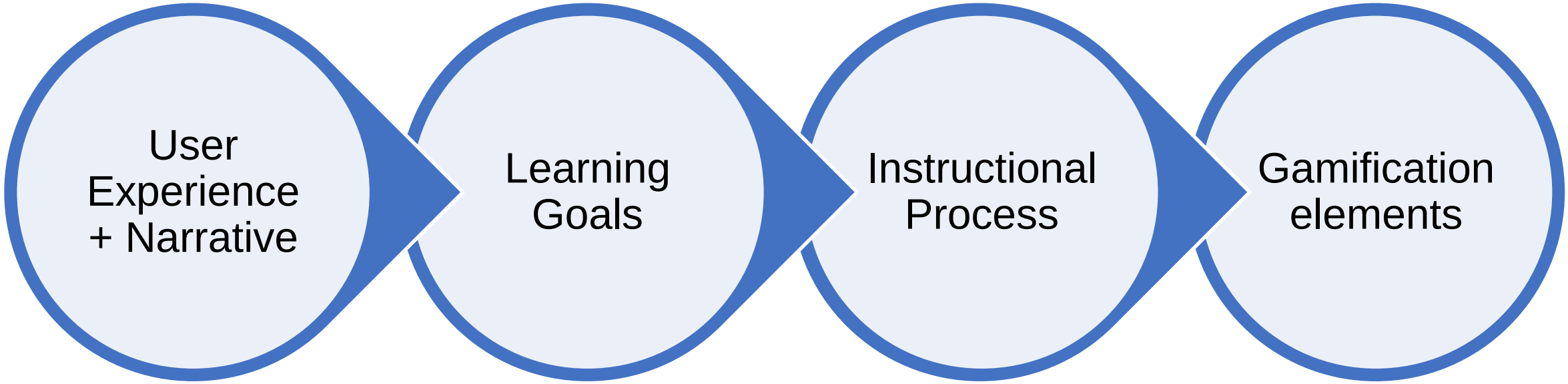


Nakamura, J.; Csikszentmihályi, M. (2001). "Flow Theory and Research". Handbook of Positive Psychology. Oxford University Press. pp. 195–206

https://gamedesign2016.wordpress.com/2016/01/27/week-2-flow-channel-endogenous-value-and-interaction-models/

Proposing a framework to design personalized gamification experiences

How to design personalized gamification activites?


User Experience + Narrative
Learning Goals
Instructional Process
Gamification elements

User Experience + Narrative

Learning Goals

Instructional Process

Gamification elements

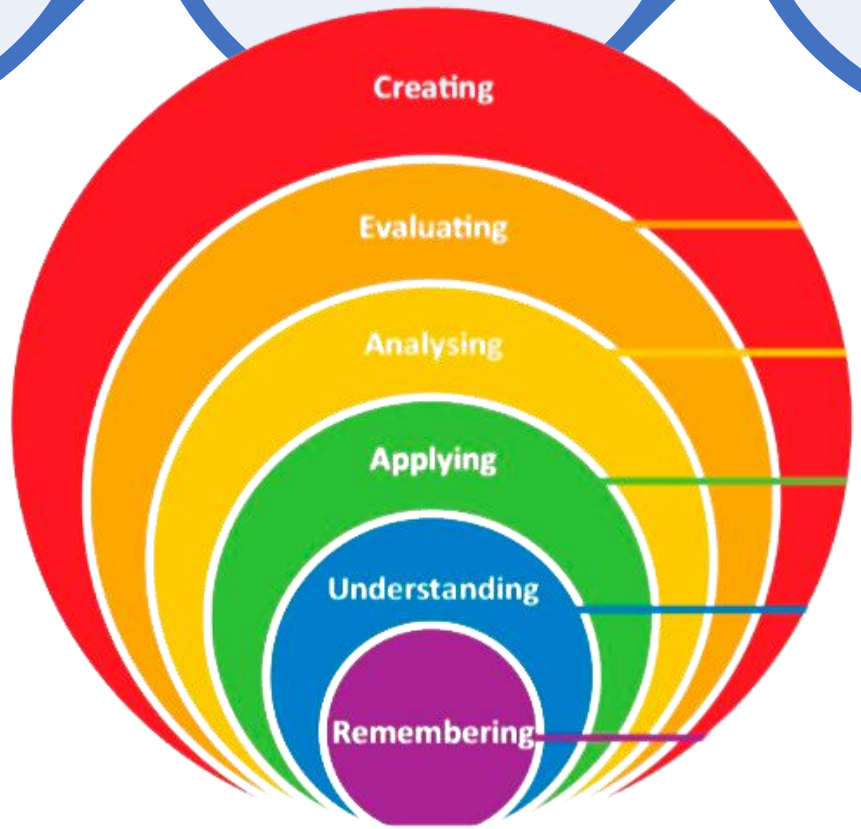
The Hero's Journey (Vlogler, 2017)

User Experience + Narrative

Learning Goals

Instructional Process

Gamification elements



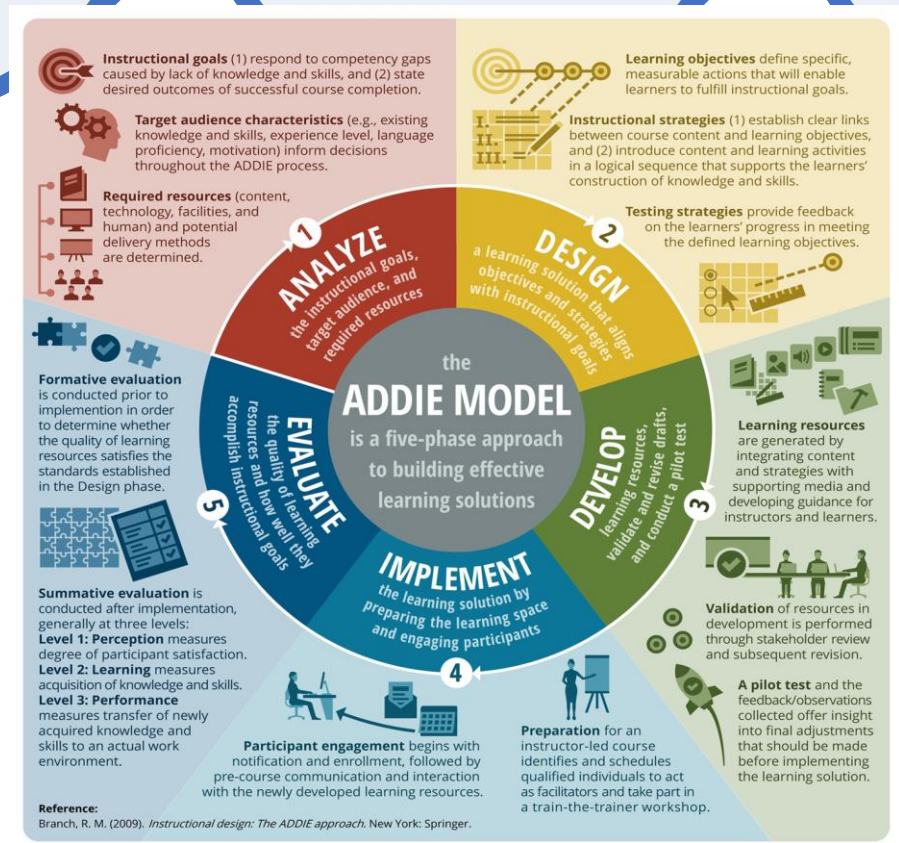
Bloom's Taxonomy (Anderson et al. 2001)

User Experience + Narrative

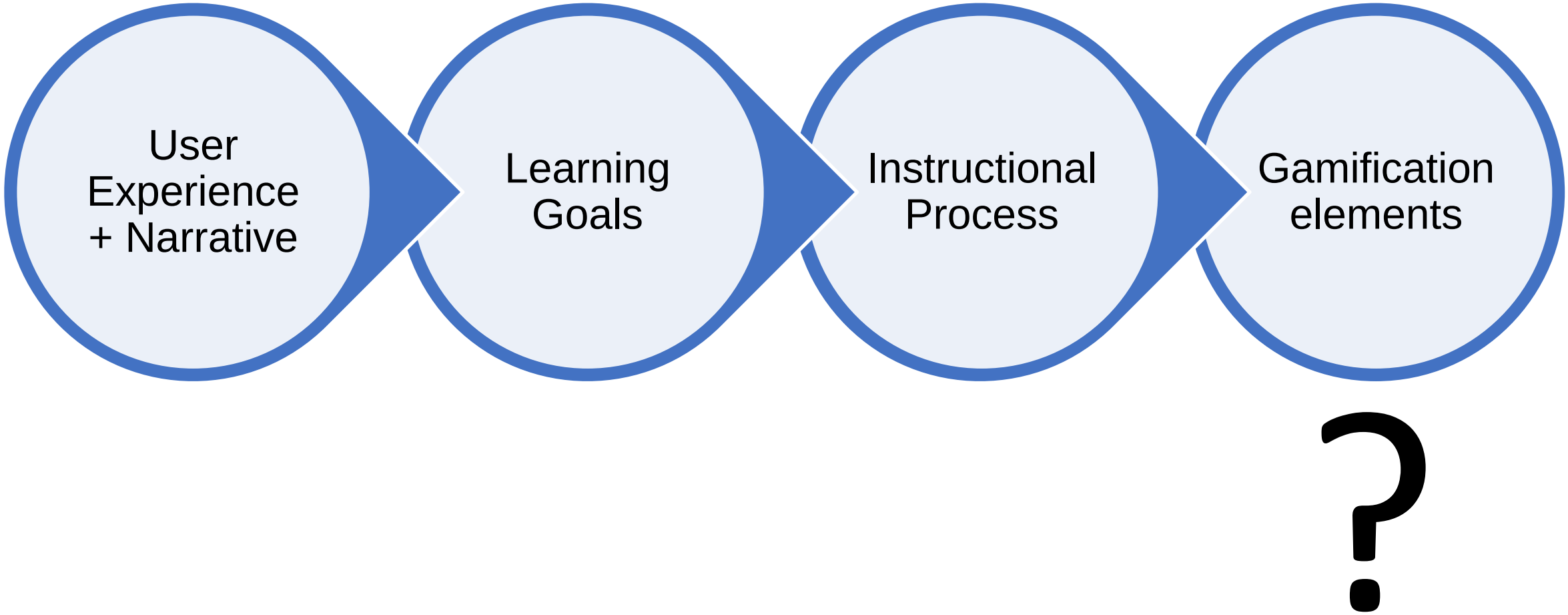
Learning Goals

Instructional Process

Gamification elements



Obsidian LEARNING


User Experience + Narrative
Learning Goals
Instructional Process
Gamification elements
?

1. How to select game design elements to support learning?

Most interesting result

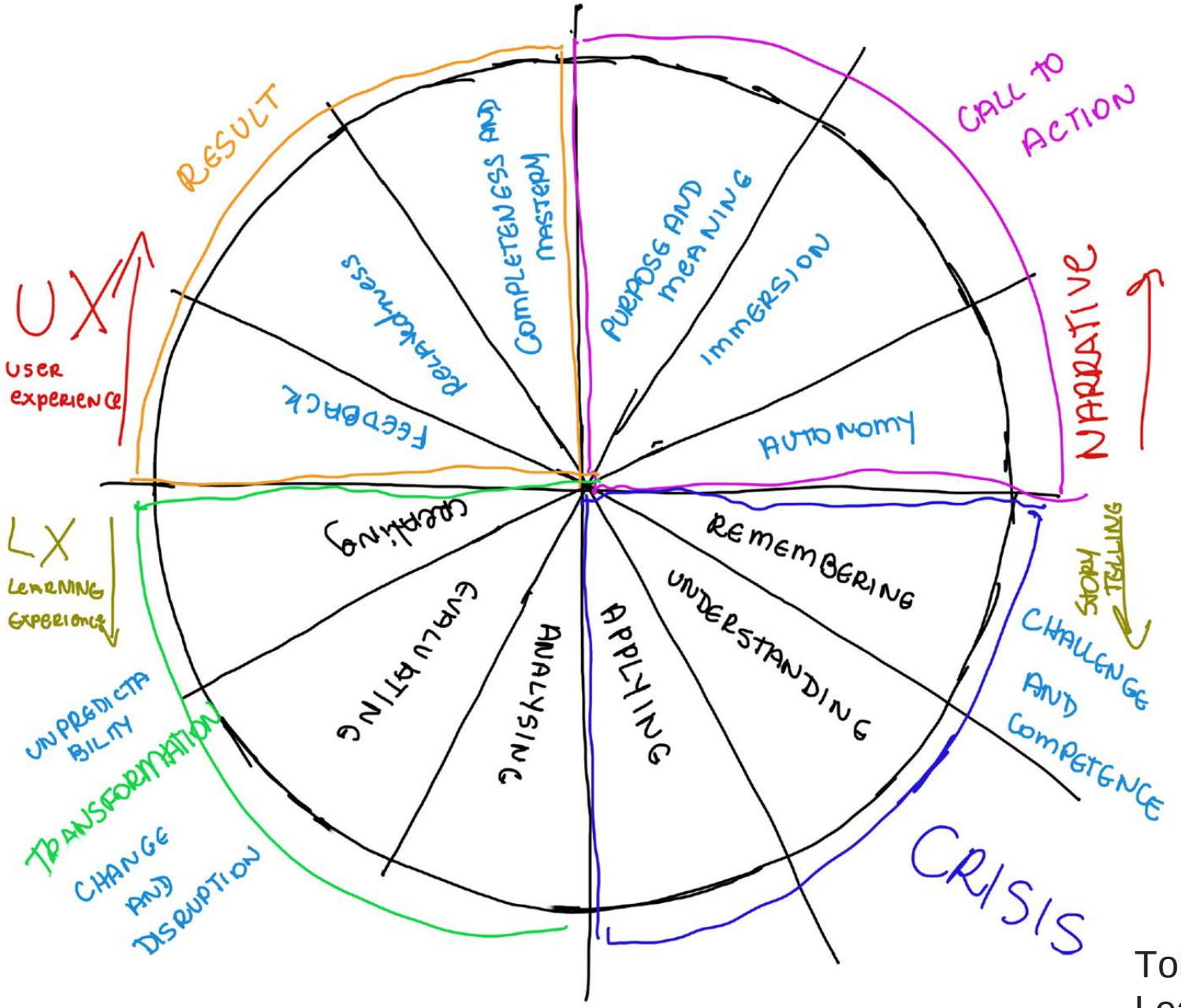
We collected data from specialists to identify the most relevant game elements that can be used in educational contexts to improve participation, motivation and engagement.

Game element	Likert Scale 1	2	3	4	5	Mean	SD
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

Toda, A. M., Klock, A. C., ... Isotani, S. & Cristea, A. I. (2019). **Analysing gamification elements in educational environments using an existing Gamification taxonomy**. *Smart Learning Environments*, *6*(1), 1-14.

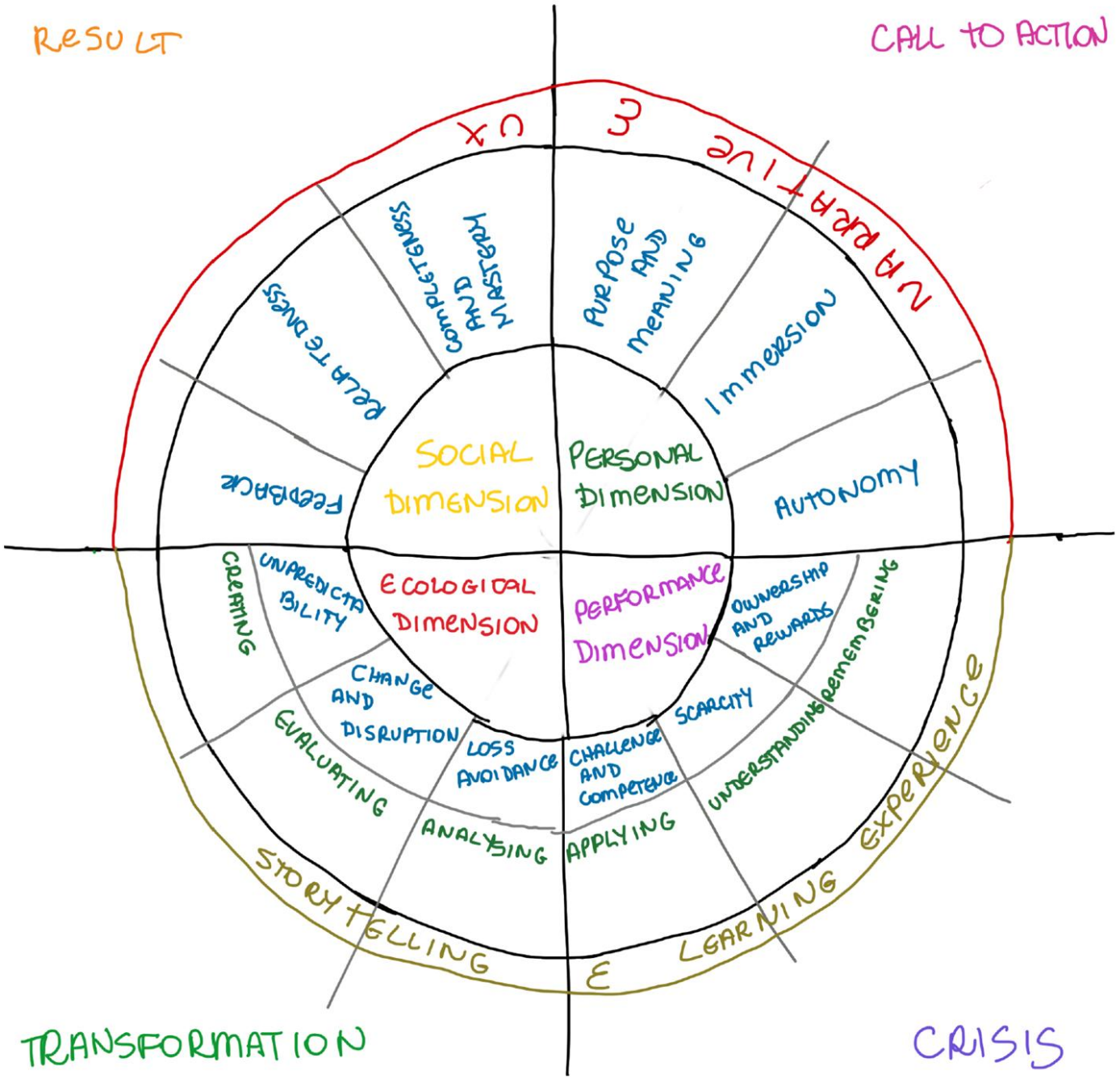
Taxonomy of game design elements that are commonly utilized in learning environments

Toda, A. M., Klock, A. C., ... Isotani, S. & Cristea, A. I. (2019). **Analysing gamification elements in educational environments using an existing Gamification taxonomy**. *Smart Learning Environments*, *6*(1), 1-14.



Student's Journey and Experience + Learning Goals

Toledo, P. (2022) Gamification of Virtual Learning Environments: A Narrative and User Experience Approach. Ph.D. Thesis



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

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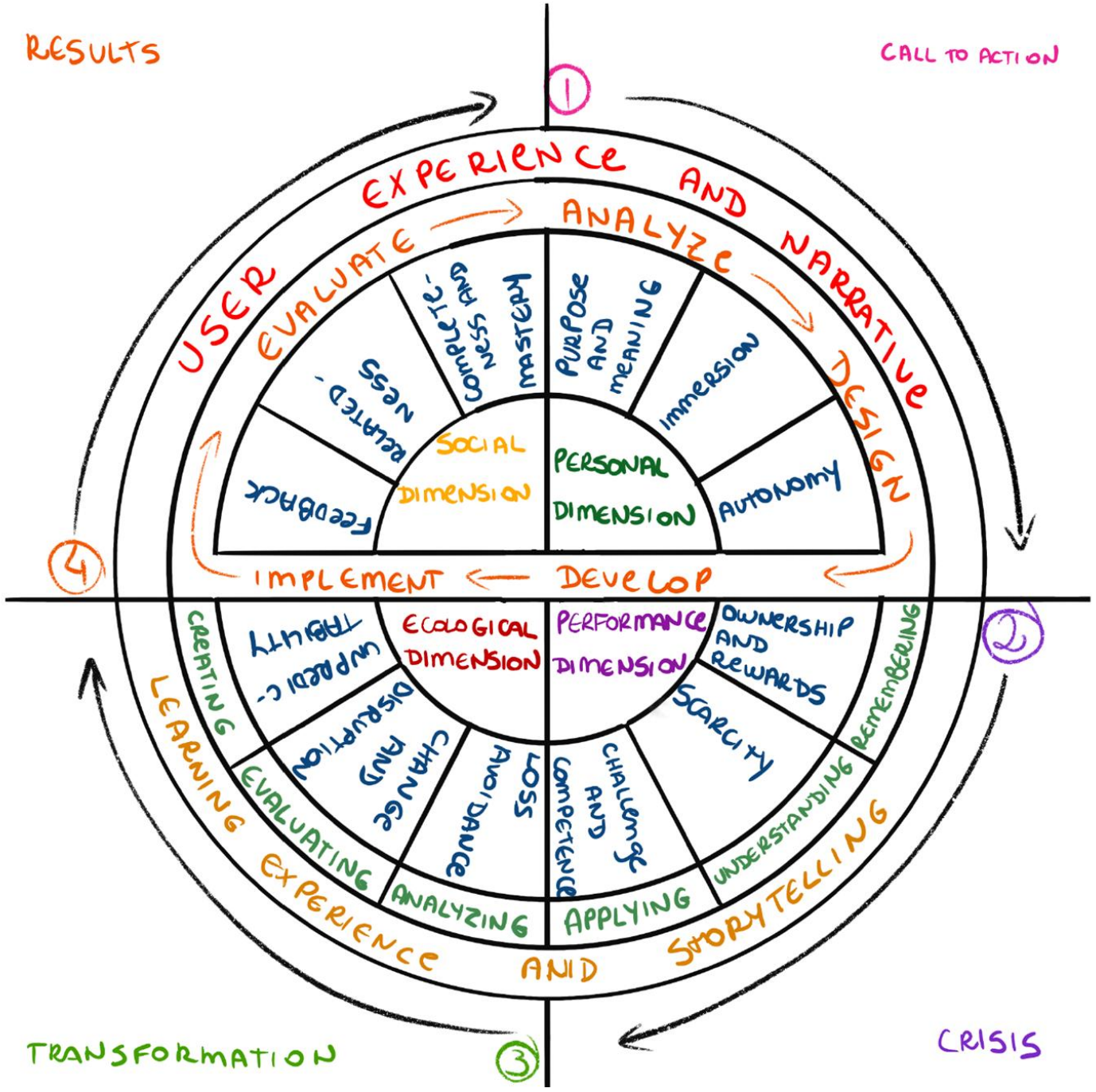


Student's Journey and Experience

+

Learning Goals

+

Gaminfication elements

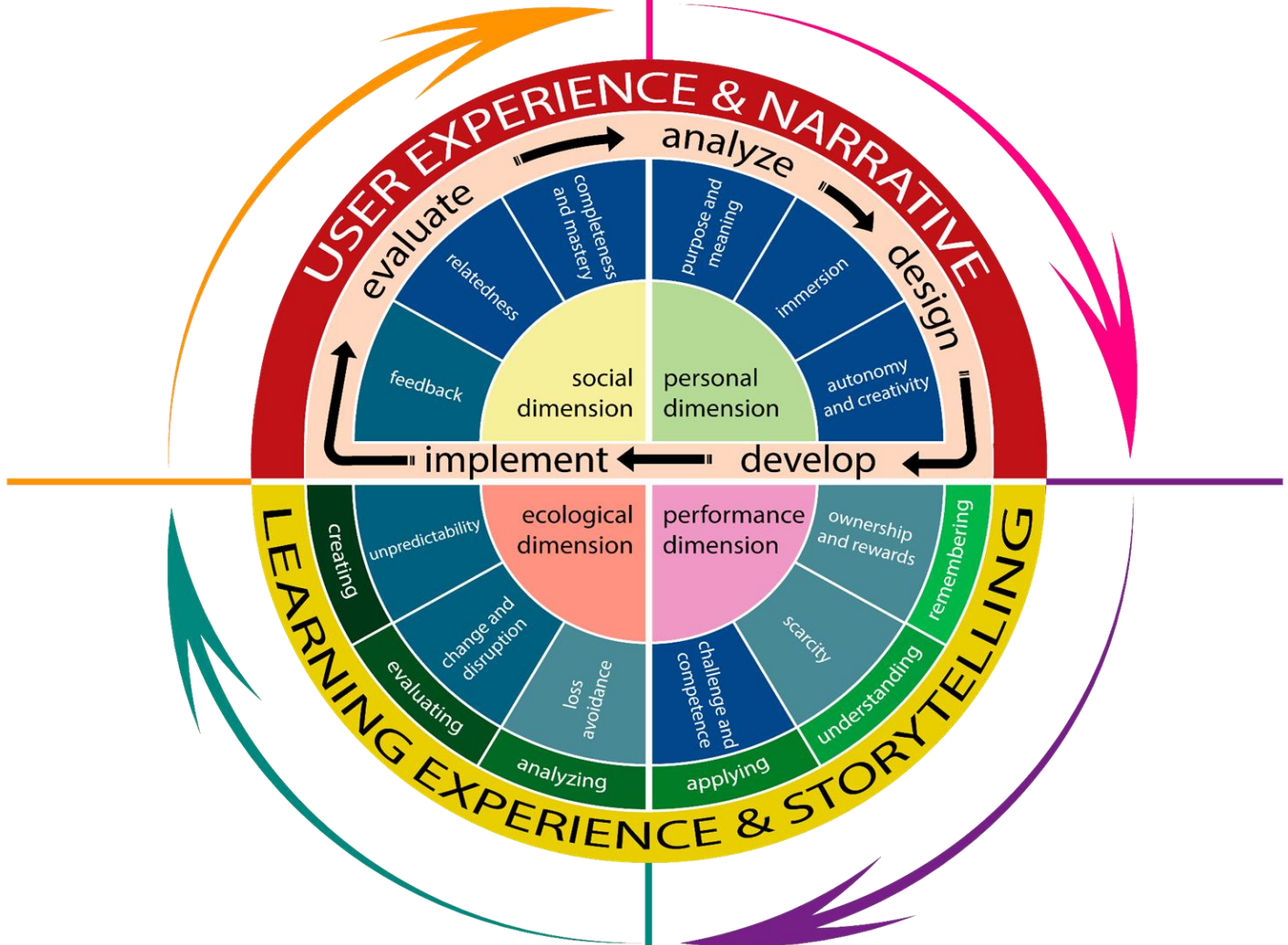
+

Instructional design

Toledo, P. (2022) Gamification of Virtual Learning Environments: A Narrative and User Experience Approach. Ph.D. Thesis

④ Results

Call to Action ①



③ Transformation

Trials ②

Toledo, P. (2022) Gamification of Virtual Learning Environments: A Narrative and User Experience Approach. Ph.D. Thesis

Step by Step

Act 1: Call to Action

- Purpose and Meaning
- Immersion
- Autonomy and Creativity

Example of use

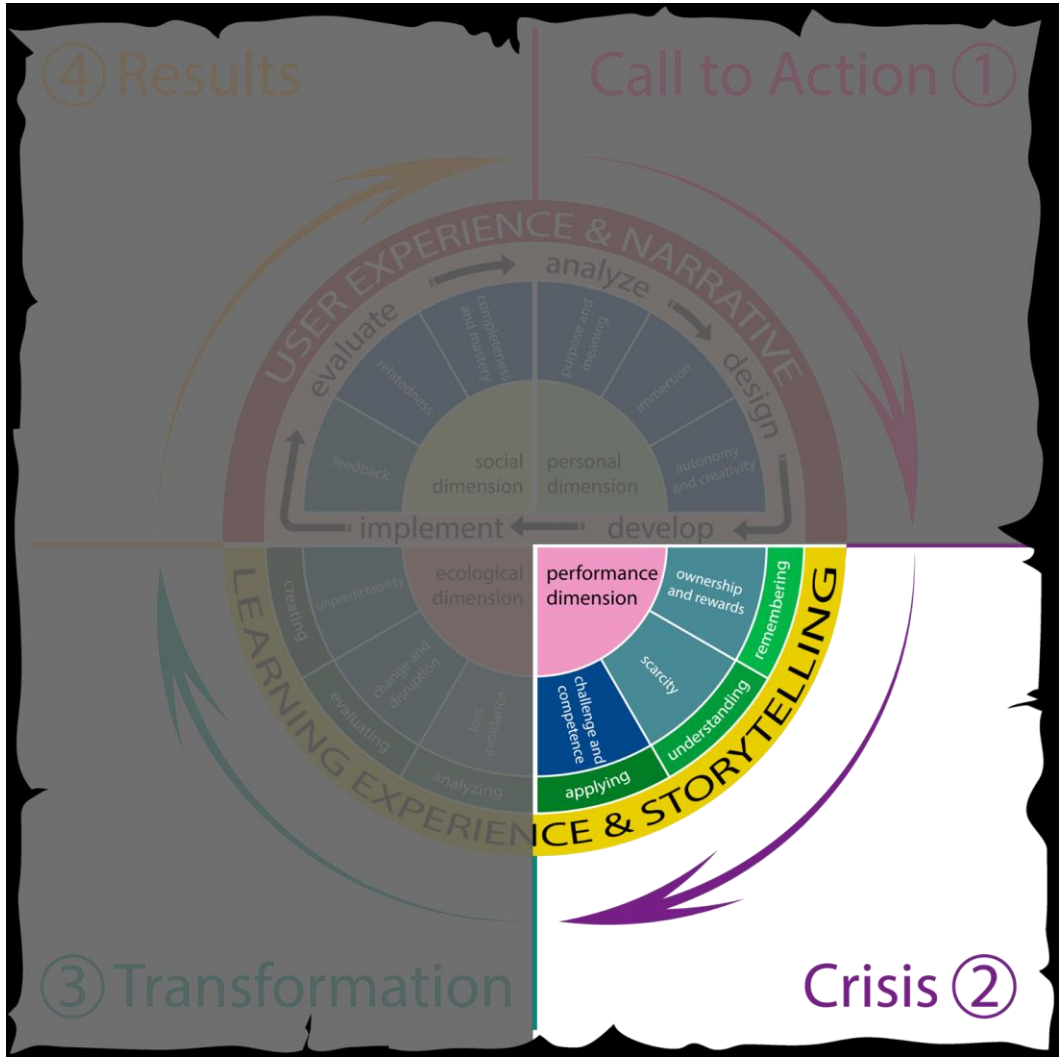
Personal Dimension

Step by Step

Act 2: Crisis (Conflict)

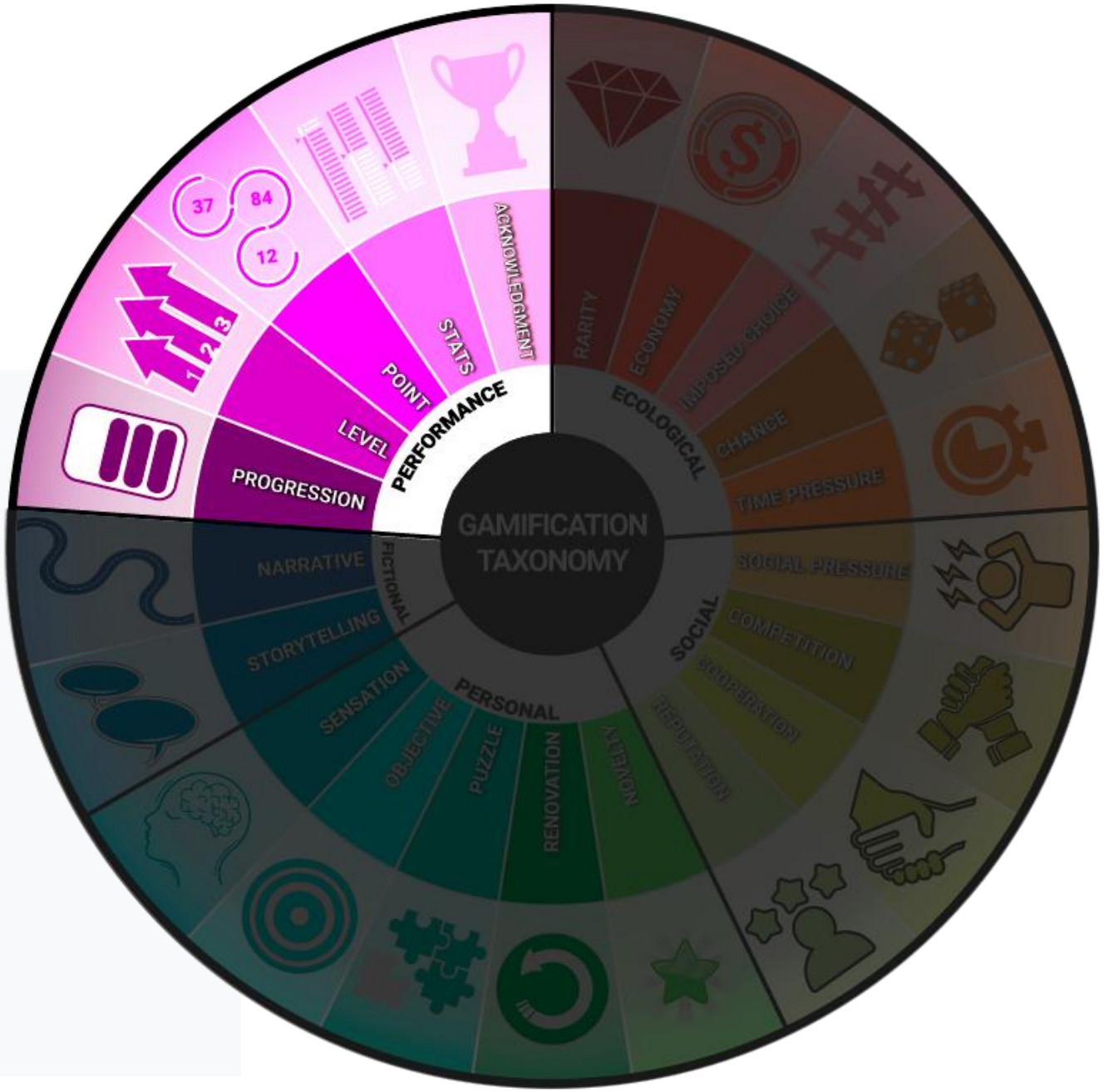
take the student out of their 'comfort zone', and **challenge them to grow.**

- Ownership and Rewards
- Scarcity
- Challenge and Competence



Step by Step

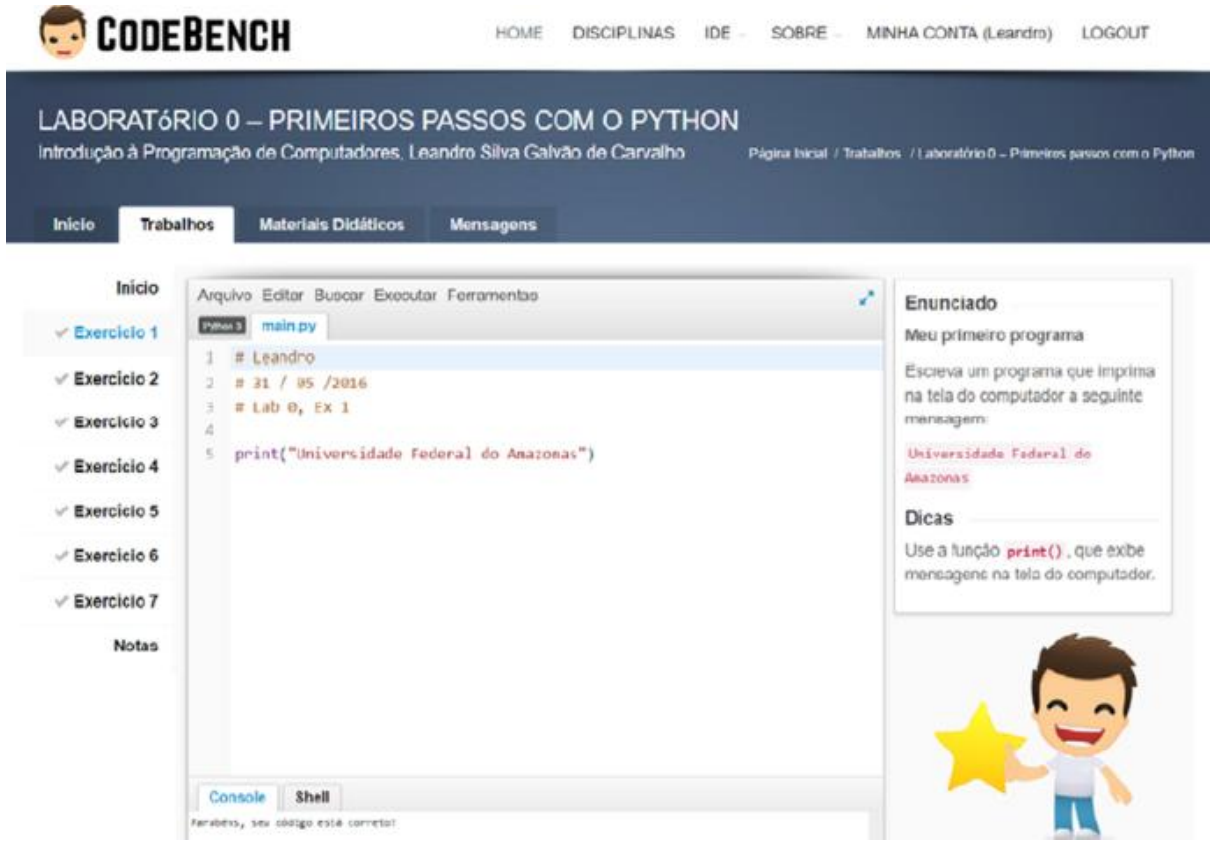
Performance Dimension



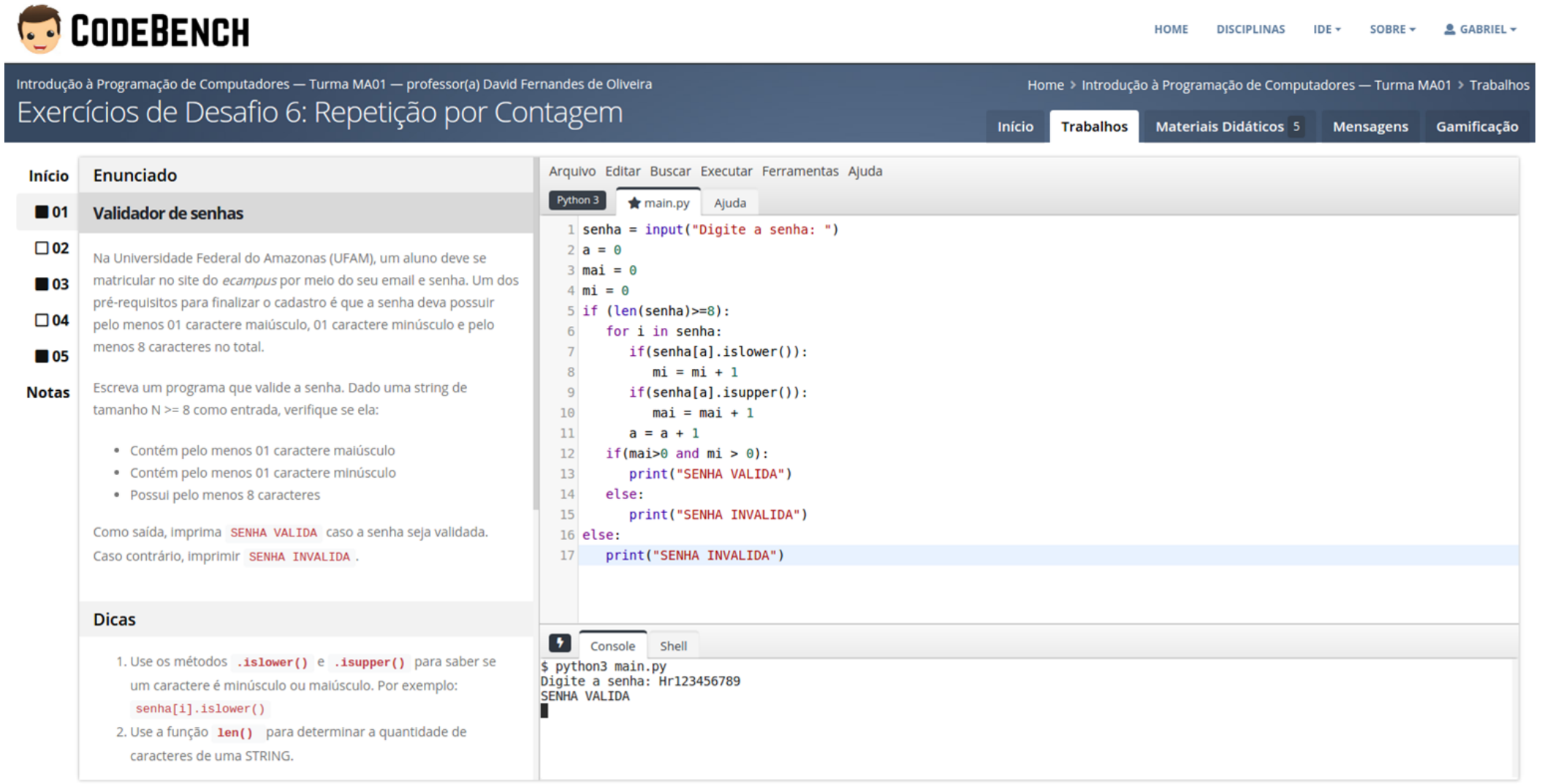
Testing the framework

Understanding the impact of personalized gamification over time on Students' behavior

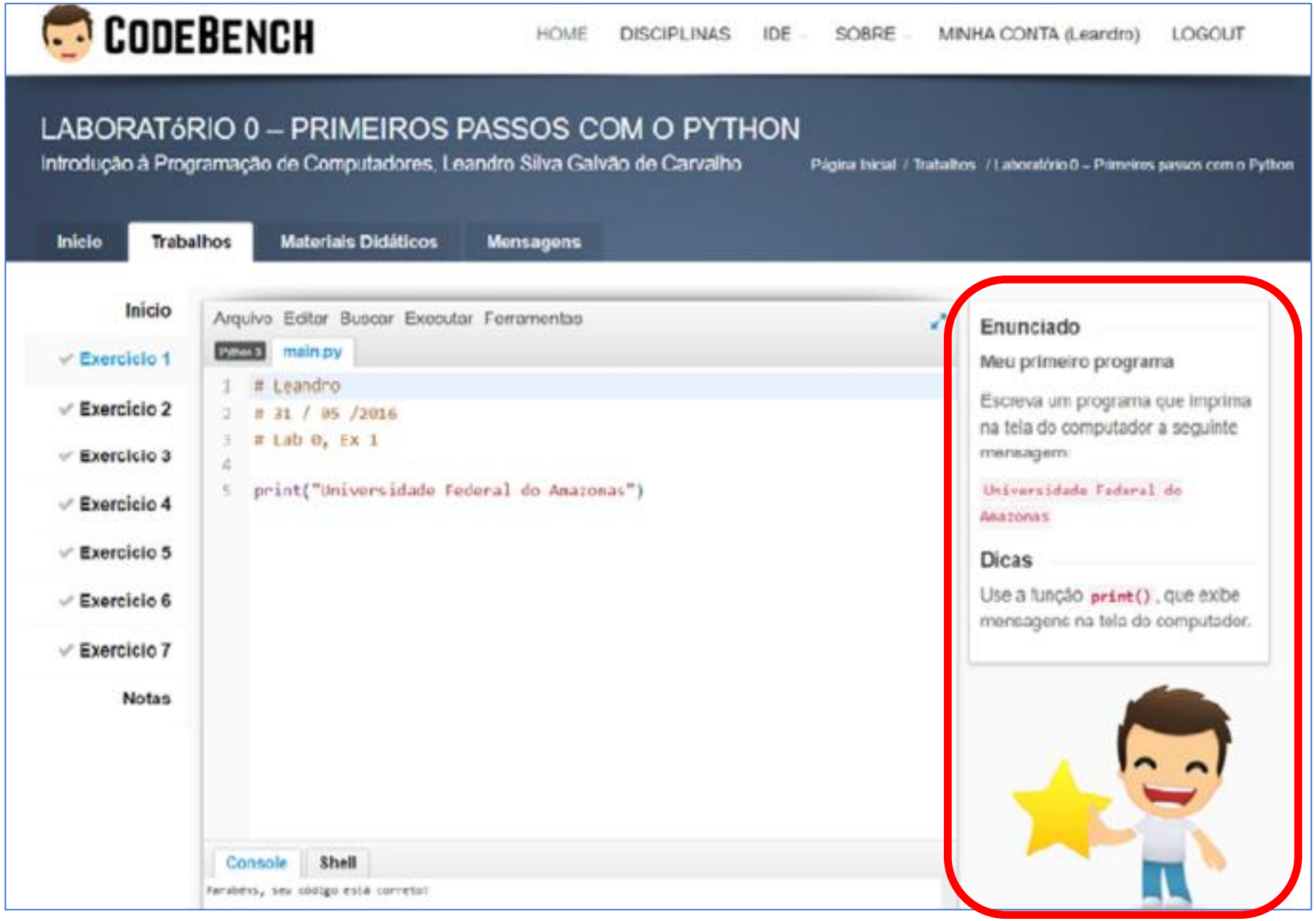
Rodrigues, L'., Pereira, F. D., ... & Isotani, S. (2022**). Gamification suffers from the novelty effect but benefits from the familiarization effect: Findings from a longitudinal study**. *International Journal of Educational Technology in Higher Education*, *19*(1), 1-25.



Online Judge - Experimental Task



Gamification suffers from the novelty effect but benefits from the familiarization effect (IJETHE)


CODEBENCH
HOME
DISCIPLINAS
IDE
SOBRE
MINHA CONTA (Leandro)
LOGOUT
LABORATÓRIO 0 – PRIMEIROS PASSOS COM O PYTHON
Introdução à Programação de Computadores, Leandro Silva Galvão de Carvalho
Página Inicial / Trabalhos / Laboratório 0 – Primeiros passos com o Python
Início
Trabalhos
Materiais Didáticos
Mensagens
Início
Exercício 1
Exercício 2
Exercício 3
Exercício 4
Exercício 5
Exercício 6
Exercício 7
Notas
Arquivo Editar Buscar Executar Ferramentas
Python 3
main.py
1 # Leandro
2 # 31 / 05 /2016
3 # Lab 0, Ex 1
4
5 print("Universidade Federal do Amazonas")
Console
Shell
Parabéns, seu código está correto!
Enunciado
Meu primeiro programa
Escreva 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.

Enredos da gamificação: Geral | Capítulo 1 | Capítulo 2 | Capítulo 3 | Capítulo 4 | Capítulo 5 | Capítulo 6 | Final

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 comércios. Entretanto, as demais partes do Reino de Midgard continuam inacessíveis. Um lacaio da **Quimera**, chamado **Stuark**, é o culpado por manter as duas vilas isoladas. **Stuark** 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: "destrancando os oito cadeados na porta do templo". Para destrancar os cadeados você precisa se 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 **Stuark**. 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.

Guerreiros e Guerreiras — Grupo Bronze 3

Gustavo Antonio de Paula Santos
Nível **3** Experiência **110** x**115**

Vida 340/340
Energia 48/48

Lua Gabriella Gonçalves Maia
Nível **2** Experiência **86** x**80**

Vida 295/320
Energia 44/44

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

CODEBENCH

HOME DISCIPLINAS IDE SOBRE MINHA CONTA (Leandro) LOGOUT

CODEBENCH

HOME TURMAS IDE SOBRE SE

LAB
Introdu
Inicie

Seiji Isotani

PROFESSOR(A)

Objetivos da disciplina

https://uspdigital.usp.br/jupiterweb/obterDisciplina?sgldis=SSC0600

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

TOTAL DE PONTOS GANHOS 10.0%

TRABALHOS COM 10.0 10.0%

MENSAGENS LIDAS 0.0%

MATERIAIS BAIXADOS 0.0%

Gamification: Immersive, Social, Challenge

Gamification suffers from the novelty effect but benefits from the familiarization effect (IJETHE)

Study Overview

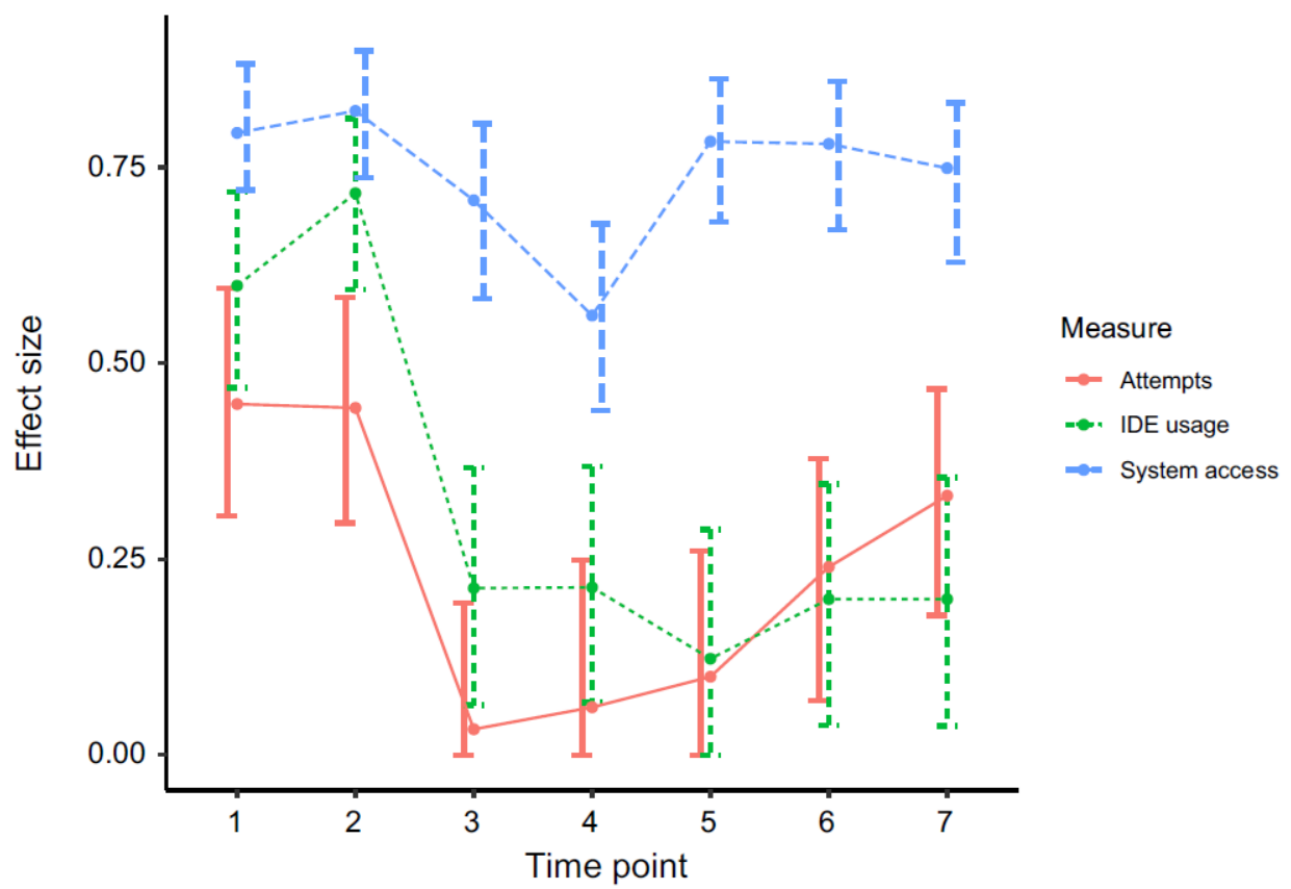
- 2x2 quasi-experimental study
  - Gamification: yes or no
  - Usage time: seven weeks

- Dataset
  - CS1, STEM students from UFAM
  - Data from 756 students (2016 to 2018)
  - Measures: Attempts, IDE usage, system access

- (Robust) Data Analysis
  - Two-way ANOVAs
  - Effect size comparisons per time point

Gamification suffers from the novelty effect but benefits from the familiarization effect (IJETHE)

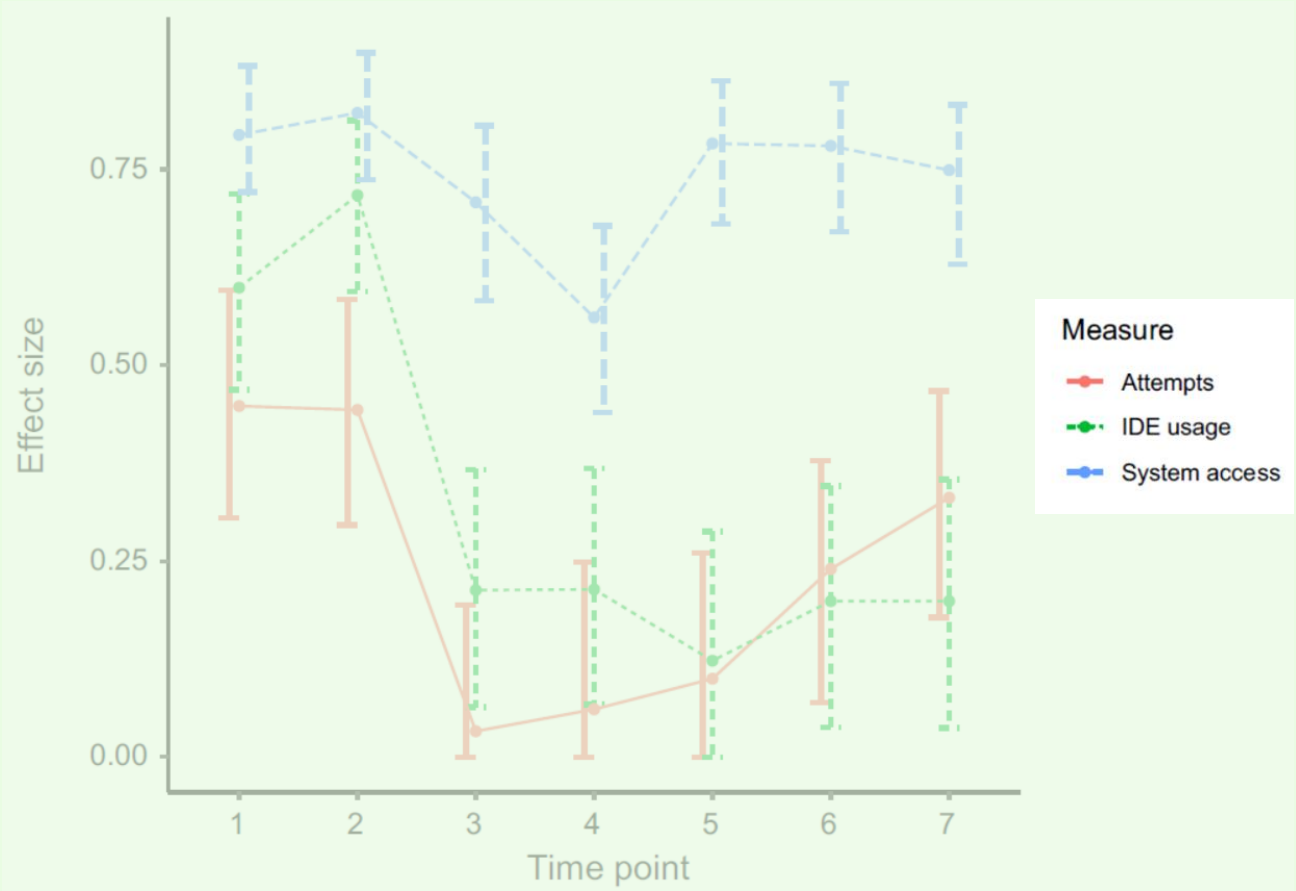
Personalized Gamification's effect over time



Bootstrap-based, 90% CIs for non-gamified vs gamified

Gamification suffers from the novelty effect but benefits from the familiarization effect (IJETHE)

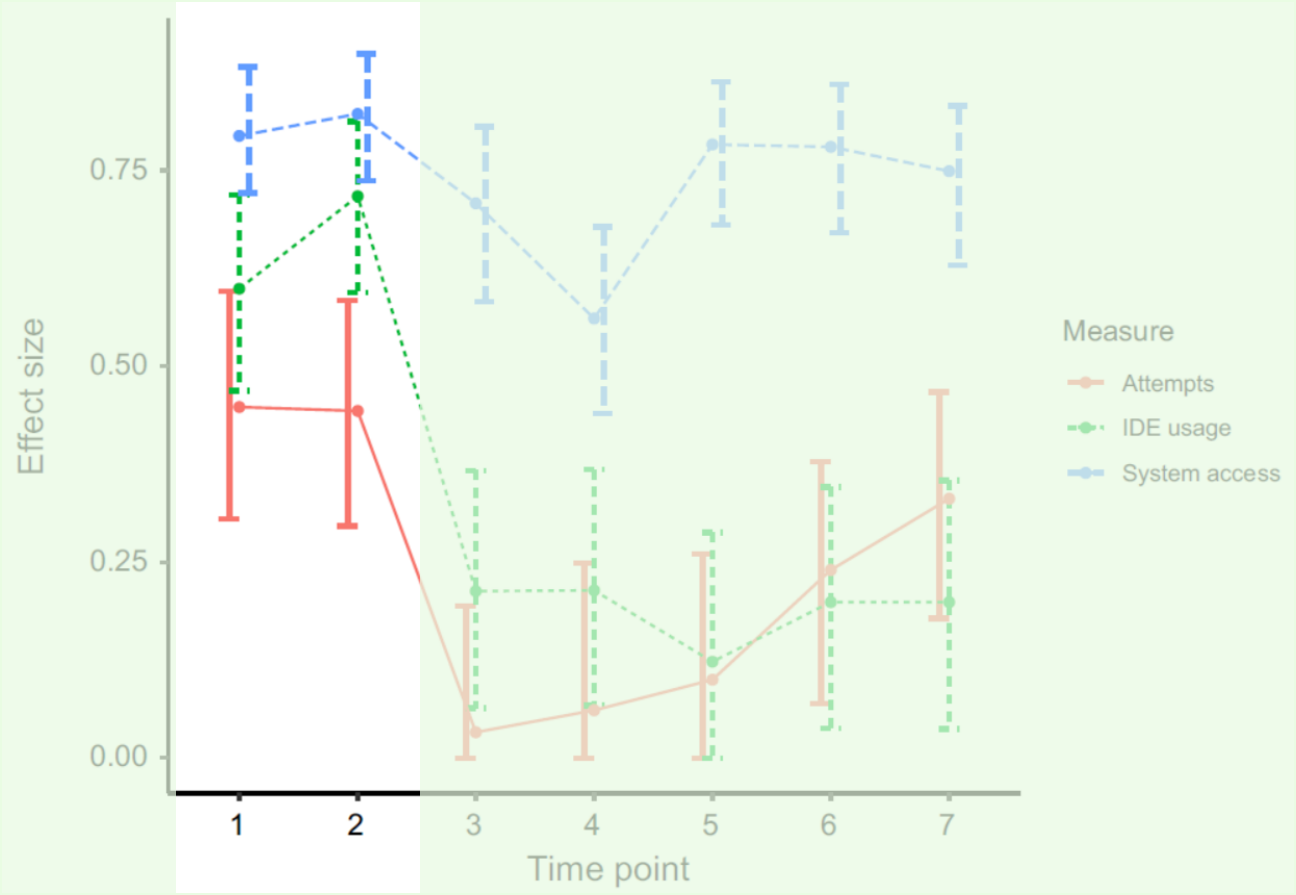
Personalized Gamification's effect over time



Bootstrap-based, 90% CIs for non gamified vs gamified

Gamification suffers from the novelty effect but benefits from the familiarization effect (IJETHE)

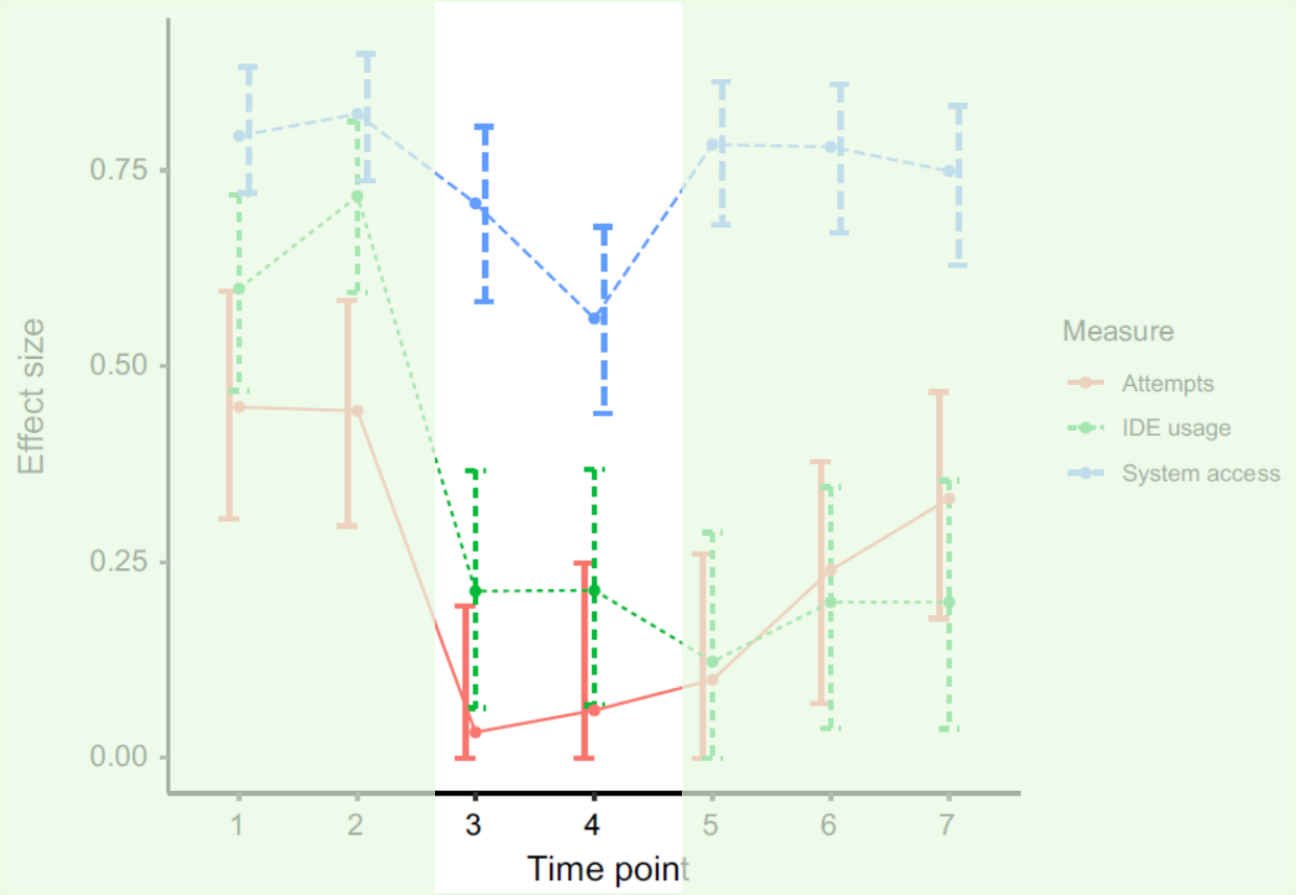
Gamification really works, until ...



Bootstrap-based, 90% CIs for non gamified vs gamified

Gamification suffers from the novelty effect but benefits from the familiarization effect (IJETHE)

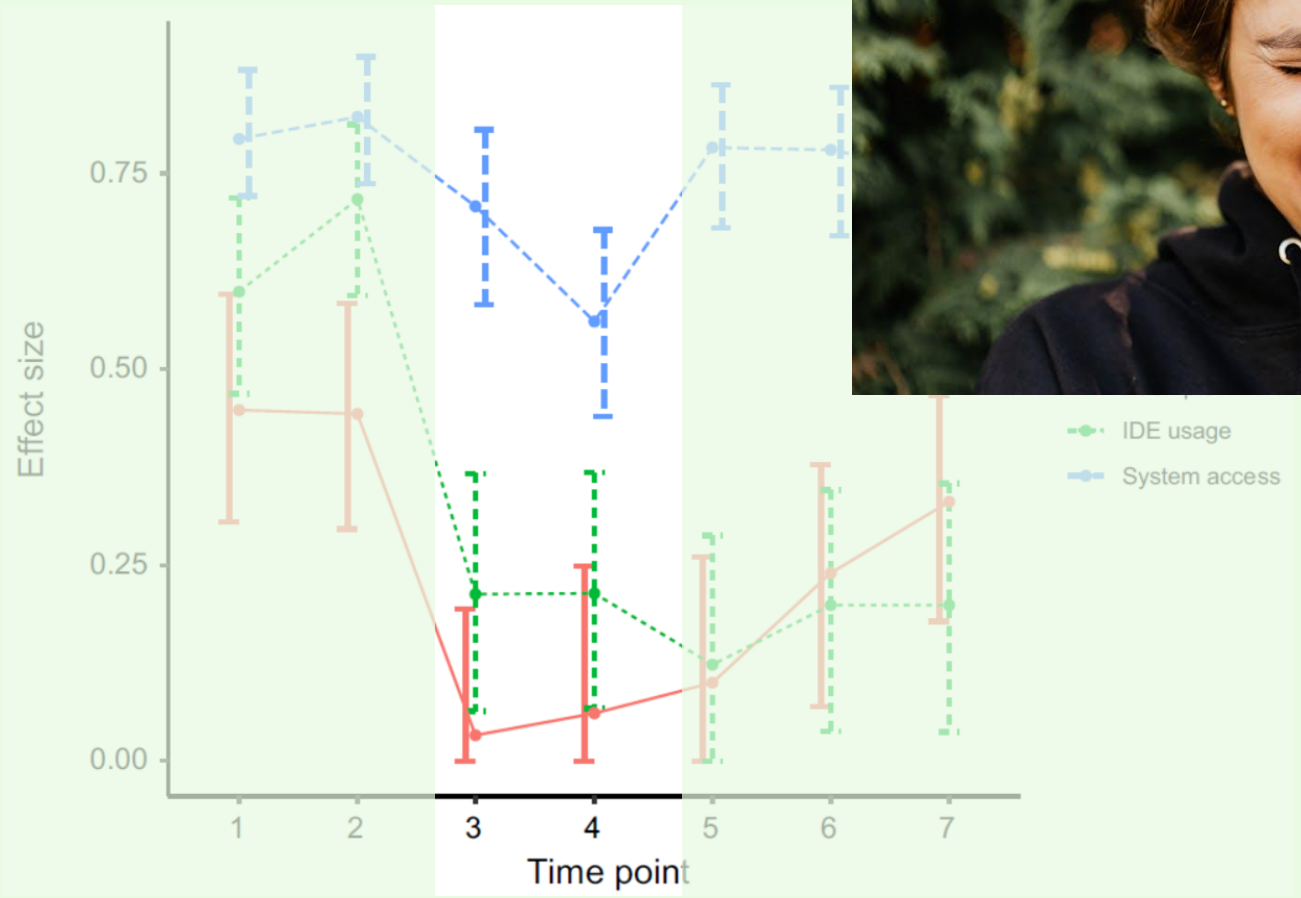
… the novelty effect wears off



Bootstrap-based, 90% CIs for non gamified vs gamified

Gamification suffers from the novelty effect but benefits from the familiarization effect (IJETHE)

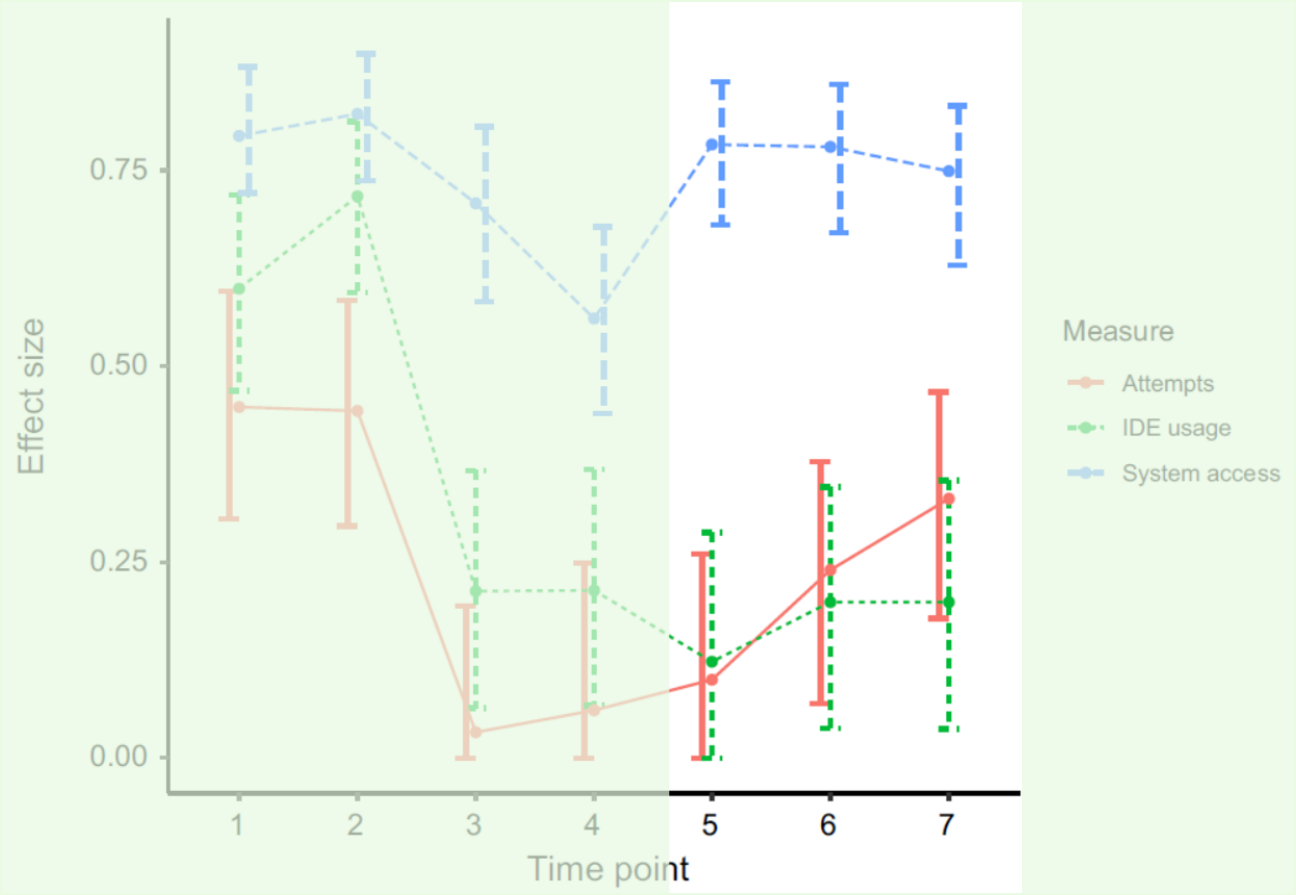
… the novelty effect wears off, bu



Bootstrap-based, 90% CIs for non gamified vs gamified

Gamification suffers from the novelty effect but benefits from the familiarization effect (IJETHE)

... familiarization brings light

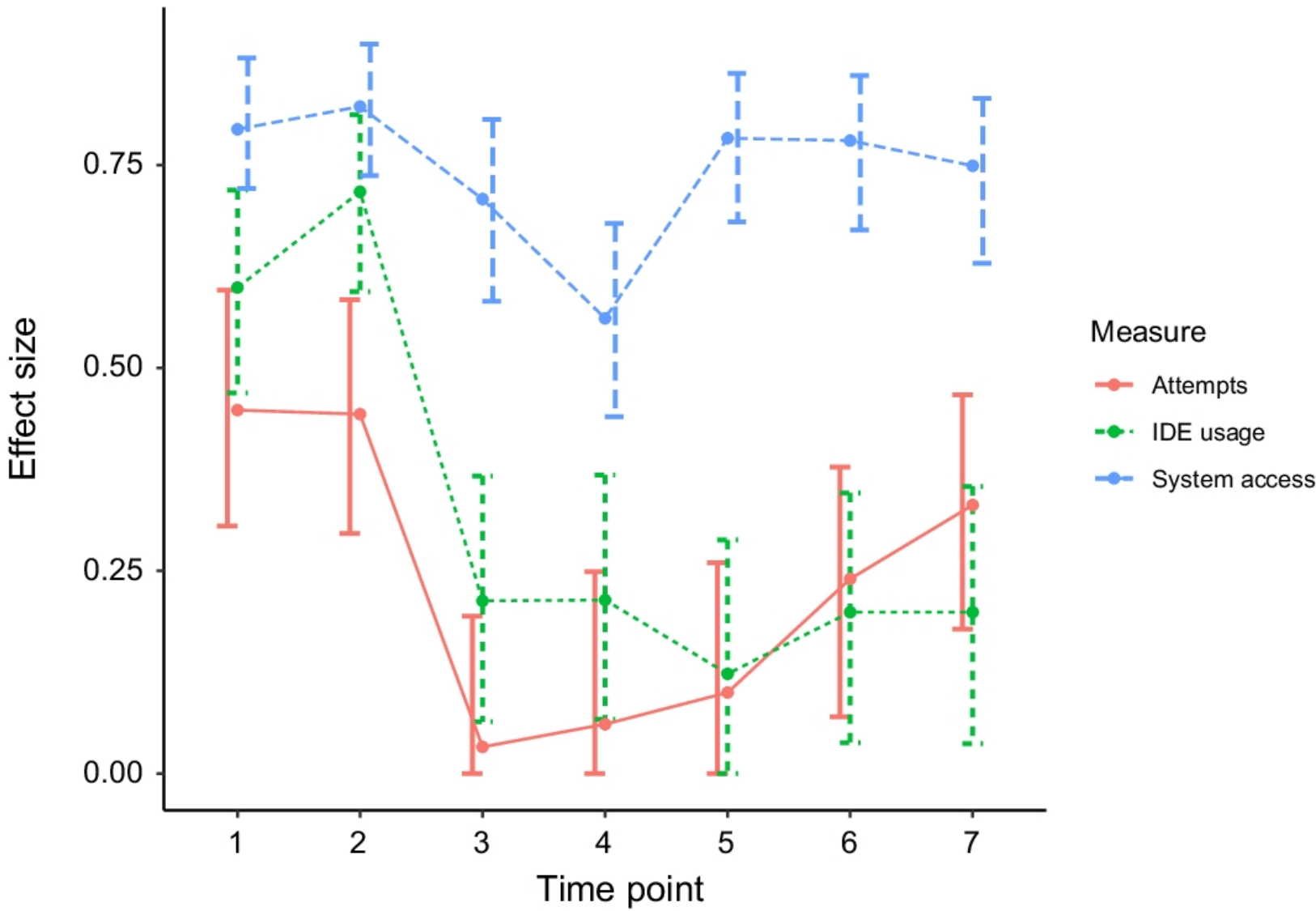


Bootstrap-based, 90% CIs for non gamified vs gamified

Gamification suffers from the novelty effect but benefits from the familiarization effect (IJETHE)

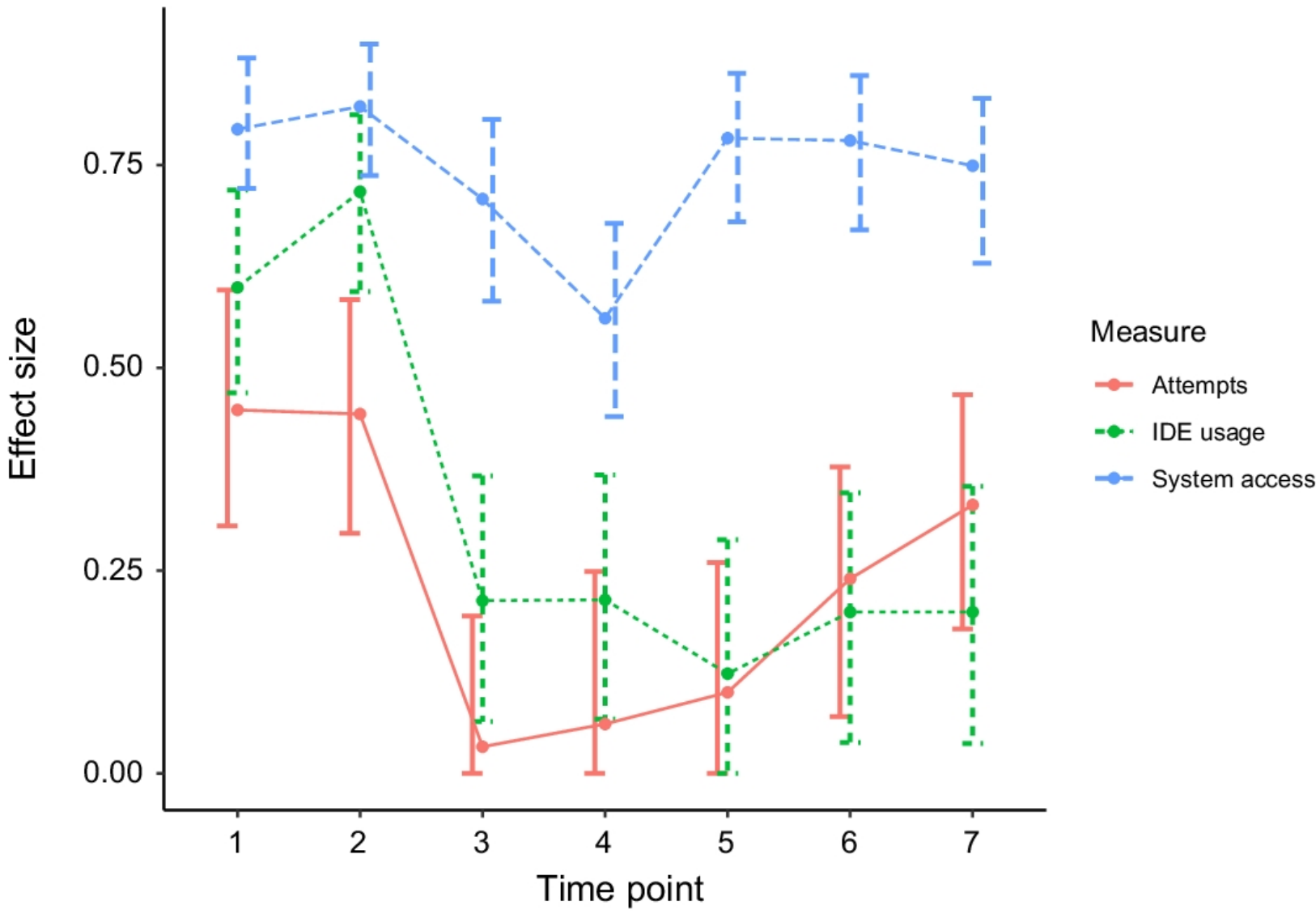
Most interesting result

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.**



My co-authors didn't like it, but I friendly call this phenomena:

THE SMILEY EFFECT



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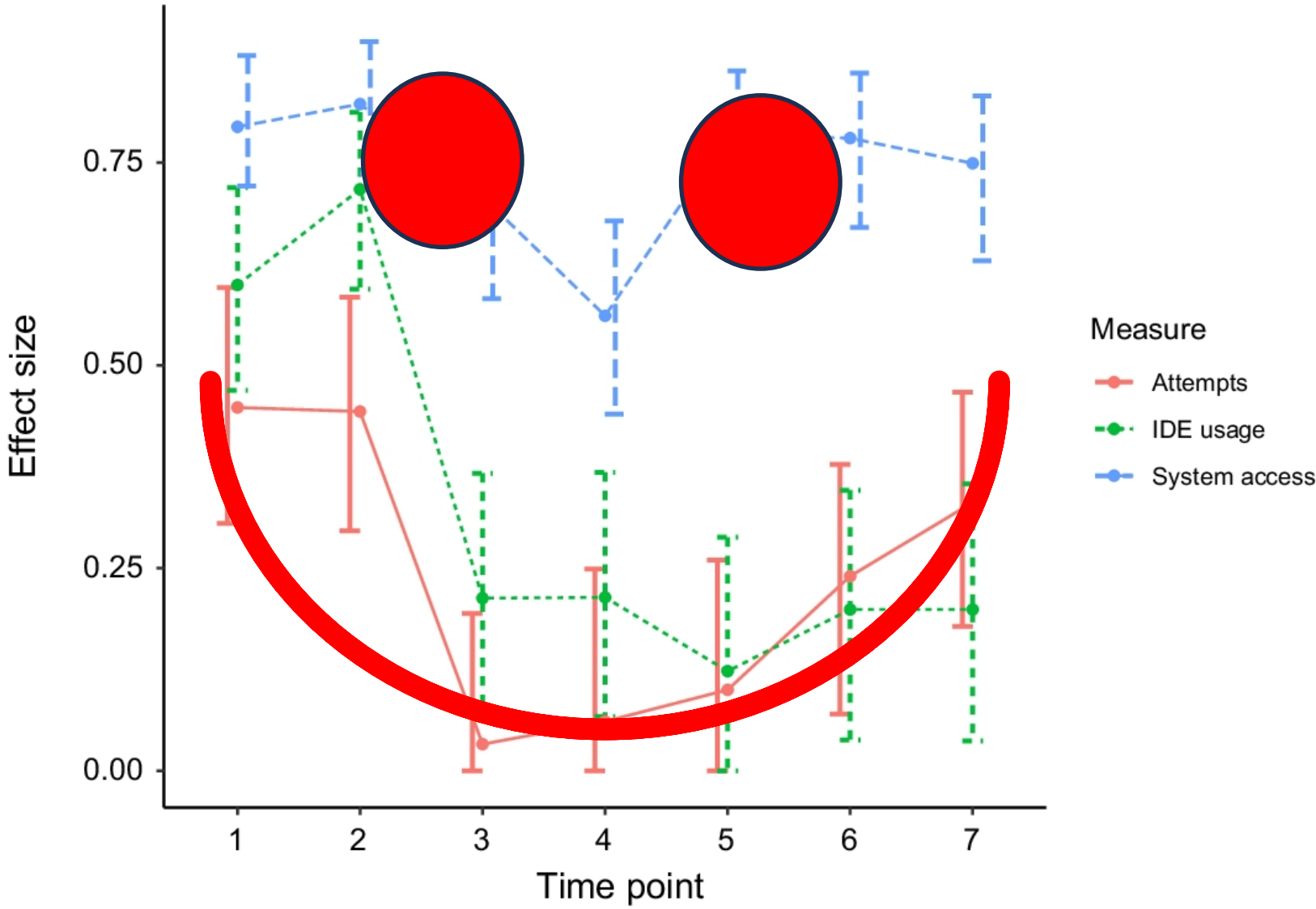


How to assist teachers to use our framework and augment their capabilities to design gamification scenarios considering other contextual variables?

- Data collected from 361 individuals from 19 different countries

- We investigate how to semi-automatically tailor gamification designs to users considering:
- geographic location, learning activity types, gender, game preferences, previous game experiences, etc.

Rodrigues, L., Toda, A. M., ...& Isotani, S. (2022). **Automating gamification personalization to the user and beyond.** *IEEE Transactions on Learning Technologies*, *15*(2), 199-212.

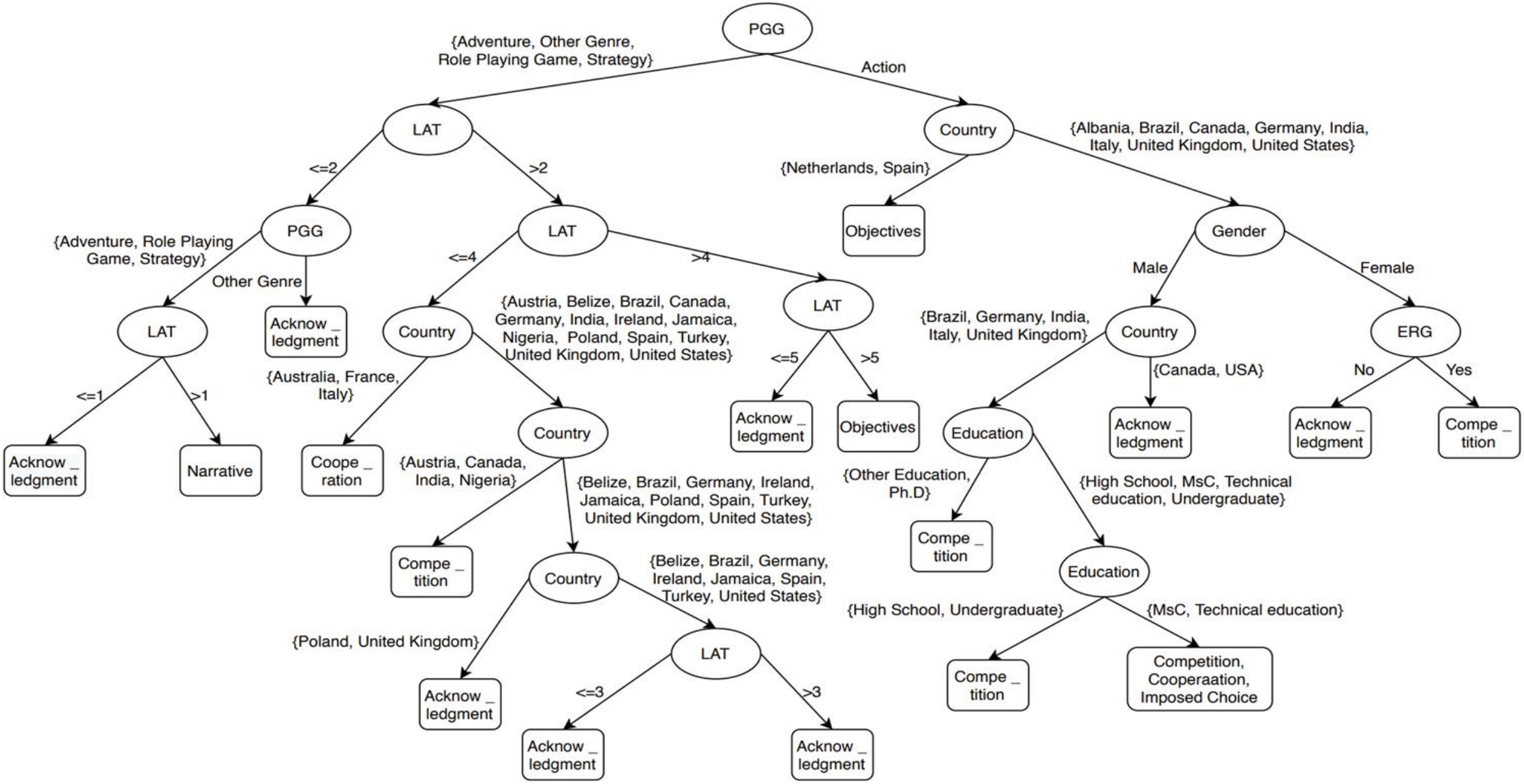
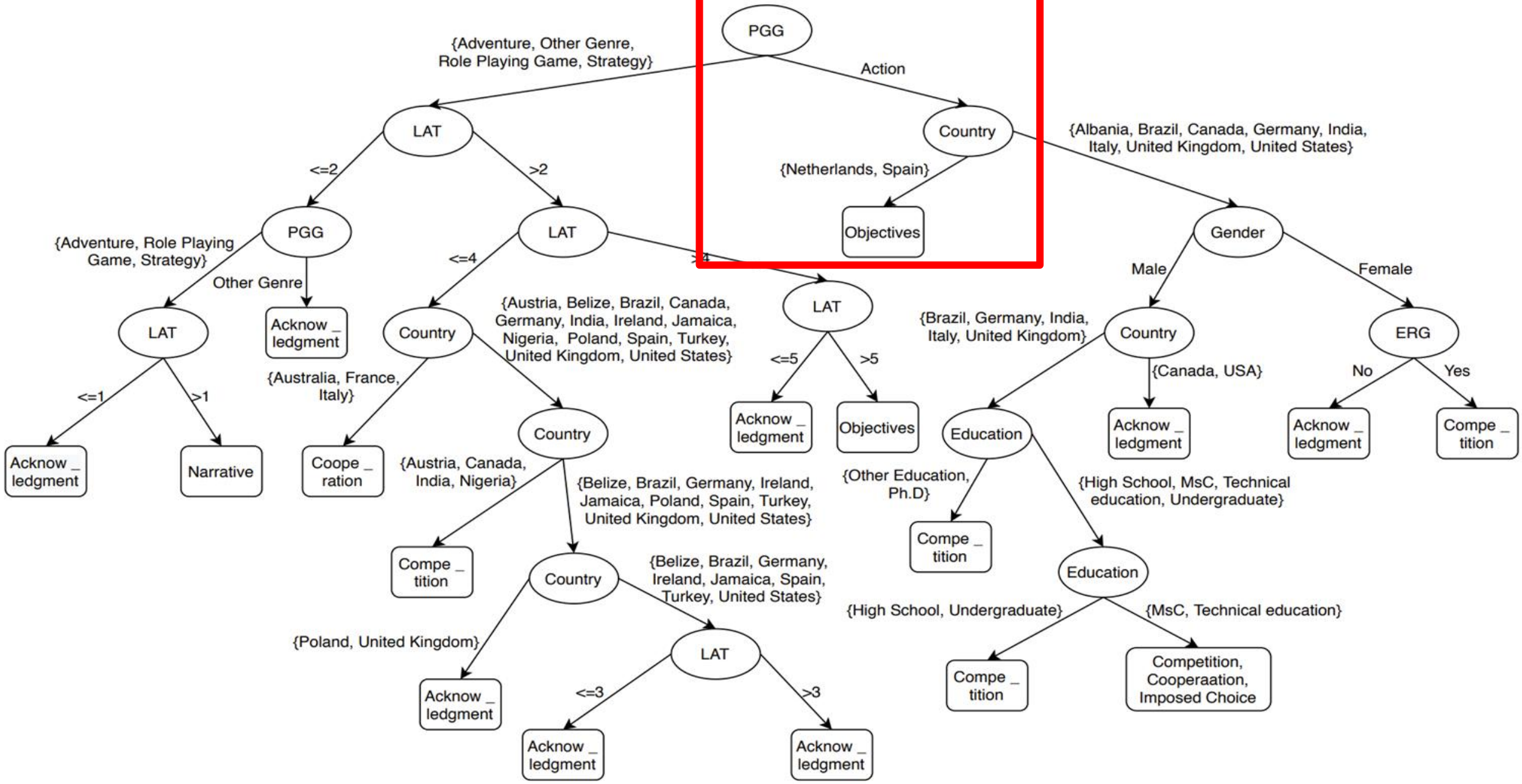


Fig. 1. Conditional decision tree for participants most preferred game element. Codes refer to preferred game genre (PGG), learning activity type (LAT), and experience researching gamification (ERG).



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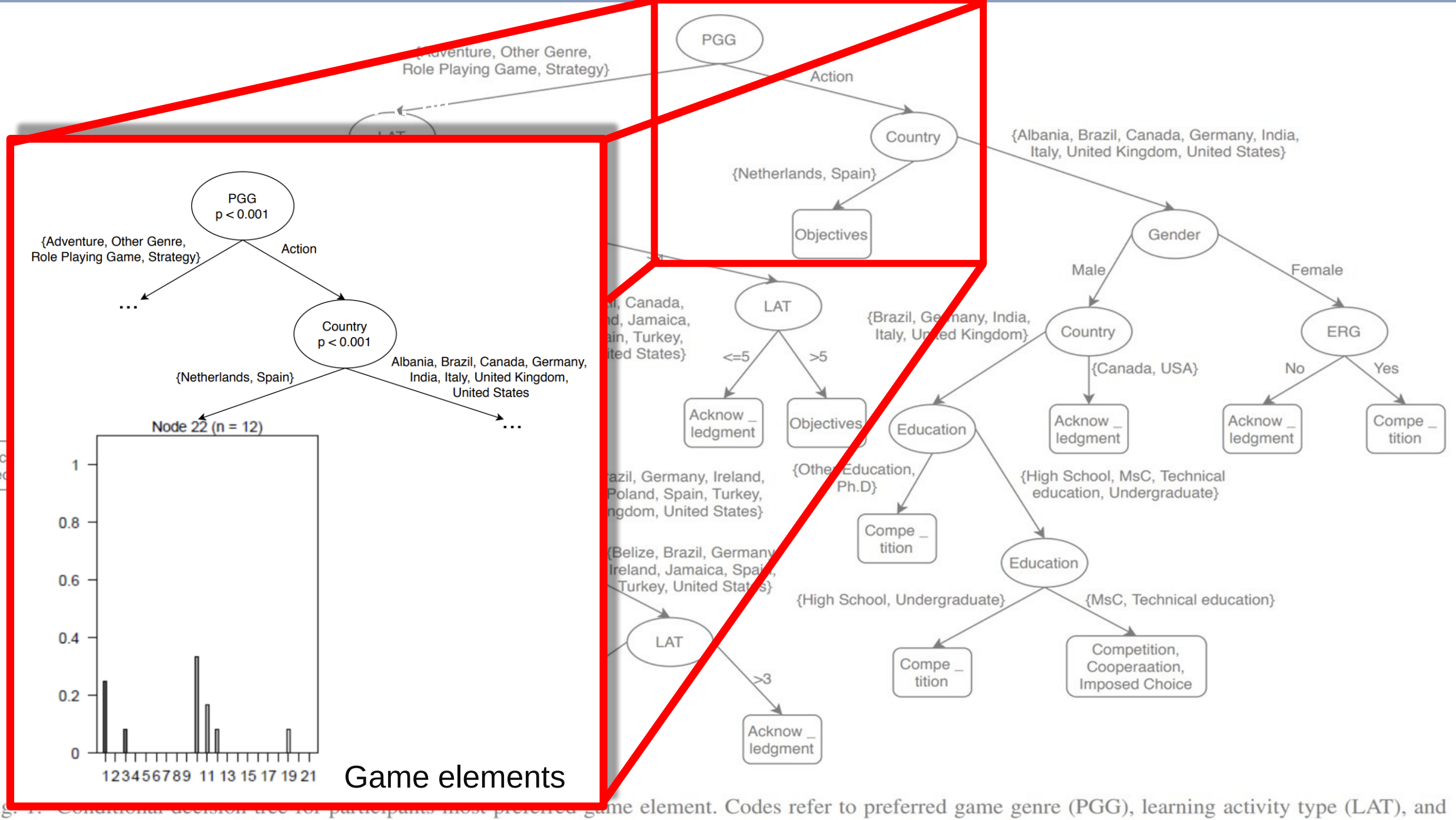
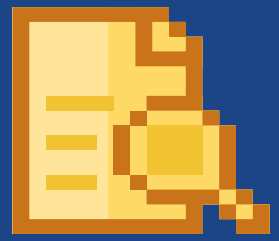


Fig. 4. Conditional decision tree for participants most preferred game element. Codes refer to preferred game genre (PGG), learning activity type (LAT), and experience researching gamification (ERG).

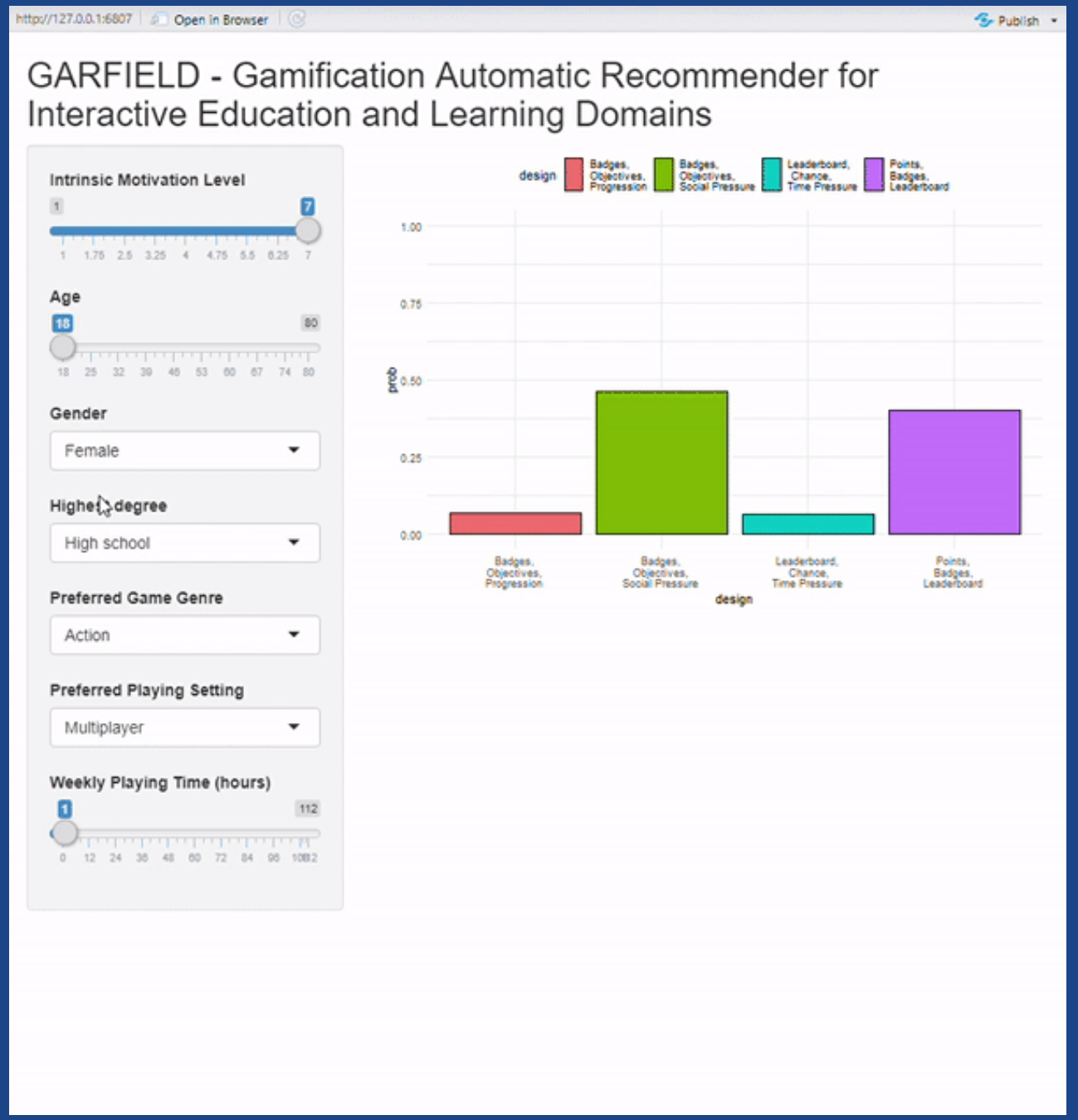


GARFIELD

Gamification **A**utomatic **R**ecommender **f**or **I**nteractive **E**ducation and **L**earning **D**omains

Rodrigues, L., Toda, A. M., ...& Isotani, S. (2022). **Automating gamification personalization to the user and beyond.** *IEEE Transactions on Learning Technologies*, *15*(2), 199-212.

Rodrigues, L., Toda, A., Pereira, F., Palomino, P. T., Klock, A. C., Pessoa, M., ... & Isotani, S. (2022). **GARFIELD: a recommender system to personalize gamified learning.** In International Conference on Artificial Intelligence in Education (pp. 666-672).



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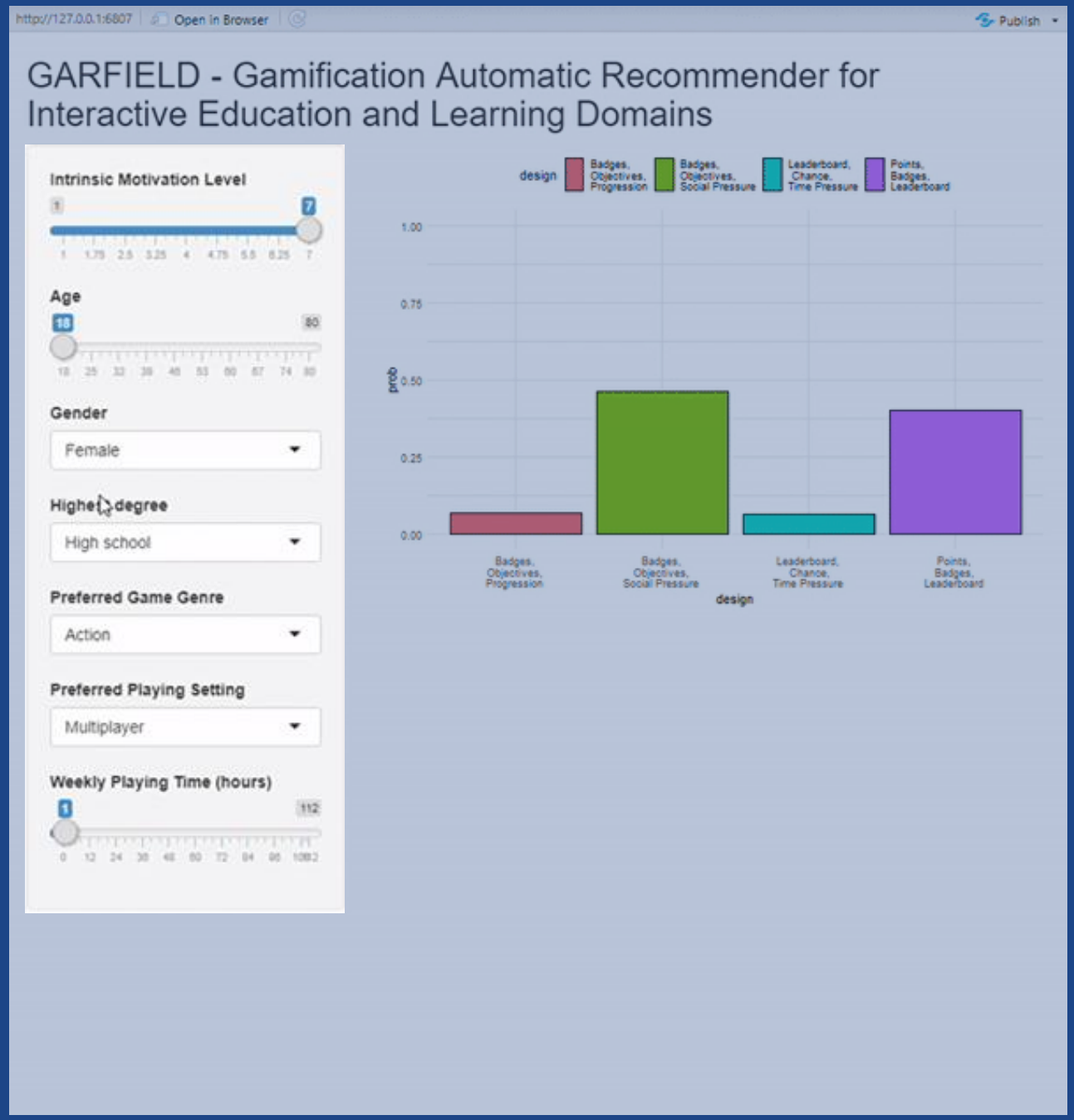

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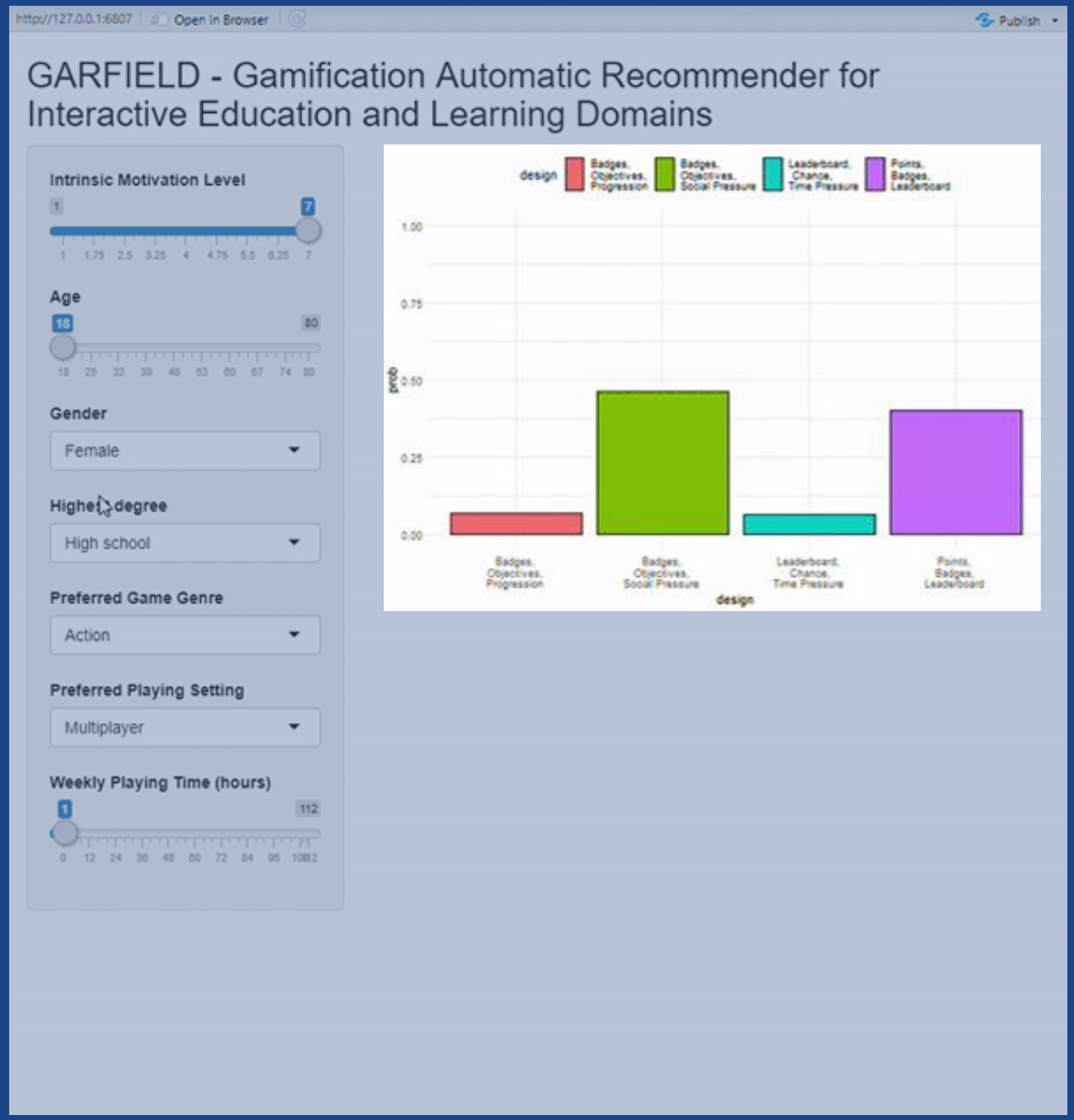
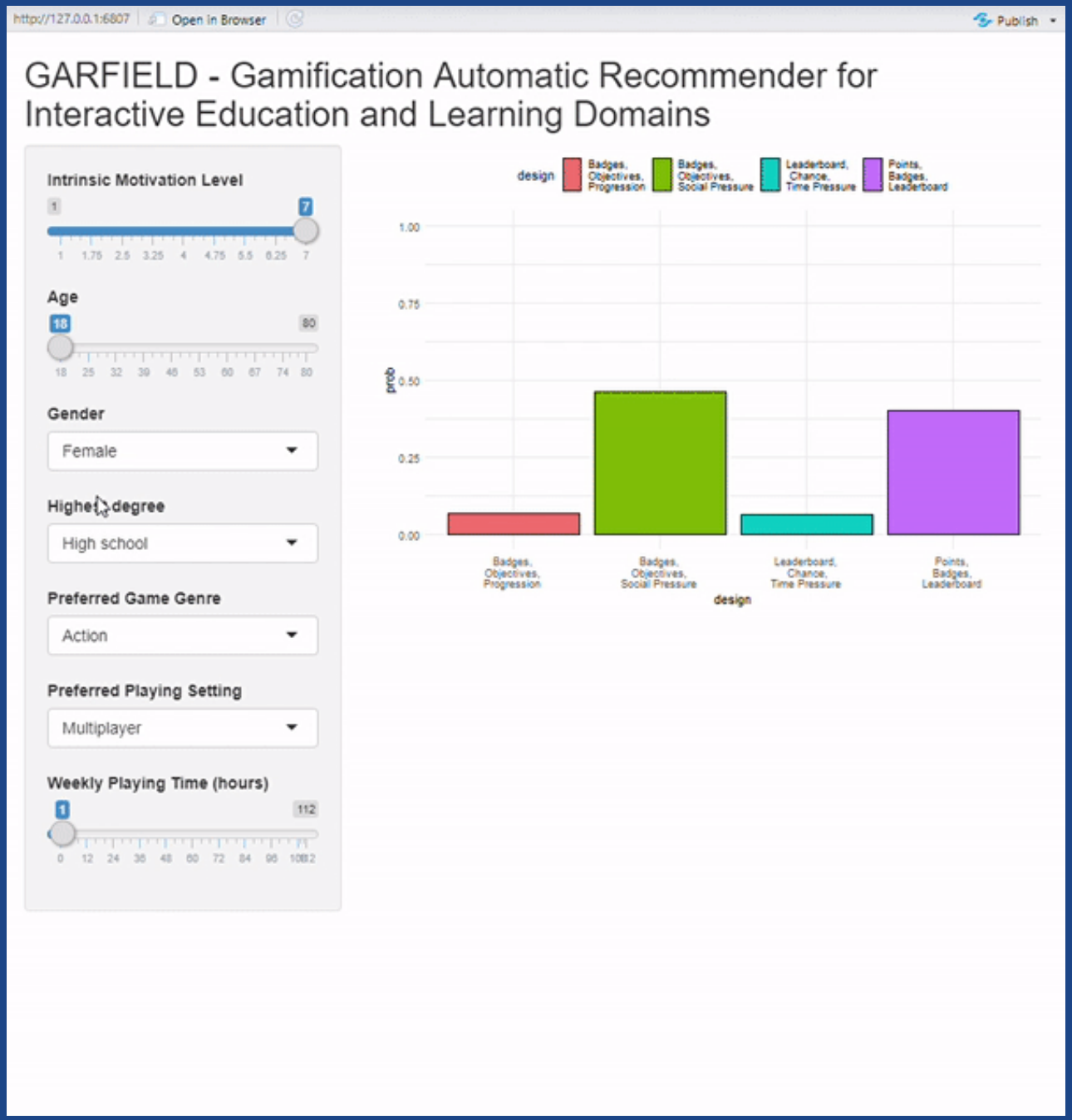
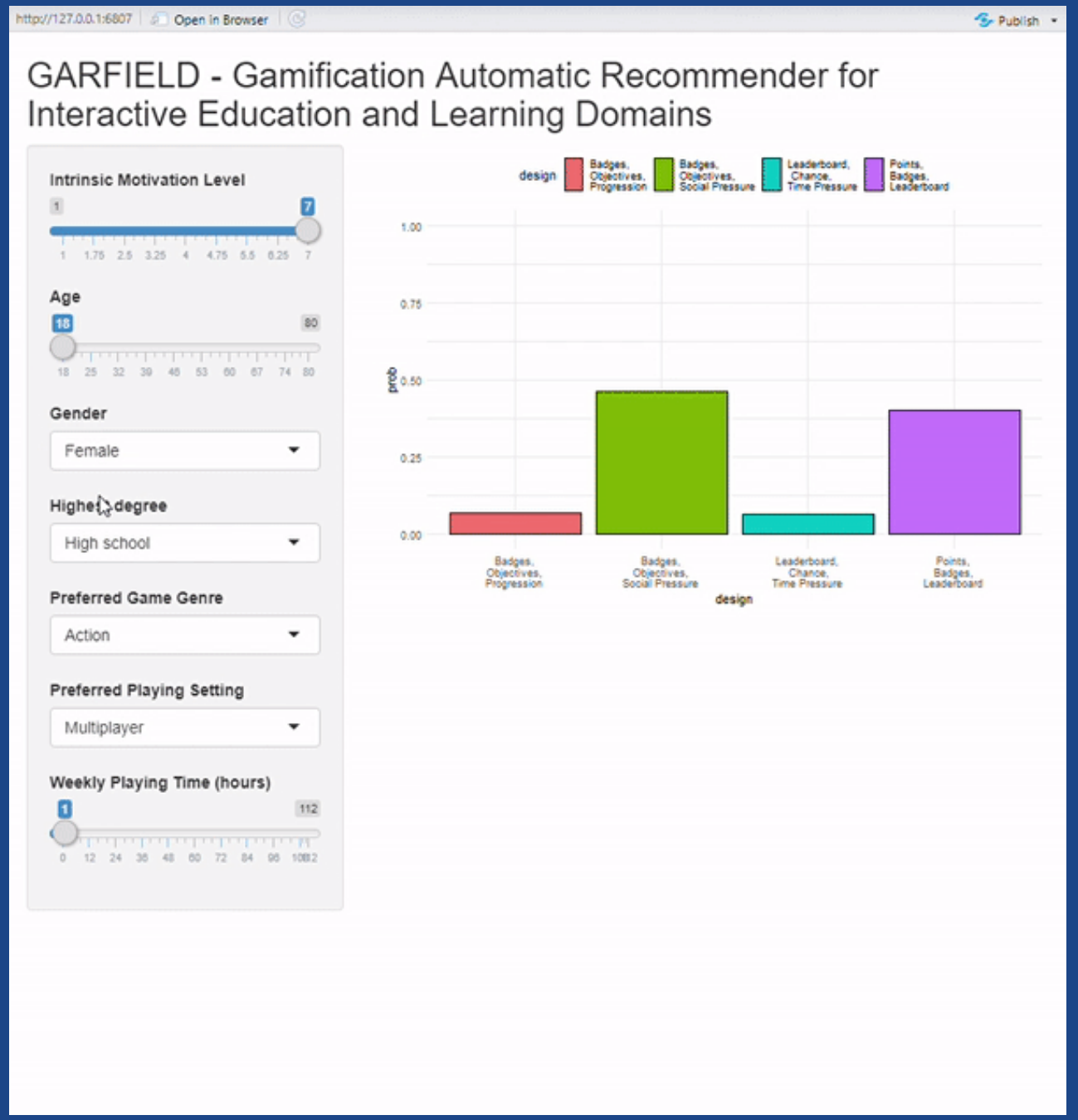


Data-driven


http://127.0.0.1:6807
Open in Browser
Publish
GARFIELD - Gamification Automatic Recommender for Interactive Education and Learning Domains
Intrinsic Motivation Level
1
7
1 1.75 2.5 3.25 4 4.75 5.5 6.25 7
Age
18
80
18 25 32 39 46 53 60 67 74 80
Gender
Female
Highe degree
High school
Preferred Game Genre
Action
Preferred Playing Setting
Multiplayer
Weekly Playing Time (hours)
1
112
0 12 24 36 48 60 72 84 96 108 112
design
Badges, Objectives, Progression
Badges, Objectives, Social Pressure
Leaderboard, Chance, Time Pressure
Points, Badges, Leaderboard
prob
1.00
0.75
0.50
0.25
0.00
design

Data-driven

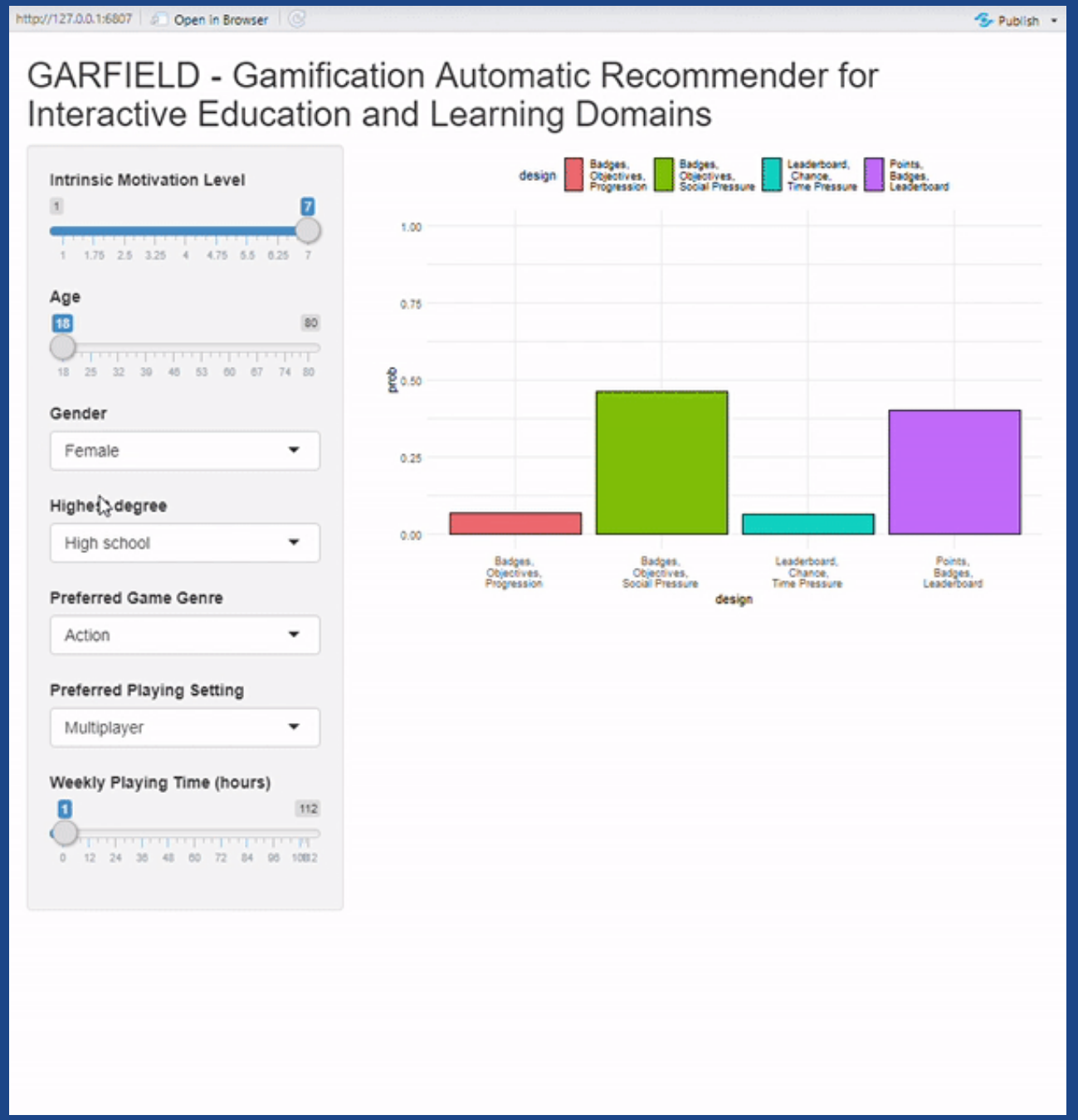
Multidimensional



Data-driven

Multidimensional

Transparent



Personalized Gamification
works,
but **how** it works,
for **whom**,
and for **how long**
remain open questions to be explored.


Challenges

Challenges

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

How to better design AI technologies to accurately guides teachers during to design of gamified educational experiences?

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

How to reduce the dependence of questionnaires to identify users' preferences and player types?

Palomino, P., Rodrigues, L., Toda, A., & Isotani, S. (2023). Enhancing Students' Learning Experience Through Gamification: Perspectives and Challenges. *Communications in Computer and Information Science, vol 1702. Springer, Cham. https://doi.org/10.1007/978-3-031-27639-2_6*

Finish!!!!

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