Serious games and gamification

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Why to gamify?

- Increased engagement
- Enhanced motivation
- Immediate feedback
- Promotion of goal setting
- Improved retention
- Development of problem-solving skills
- Customization and personalization
- Encourages collaboration
- Safe learning environment
- Integration of technology

FIGURE 16. Word cloud of the most frequent keywords.

Trinidad, M., Ruiz, M., & Calderon, A. (2021). A bibliometric analysis of gamification research. IEEE Access, 9, 46505-46544.

Serious games

- *Serious games* are games designed for a purpose beyond pure entertainment.
  - use the motivation levers of **game design** (competition, curiosity, collaboration, individual challenge) and **game media** (board games through physical representation or video games, through avatars and 3D immersion), **to enhance the motivation of participants to engage in complex or boring tasks.**
- SGs are used in a variety of professional situations such as education, training, assessment, recruitment, knowledge management, innovation, and scientific research.

Laamarti, F., Eid, M., & Saddik, A. E. (2014). An overview of serious games. International Journal of Computer Games Technology, 2014, 11-11.

Definition of SG

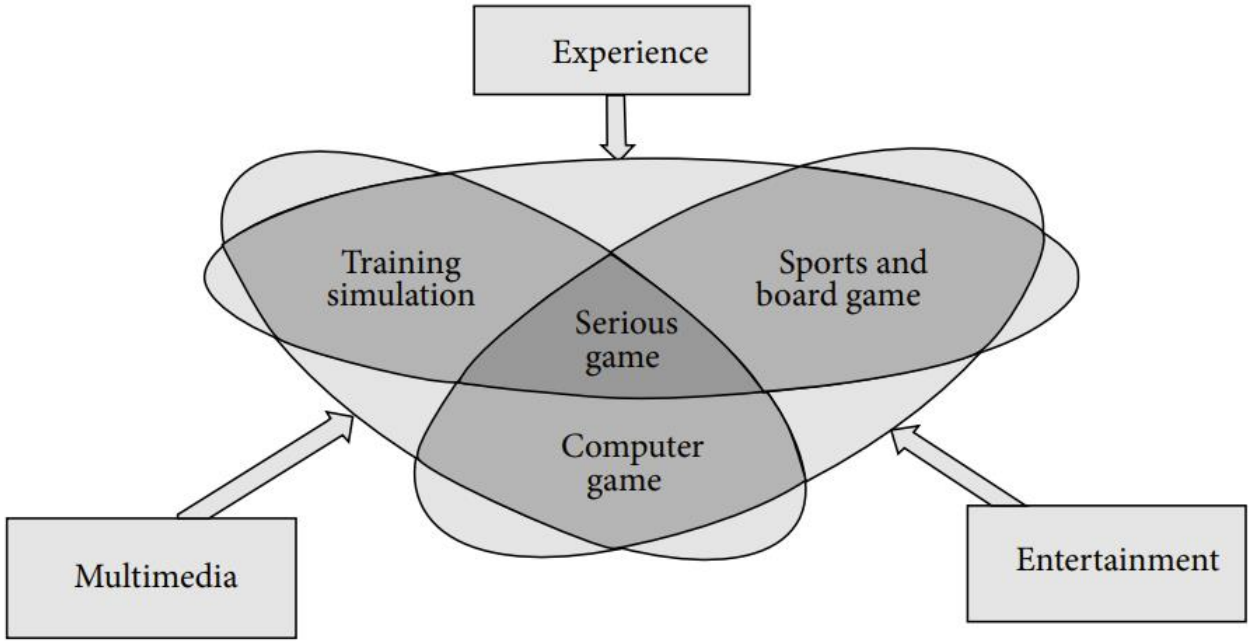


FIGURE 3: Definition of serious games.

Laamarti, F., Eid, M., & Saddik, A. E. (2014). An overview of serious games. International Journal of Computer Games Technology, 2014, 11-11.

Table 1: Milestones in the history of serious games.

Year	Serious game	Application
1970	Serious Games book by C. Abt	Academic book
1972	Magnavox Odyssey	Education
1973	The Oregon Trail	Education
1980	BattleZone	Training
1981	The Bradley Trainer	Training
1982/1983	Pole Position/Atari VCS 2600 console	Training
1996	Marine Doom	Military
2002	America's Army	Military
2003	DARWARS	Military
2005	VBS1	Military
2006	BiLAT	Interpersonal communication
2009	VBS2/Game After Ambush	Military
2012	X-Plane 10	Training

Laamarti, F., Eid, M., & Saddik, A. E. (2014). An overview of serious games. International Journal of Computer Games Technology, 2014, 11-11.

The reasons of using SGs

- improve learner engagement and motivation
- engage learners more deeply in the learning process (active learning, experiential learning, skills development, etc.)
- improve learning outcomes (skills development, risk-free practices, complex decision-making, etc.)
- improve attendance and participation
- data collection and assessment
- behavior change and awareness

Zhonggen, Y. (2019). A meta-analysis of use of serious games in education over a decade. International Journal of Computer Games Technology, 2019.

Taxonomy of SGs

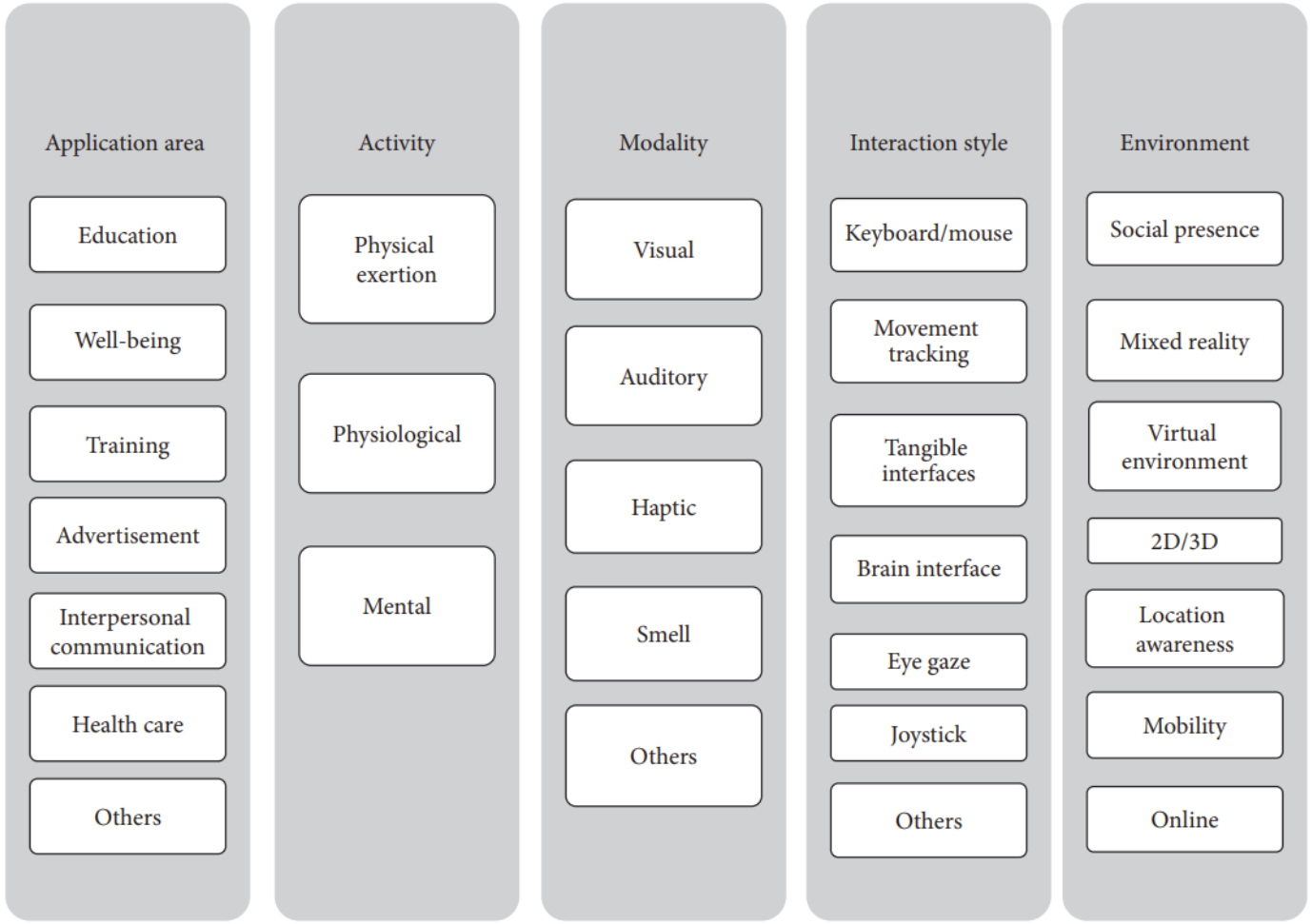


FIGURE 4: Taxonomy of serious games.

Laamarti, F., Eid, M., & Saddik, A. E. (2014). An overview of serious games. International Journal of Computer Games Technology, 2014, 11-11.

Serious Game Design Conceptual Framework (SGDCF)

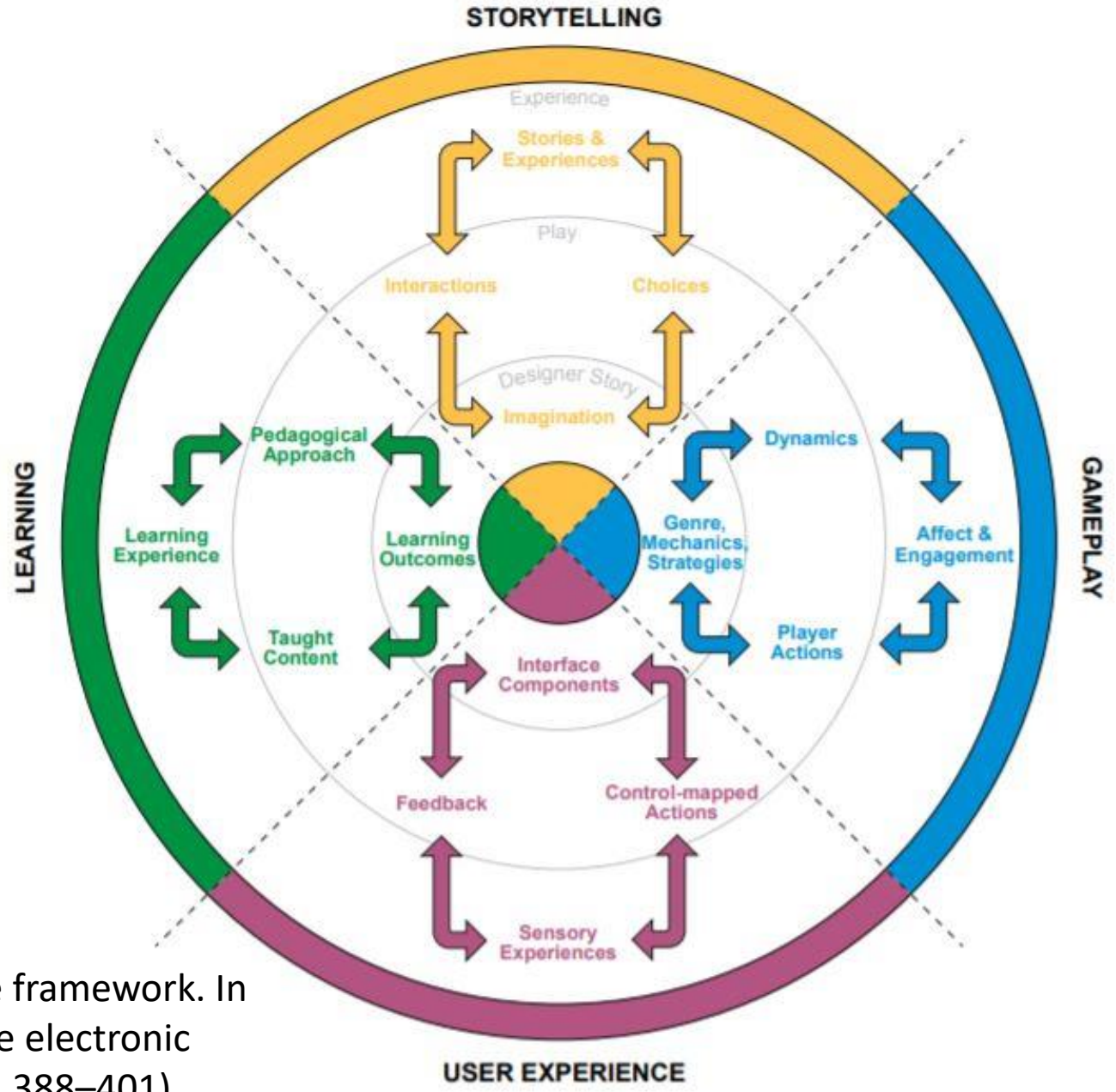
- Based on four important game elements: Learning, Storytelling, Gameplay and User Experience
  - *Learning* refers to the content to be learned by players through the game with specific and measurable learning outcomes.
  - *Storytelling* refers to the background story of the game and includes a description of the character(s), the setting, and the ultimate goal of the game.
  - *Gameplay* refers to the way in which the player interacts with the game, or with other players (if a multiplayer game). It encapsulates the type of activity (e.g., puzzle, trivia, etc.) found in the game.
  - *User Experience* refers to the player's emotions and attitudes while playing the game, as well as how the player interacts with the game.

Yusoff, A. (2010). A conceptual framework for serious games and its validation (Doctoral dissertation, University of Southampton).

Main layers of SGDCF

1. The innermost *Design layer* symbolizes the designer's "story," or all the elements that the designer introduces to the game that will allow the player to play the game.
2. The middle layer, *Play*, which symbolizes the "mediated experience" between the player and design input through play, is influenced by the design and the player's background brought into the play experience.
3. The outermost *Experience layer* symbolizes the varying play experiences that players can have depending on their backgrounds, as well as the choices and actions made during game play.

Serious Game Design Methodology Circle

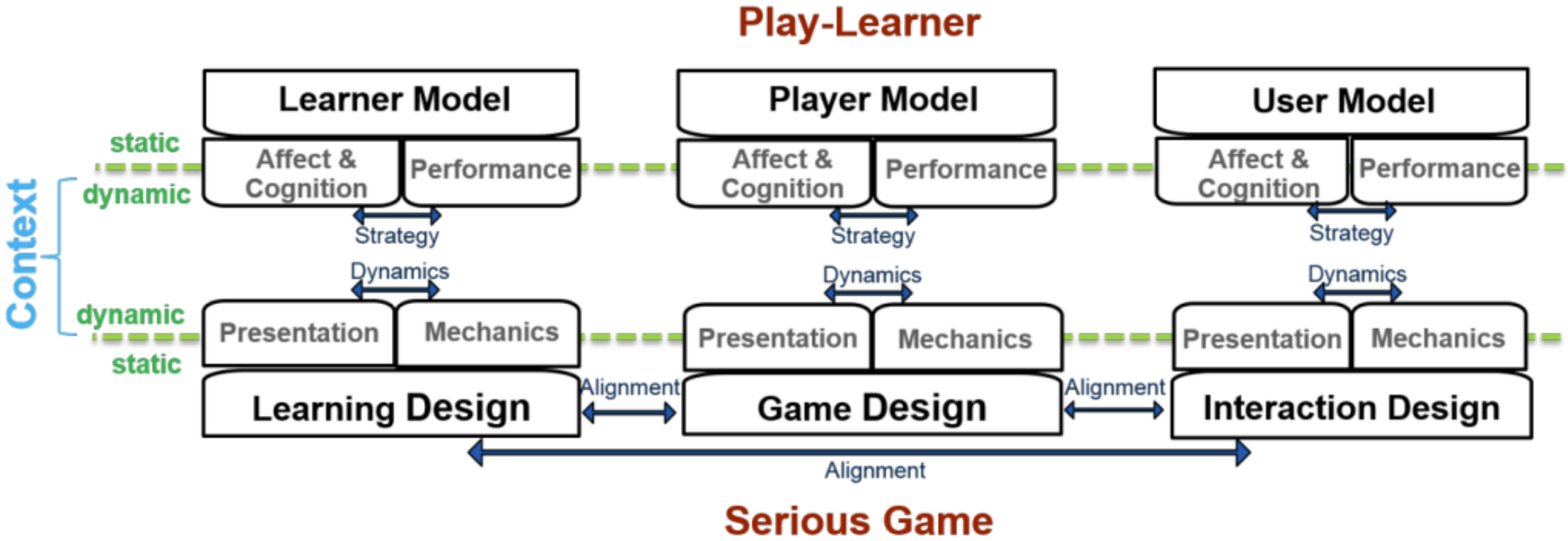


Winn, B. (2009). The design, play and experience framework. In R. Ferdig (Ed.), Handbook of research on effective electronic gaming in education. Hershey, PA: IGI Global (pp. 388–401).

Key elements of SGDCF

1. Learning objectives and goals
2. User-centered design
3. Game Mechanics
4. Content integration
5. Assessment and feedback
6. Interactivity and engagement
7. Adaptivity
8. Storytelling and narrative
9. Technology and platforms
10. Feedback loop
11. Ethical considerations
12. Evaluation, alignment with objectives

Dimensions of serious game evaluation



Shoukry, L., & Göbel, S. (2017). Reasons and responses: A multimodal serious games evaluation framework. IEEE Transactions on Emerging Topics in Computing, 8(1), 245-255.

Serious Games Guide: Everything you need to know

https://www.chaostheorygames.com/blog/serious-games-guide-everything-you-need-to-know-in-2021

Examples of educational SGs

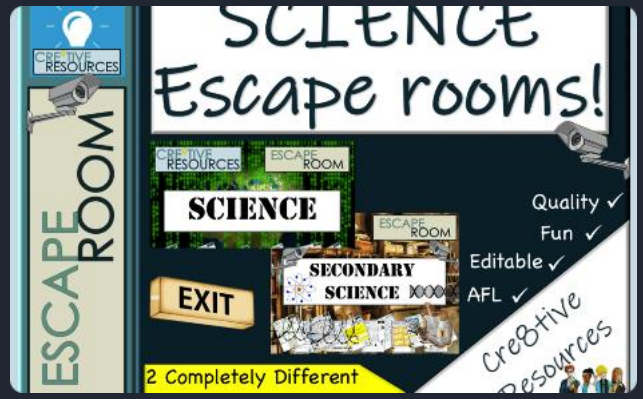
Educational escape rooms

Pabėgimo kambariai yra smagi ir interaktyvi mokymo priemonė, leidžianti derinti žaidimo mechaniką su mokomąja medžiaga. Šiame pristatyme sužinosite, kaip sukurti pabėgimų kambarį naudojant PPT ir Google skaidres.

Examples of educational escape rooms

A secret of history

Students must solve puzzles and riddles related to famous historical events to escape the room.



Run from the laboratory

Students assume the role of scientists who must escape the lab by solving science-related puzzles and clues.

The house of mathemathics

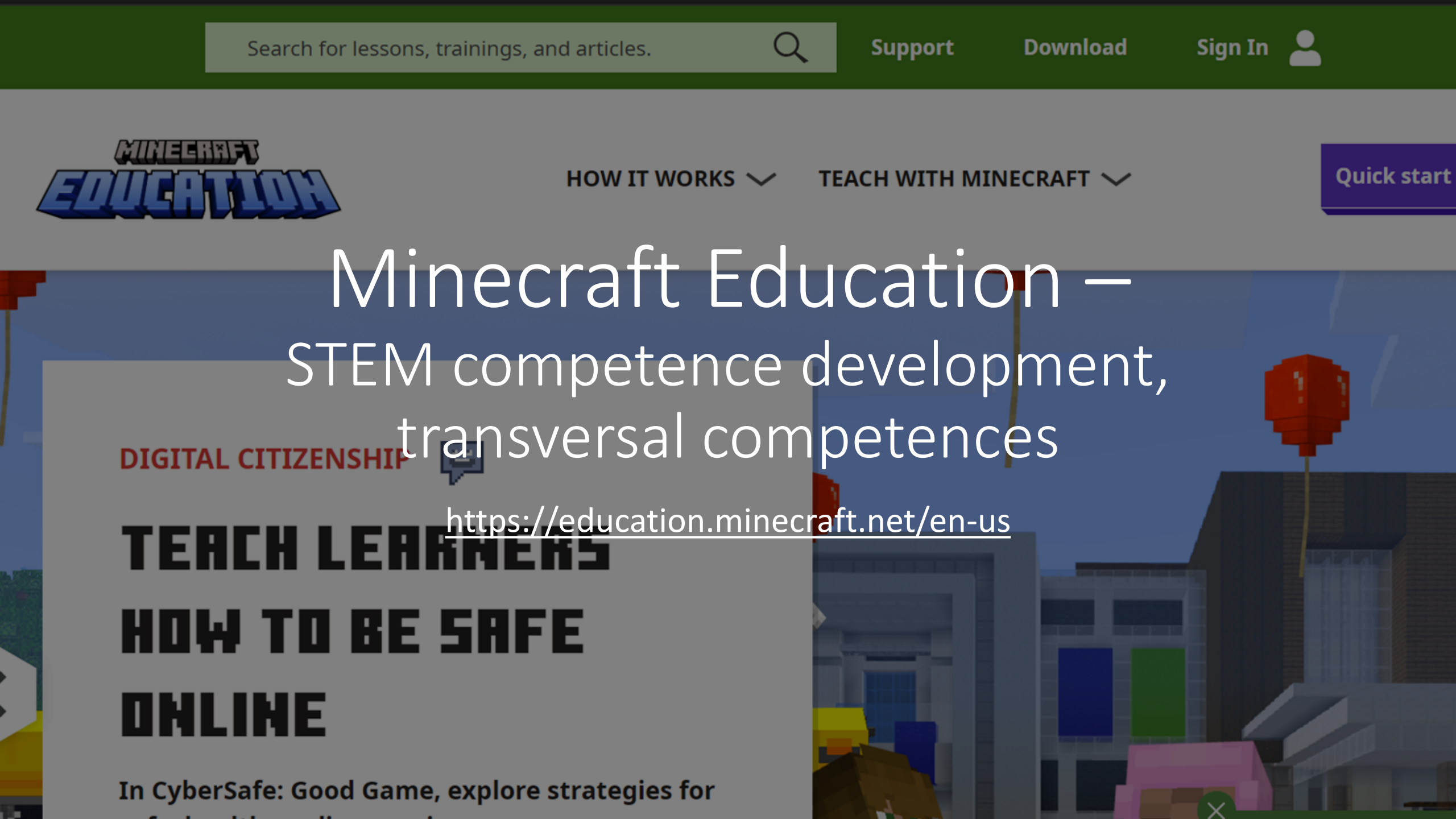
Students use math skills to solve puzzles and riddles related to geometry, algebra, and other math topics to escape the mansion.

Frozen in a language

Students must use language skills to solve puzzles and riddles related to grammar, vocabulary, and other language topics to escape the locked-up room.

Examples

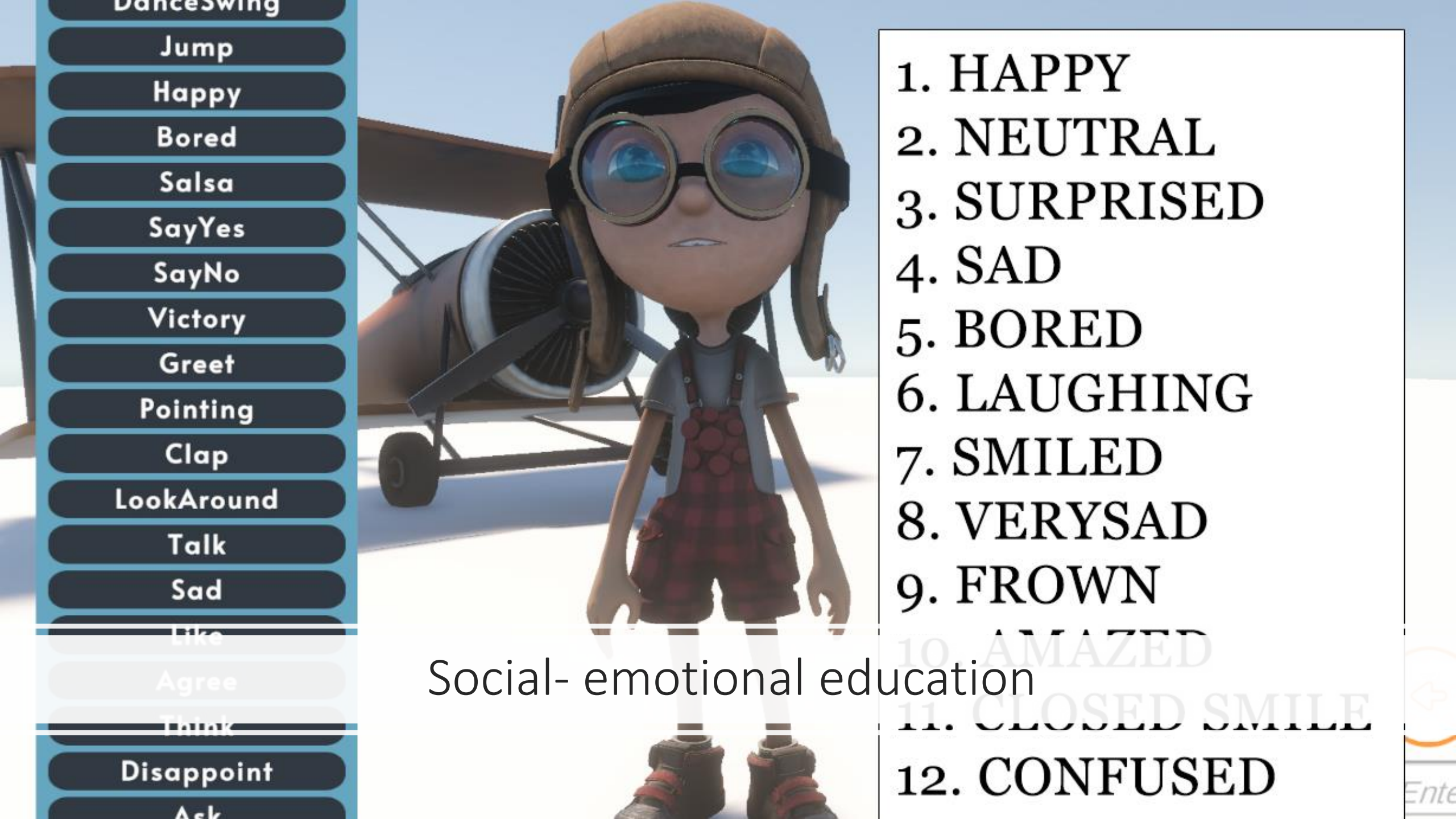
- https://view.genial.ly/65d5bdefcc93be001499bcea/interactive-content-mokyklos-pabegimo-kambarys
- https://view.genial.ly/65dc8418cb86b90014aa5c98/interactive-content-pabegimo-kambarys-matematikai



Minecraft Education –

STEM competence development, transversal competences

https://education.minecraft.net/en-us



Social- emotional education

Gamification

Different definitions of gamification

- the process of using game thinking and game mechanics to solve problems and engage users
- integrating game dynamics into your site, service, community, content or campaign, in order to drive participation
- the application of typical elements of game playing (e.g. point scoring, competition with others, rules of play) to other areas of activity, typically as an online marketing technique to encourage engagement with a product or service.

Landers, R. N., Auer, E. M., Collmus, A. B., & Armstrong, M. B. (2018). Gamification science, its history and future: Definitions and a research agenda. Simulation & Gaming, 49(3), 315-337.

Purpose of gamification

- Motivation and long-term user engagement and loyalty.
- Making things more pleasurable in an interaction, process and information overloaded world (gain user attention).
- Creates a brand connection with users or customers in a meaningful and interesting way and aligns business objectives with user's motivations.
- Can be used in different roles and scenarios: customer, patient, user, student, employee, personal motivation and engagement.
- Builds complex systems for motivation that meets people's intrinsic desire but also make them feel that they are accomplishing something aspirational and make them move forwards in their life.

Hamari, J., Koivisto, J., & Sarsa, H. (2014, January). Does gamification work?--a literature review of empirical studies on gamification. In 2014 47th Hawaii international conference on system sciences (pp. 3025-3034). Ieee.

Why to use gamification in business or education settings?

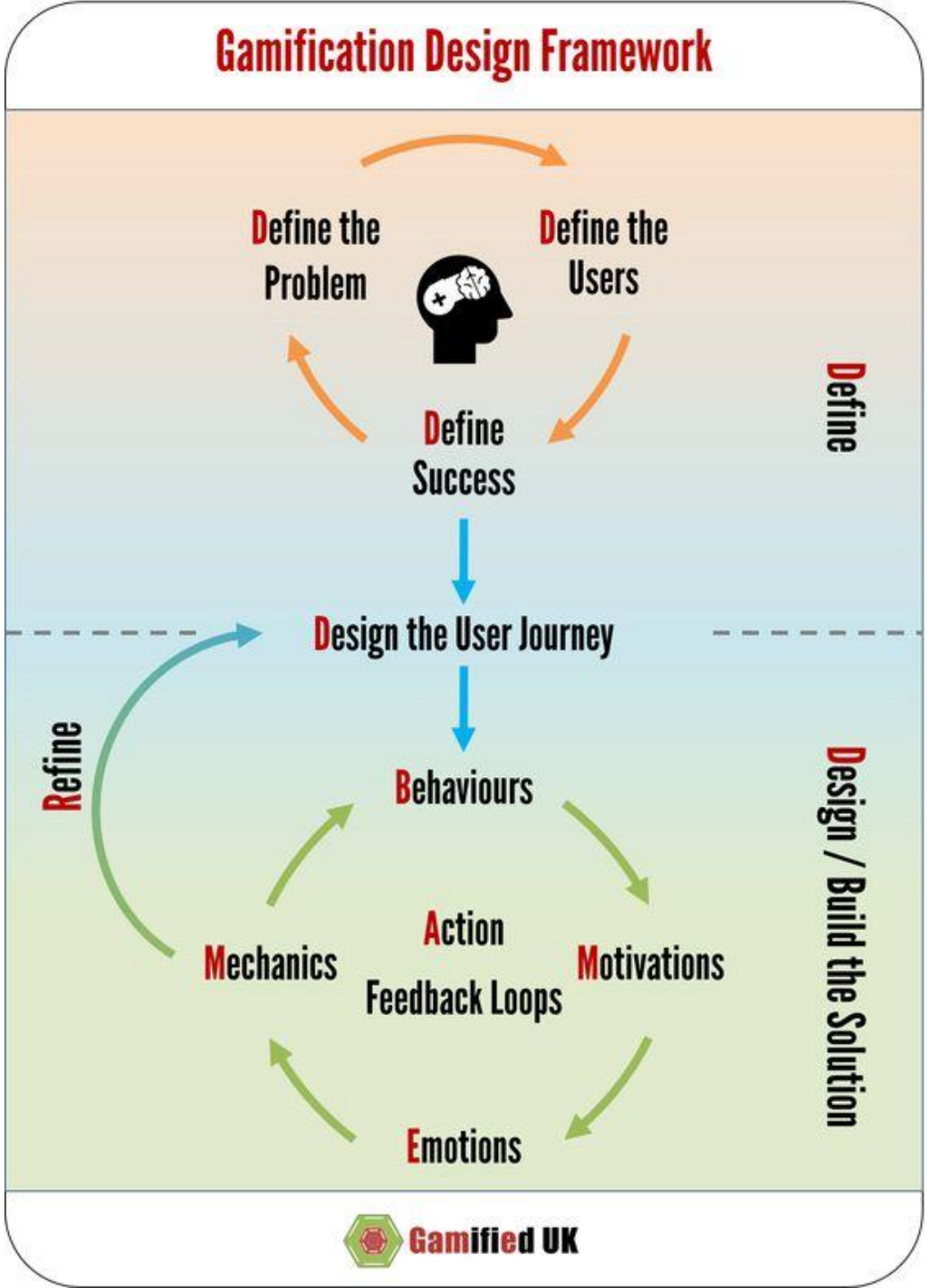
- *Consumer engagement* - using game mechanics to draw consumer attention and sell more goods and services.
- *Employee immersion into work*– using game mechanics for more employee productivity or for employee training, incentives, etc.
- *Collaborative activities* – to encourage teams to discover solutions.
- *Stream for social change* – using game mechanics to enact social change.

Gamification design framework

Successful gamification is player-centric

Player

Game



Mora, A., Riera, D., González, C., & Arnedo-Moreno, J. (2017). Gamification: a systematic review of design frameworks. Journal of Computing in Higher Education, 29(3), 516-548.

Framework of knowledge communication in gamified environments

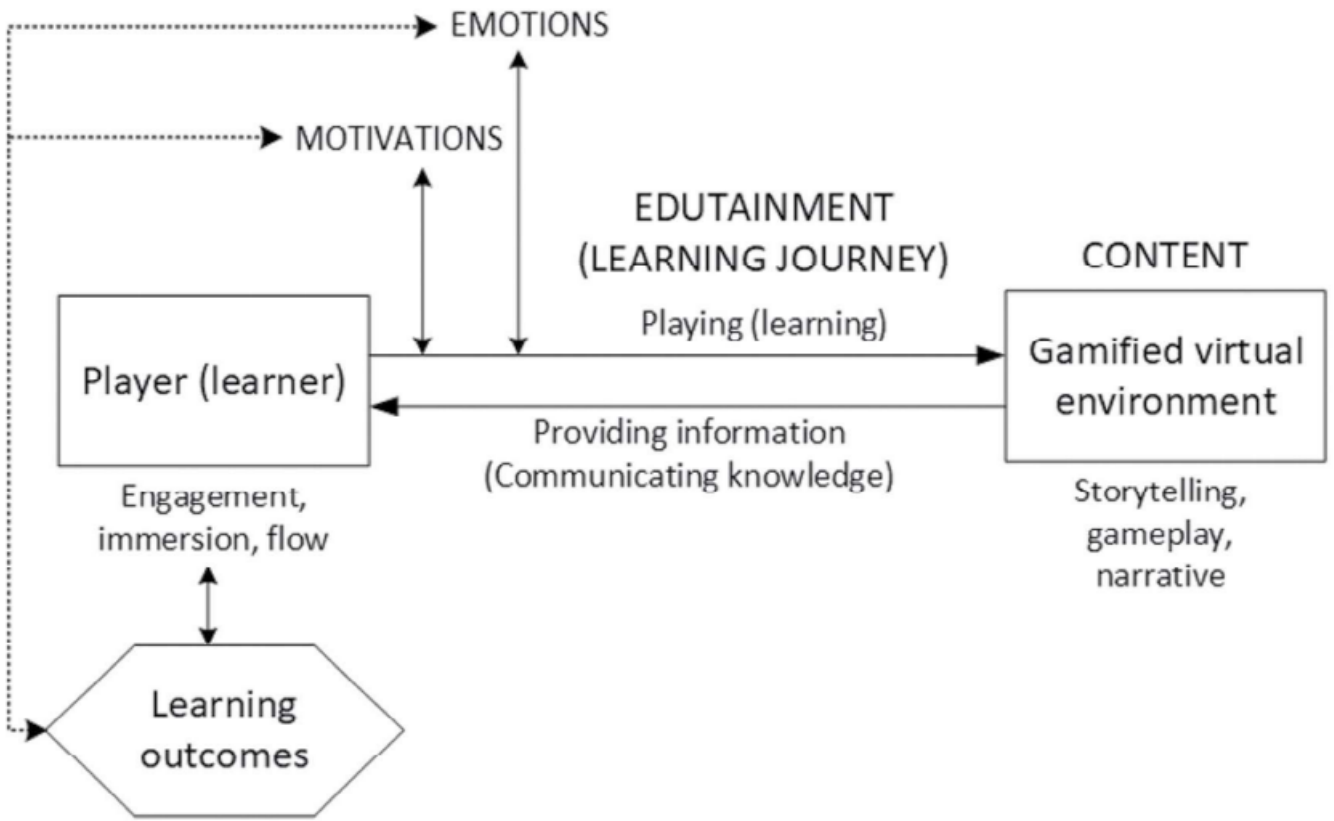


Figure 5. Revised framework of knowledge communication in gamified virtual environments (based on Winn, 2009; Alexiou & Schippers, 2018).

Kasperiuniene J. (2022). Science communication in environmental online games. In book: Discovering the New Place of Learning (pp.159-194) Publisher: Peter Lang

Designing the gamified educational product/service

- *Socially engaging educational product* – the learner would like to
  - compete (win, beat, brag, taunt, challenge, pass, fight, etc.)
  - cooperate (join, share, help each other, gift, greet, exchange, trade, etc.)
  - explore (view, read, search, collect, complete, curate, etc.)
  - express their opinions (choose, customise, layout, design, dress up, showoff, etc.)

Learner-player skills and gamified actions

- Skills
  - Physical – walking, running, typing, using a chefs knife, etc.
  - Mental – pattern recognition, memory, spatial logic, organization, etc.
  - Social – presentation, conversation, meeting new people, etc.

- Tips for gamified product development
  - Choose user skills that have long learning curves and can be developed over time.
  - Are the skills you are considering measurable? How might you make them measurable?
  - Break longer mastery arcs into smaller nested sill-chains.

Elements of designing gamified product/service experience

- *Competition types:* player vs player, player vs system, self directed.
- *Time pressure: r*elaxed explorative play or brash tactics get things done play.
- *Scarcity*: scarcity can add a level of challenge and strategic game play.
- *Puzzles*: problems that promise the existence of a solution.
- *Novelty*: change presents a new set of challenges & patterns to master.
- *Levels*: provide roadmap of progress.
- *Social pressure / proof: "*The herd must be right*"*.
- *Teamwork*: can also be resistance when we need to work with others.
- *Currency*: anything that can be exchanged for something of value will be sought.
- *Renewals and power-ups*: "Unstick" players and redirect from dead-ends.

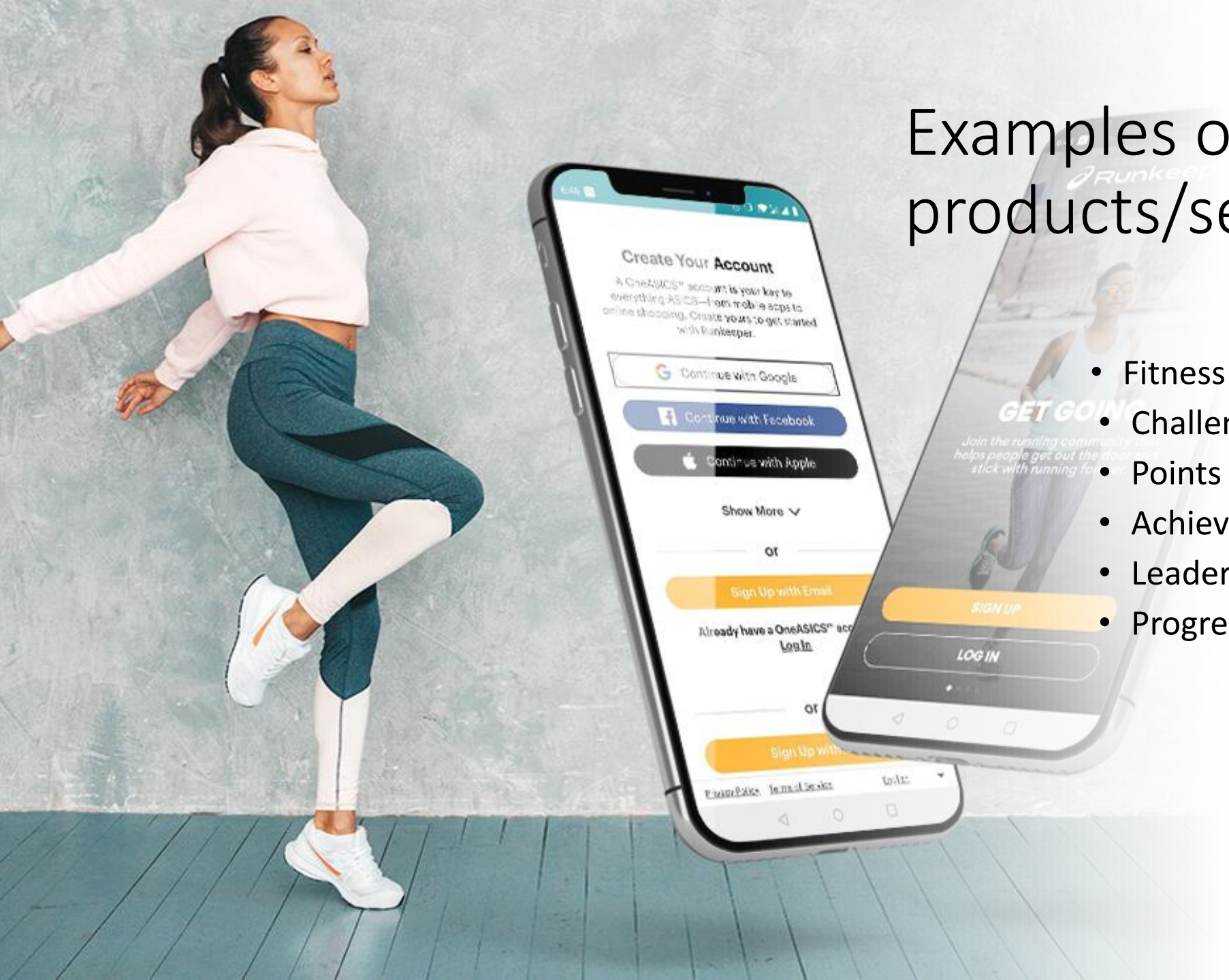
Gamified outcomes

- Gamified feedback, rewards and results
  - Positive and negative
    - *Positive* includes both tangible & intangible rewards such as moving up a level.
    - *Negative* might be starting a challenge over.
  - Outcomes can be contingent or scheduled. Players can trigger an outcome based on specific action they take or based on a time frame within a game.
  - The ultimate objective (to win the game) may take weeks, months, years to achieve but *along the way players need to see and feel incremental successes and failures*.

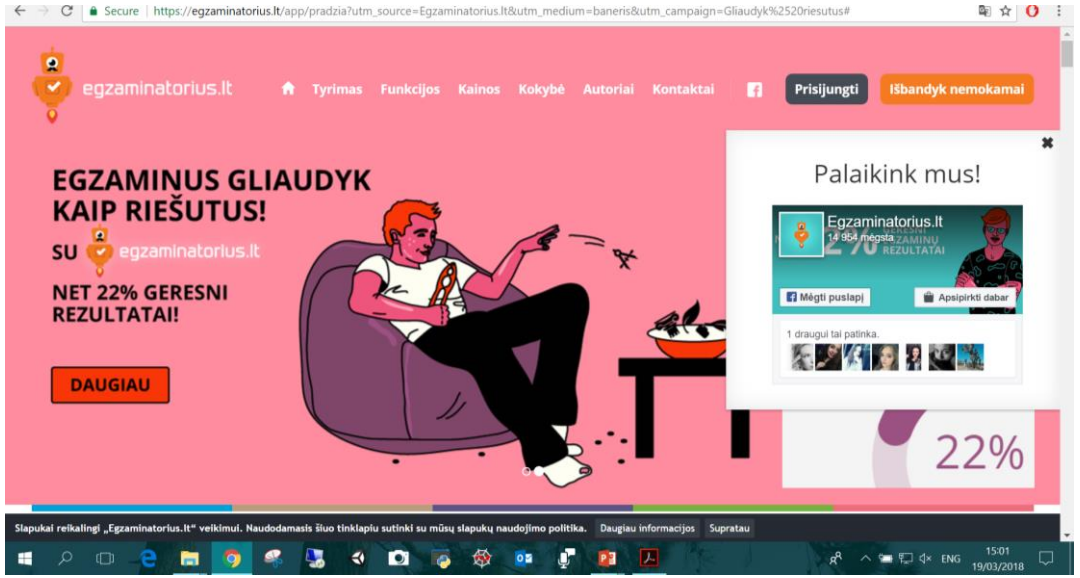
Game Concepts in the Real World

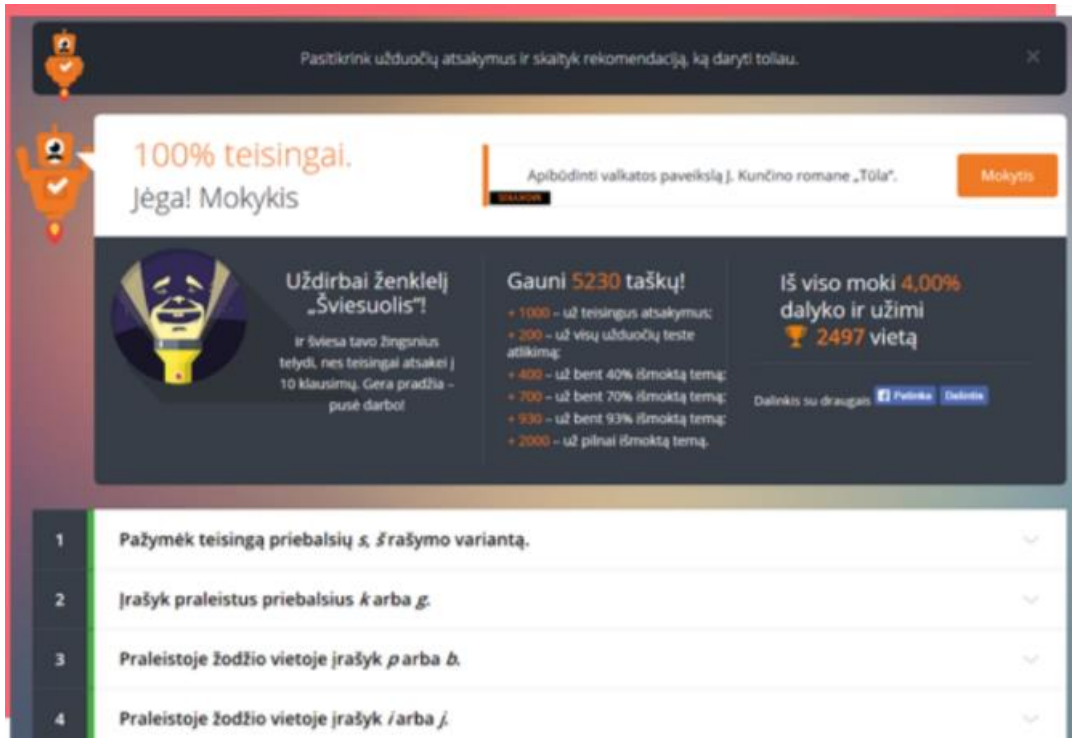
Real-World Activity	Game Concept
Monthly sales competition	Challenge
Frequent flyer program tiers	Levels
Weight Watchers group	Team
Free coffee after ten purchases at Starbucks	Reward
American Express platinum card	Badge

Examples of gamified products/services



- Fitness app achievement badges
- Challenges;
- Points and rewards;
- Achievement badges;
- Leaderboards;
- Progress tracking

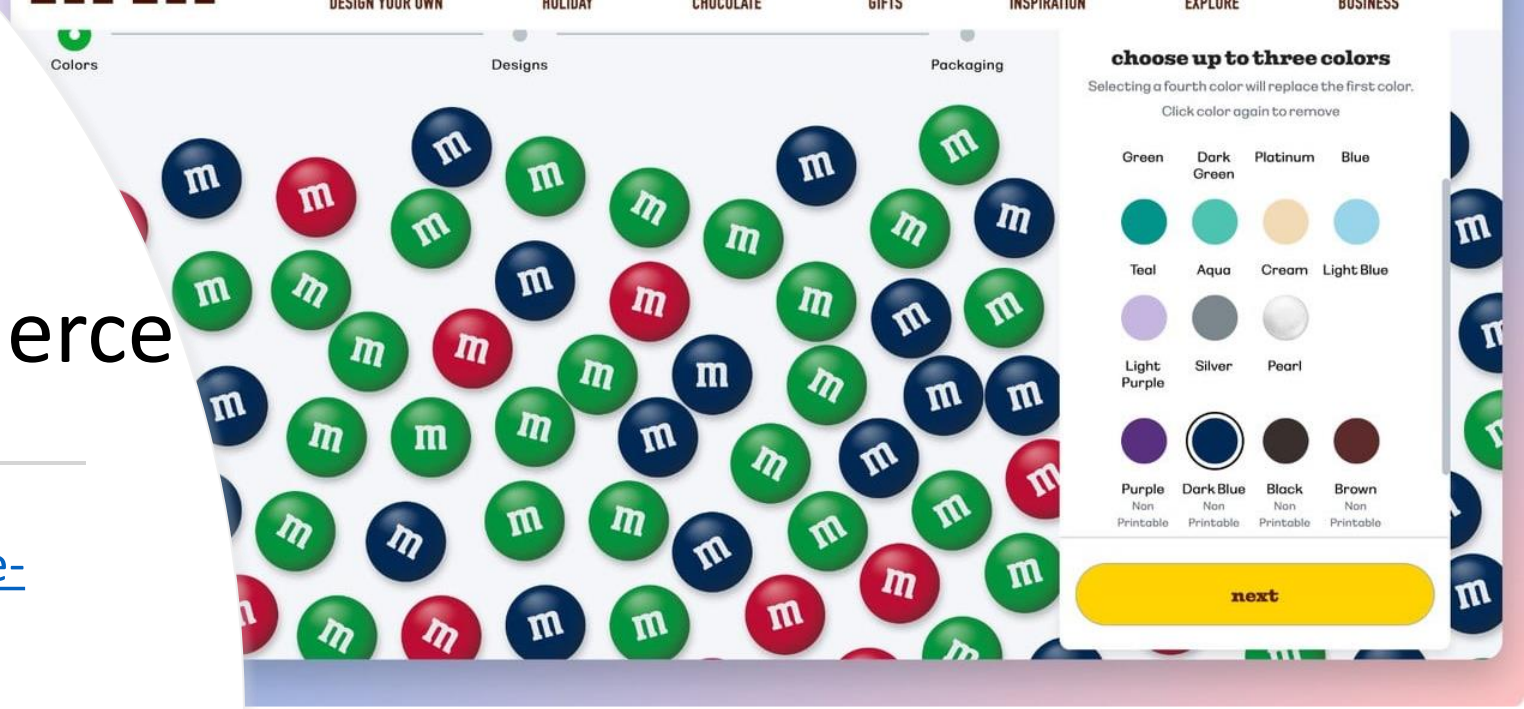


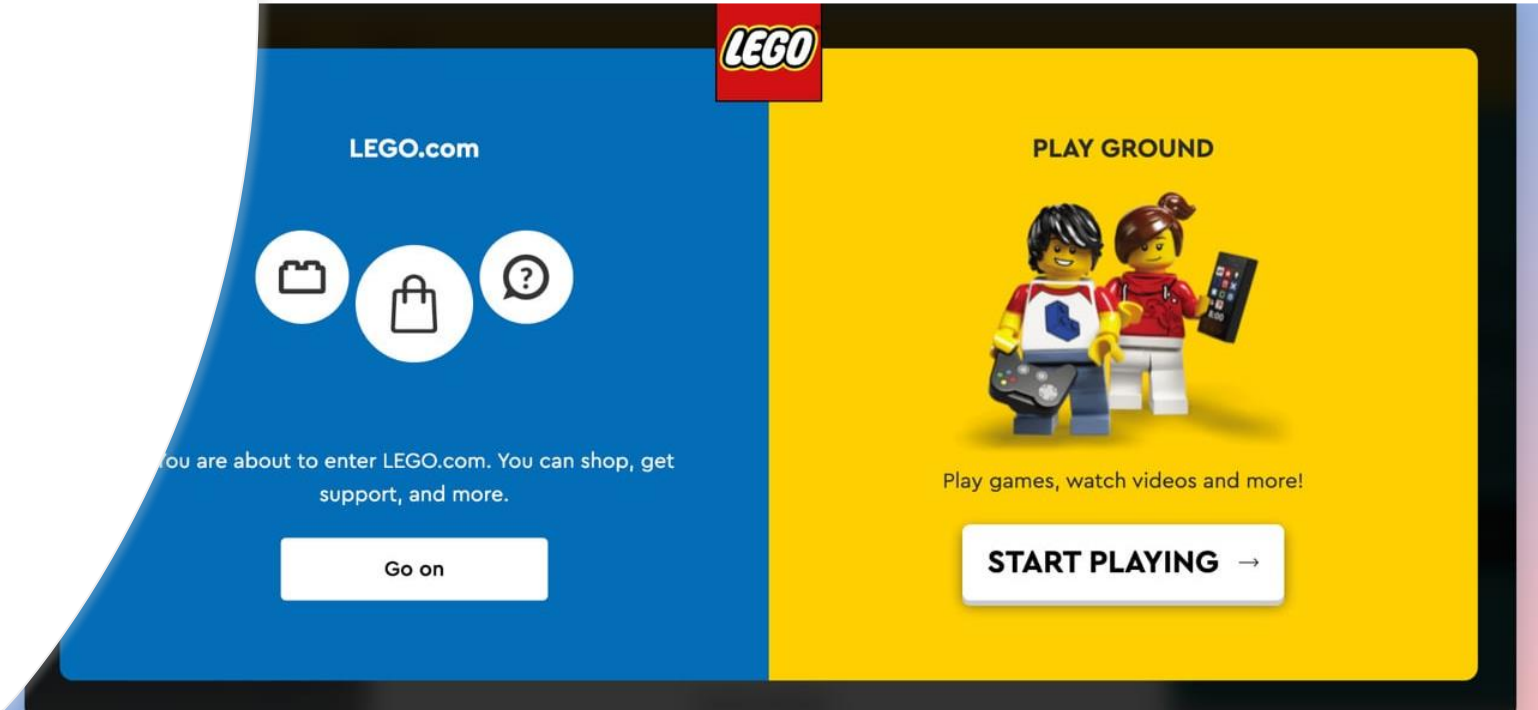


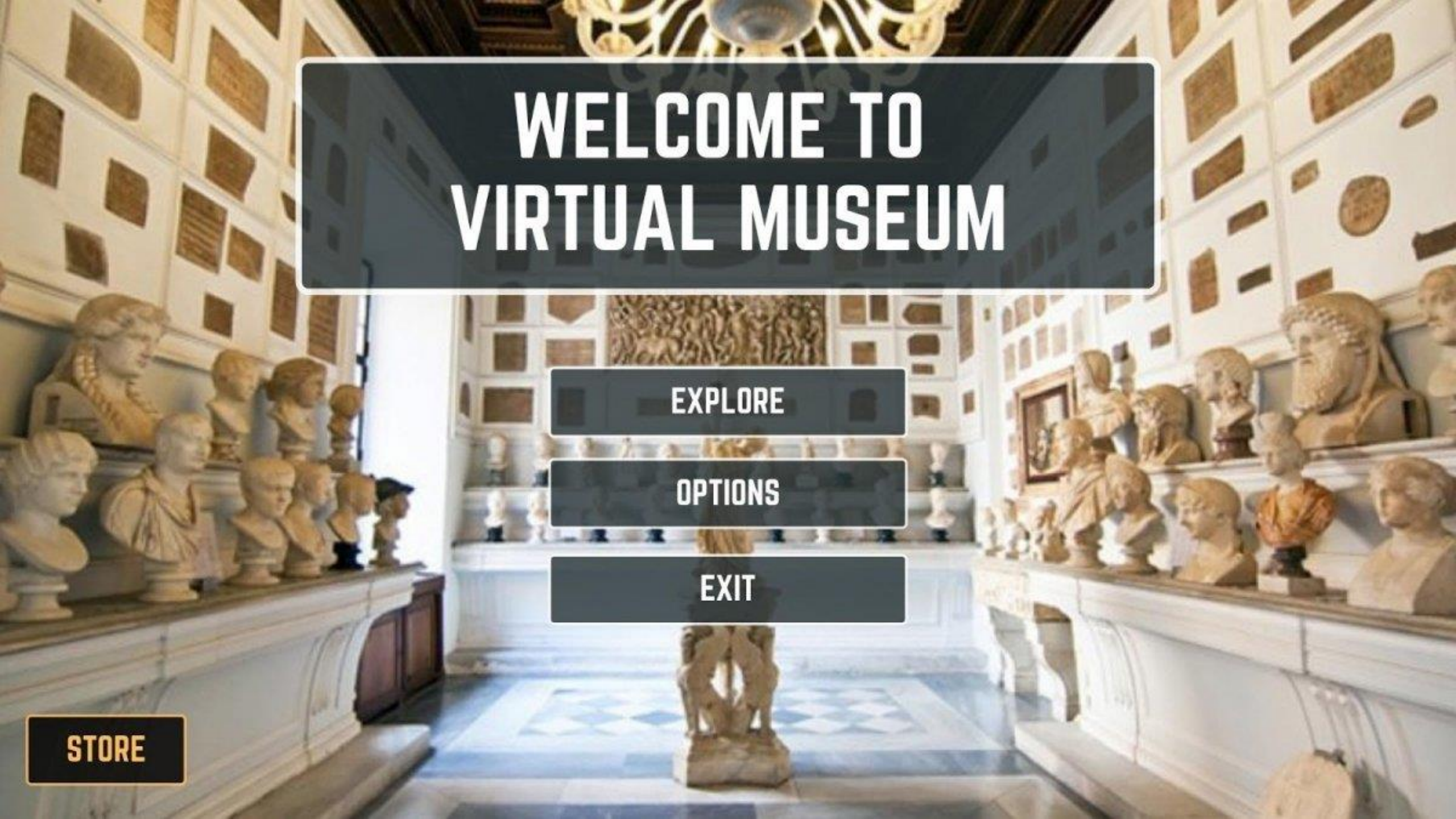
Portal of electronic examination and preparation for secondary school exams

Gamification of e-commerce

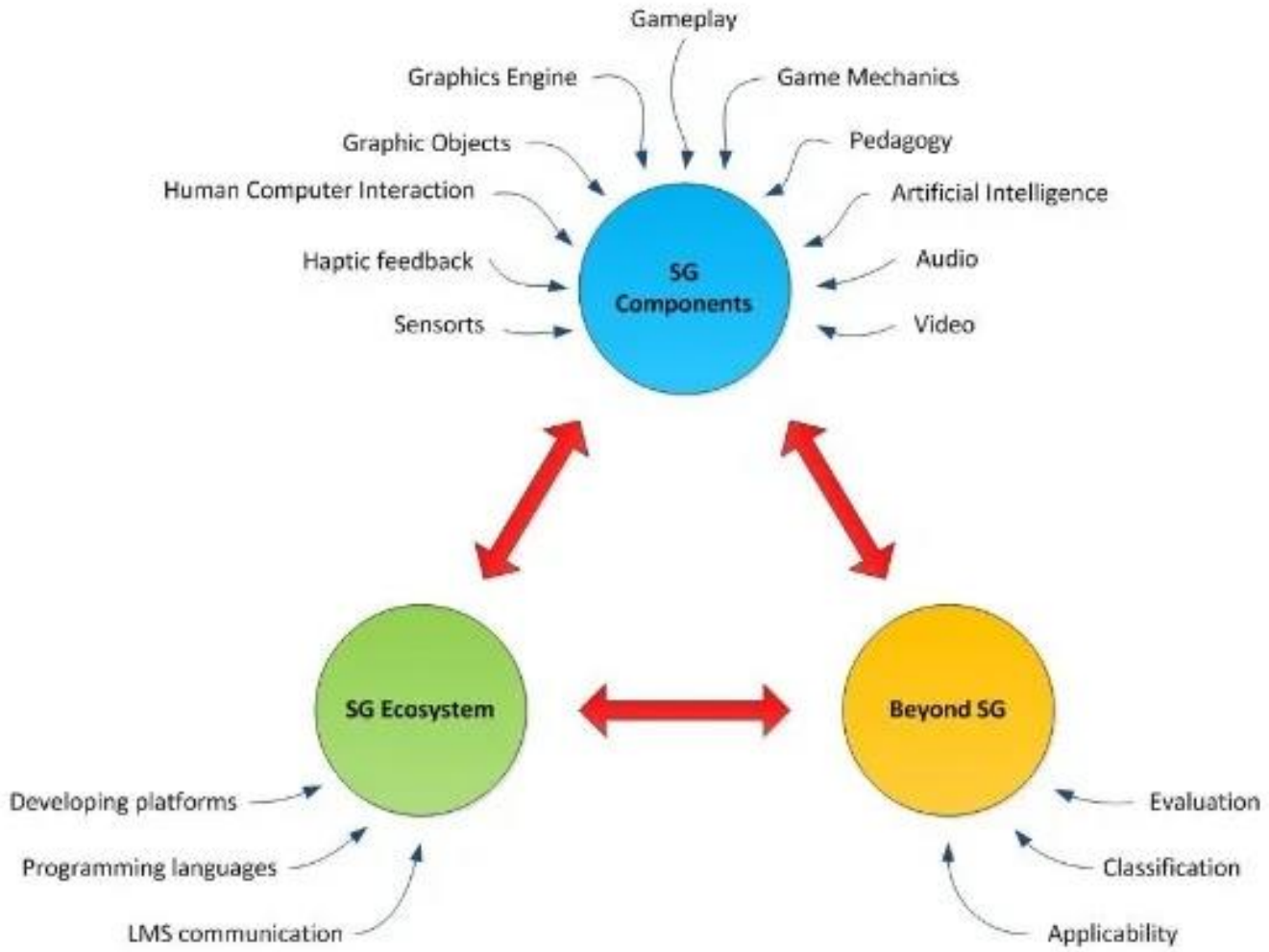
https://popupsmart.com/blog/ecommerce-gamification






WELCOME TO
VIRTUAL MUSEUM
EXPLORE
OPTIONS
EXIT
STORE

The Serious Games Convergence



Recommendations that a serious game need to include

- Initial motivation – It should be interesting for the player.
- Theory – Effective and understandable explanations.
- Practice – Various levels with rising difficulty, freedom to choose levels, covering provided theory.
- Verification – Checking the understanding of practice.

De Gloria, A., Bellotti, F., & Berta, R. (2014). Serious Games for education and training. International Journal of Serious Games, 1(1).

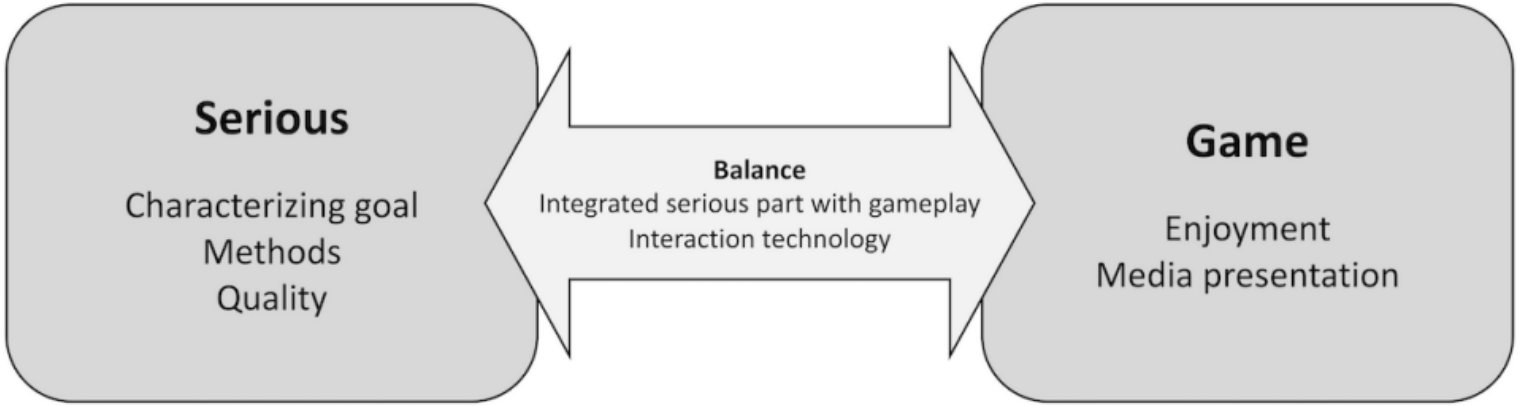
Key benefits

- Critical thinking
- Learning through experience
- Feedback and rewarding
- Decision making

Anastasiadis, T., Lampropoulos, G., & Siakas, K. (2018). Digital game-based learning and serious games in education. International Journal of Advances in Scientific Research and Engineering, 4(12), 139-144.

SG quality criteria

Figure 1. Quality criteria for the serious part and game part, as well as the balance between them.



Caserman, P., Hoffmann, K., Müller, P., Schaub, M., Straßburg, K., Wiemeyer, J., ... & Göbel, S. (2020). Quality criteria for serious games: serious part, game part, and balance. JMIR serious games, 8(3), e19037.

Quality criteria for the serious part

Table 1. Summary of quality criteria for the serious part.

Quality criteria and relevant quality aspects	Explanation
Characterizing goal	
Focus on the characterizing goal	• Learning/training goal must remain in focus, for which a combination of physical and cognitive training can be beneficial • Support players to achieve the characterizing goal • Game elements should not interfere with the learning/training process
Clear goals	• Appropriate methods for the specific application area and target group • Goals are clear and appropriate so that players can work towards the characterizing goal
Indispensability of the characterizing goal	• Serious part must be mandatory • Characterizing goal must not be avoidable • Training and learning tasks should not be a hurdle
Methods	
Correctness of the domain expert content	• Avoid errors and ensure that the content is technically correct • Ensure correct technical language • Remain neutral, especially on political and social issues
Appropriate feedback on progress	• Players should receive feedback on their performance and progress • Visible and recognizable effects • Provide simultaneous feedback (eg, visual, audio, haptic; multimodal feedback)
Appropriate rewards	• Provide positive reinforcement and in-game awards
Quality	
Proof of effectiveness & sustainable effects	• Prove that the characterizing goal is achieved • Learning/training effects need to be sustainable
Awards and ratings	• Game awards, professional and user ratings, recommendations by domain experts, game reviews, and number of players/downloads state the quality of the game

Caserman, P., Hoffmann, K., Müller, P., Schaub, M., Straßburg, K., Wiemeyer, J., ... & Göbel, S. (2020). Quality criteria for serious games: serious part, game part, and balance. JMIR serious games, 8(3), e19037.

Quality criteria for the game part

Table 2. Summary of quality criteria for the game part.

Quality criteria and relevant quality aspects	Explanation
Enjoyment	
Ensure player engagement and experience	• Ensure positive experience during playing • Serious games should be engaging and enjoyable (Koster's theory of fun for game design [82], GameFlow approach [13], and PLAY[a] heuristics [14]) • Provide an engaging experience for different player types
Ensure flow	• Keep a balance between a player's skills and challenge (Csikszentmihalyi's flow theory [83]) • Dynamically adapt the difficulty level depending on the current player's performance in the game • Adapt to players to increase effectiveness (eg, motivate them to repeat the exercises continuously and regularly) • Increase complexity as the player gets better (Bushnell's theorem of "easy to learn, difficult to master" [84]) • Provide varied gameplay
Establish an emotional connection	• Allow emotions and arouse instinct (Dillon's 6-11 framework [85], LeBlanc's theory of 8 kinds of fun [86])
Sense of control	• Players should have control over their actions in the game
Support social interactions	• Provide different game modes (collaborative and competitive settings for players that perform better in groups)
Ensure immersive experience	• Include multimodal sensory stimulations: visual, audio, haptics, smell • Ensure the sense of "being there"
Media presentation	
Attractive graphics	• Graphics must be appropriate for the game purpose, application area, and target group • Ensure clear interface without unnecessary information to not distract players from a specific task
Appropriate sound	• Include appropriate background music and sound effects

Caserman et al., 2020