StartPLAY
Interdisciplinary Conference on Gamification and Entrepreneurship

UNIVERSITÄT KOBLENZ · LANDAU

STARTPLAY 2022

Proceedings of the 1st Interdisciplinary Conference on Gamification & Entrepreneurship

Koblenz, Germany, August 05-06, 2022

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These proceedings contain 6 papers presented at the 1st Interdisciplinary Conference on Gamification and Entrepreneurship (StartPlay) 2022. The conference was held at the University of Koblenz-Landau in Koblenz, Germany, on August 05-06, 2022.

Preface

On August 5 and 6, 2022, the StartPlay conference took place for the first time as an interdisciplinary conference of science and practice around the topic of gamification and entrepreneurship at the University of Koblenz-Landau. The aim of StartPlay is to aggregate and discuss the emerging knowledge on the use of gamification, (serious) games and game-based learning, for example, for the development of business ideas, design of business models, products, services and customer communication, promotion of innovation processes and idea development, acceleration of social innovation processes, design of new industries, markets and fields of work, and training and empowerment of prospective entrepreneurs, and at the same time to transfer it to the start-up and founding scene In addition, StartPlay explicitly promotes the national networking of researchers in the field of gamification, (serious) gaming, game-based learning, entrepreneurship, start-ups and entrepreneurial education.

The paper presentations at StartPlay were framed by an extensive science-practice program, which included three thematically linked workshops by systainchange GbR from Berlin and the EMPAMOS project of TH Nuremberg on the development of a sustainable game idea, as well as three keynotes by internationally recognized speakers from science and practice. Specifically, StartPlay hosted keynotes from Prof. Dr. Sofia Schöbel (University of Osnabrück, Germany), Jasmin Karatas (Gamification Advisor, Zurich) and Prof. Dr. Fabrizio Palmas (University of Applied Management, Munich). At StartPlay, three academic paper presentation sessions were held on different focus topics: Innovation in Gamification Design, Innovative Applications of Gamification in Education, and Innovative Applications of Gamification in Business. In total, about 60 participants from academia and practice attended the conference.

The StartPlay 2022 Best Paper Award, determined by the conference committee, was awarded to Jessica Ulmer, Sebastian Braun and Jörg Woller for their paper “Gamification of assembly routines: Planned user study evaluating a level system with customized feedback elements”.

The StartPlay 2022 Best Presentation Award, determined by audience vote, was awarded to Jürgen Frentz, Marie Tuchscherer and Claudia Wiepcke for their paper “Gamified Sustainable Entrepreneurship Education – A digital Educational Escape Room for economy classes in German High Schools”.

Many thanks to our reviewers:

Adam Palmquist	Andreas Janson	Athanasios Mazarakis
Bastian Kordyaka	Christian Tuschner	Hella Hörsch
Jasmin Karatas	Linda Schürmann	Manuel Schmidt-Kraepelin
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Contents

Game-Balance Simulation as a Tool for the Evaluation of Systematically Designed Gamification Strategies

David Kessing and Manuel Löwer

Abstract

The development of successful gamification strategies requires a consistent, systematic approach including context analysis, ideation, and mechanic design. Finally, in the evaluation phase, it is verified what impact the gamification strategies actually have in order to make adjustments before implementation in the target context. The evaluation is mainly based on elaborate empirical methods. An objective, non-empirical evaluation method does not exist yet. Video game balancing can be tested by digital simulation tools (e.g., machinations.io) that illustrate game element relationships in flowcharts. This research demonstrates an approach to modeling gamification strategies in game balance simulation tools to make better assessments of the probability of success by combining results from the relevant literature and current research. Conclusions and implications for future research for the simulation of gamification strategies with game balancing tools are derived from a theoretical model implementation.

Introduction

Gamification is a modern approach to increasing motivation by using "game design elements in non-game contexts" [1]. The goal of gamification is usually to extrinsically and intrinsically increase people's motivation to perform certain actions, behaviors, or decisions by incorporating elements from video games into real-world situations. Gamification projects in most cases follow a structured design process to support successful development as described in *How to design gamification? A method for engineering gamified software* by Morschheuser et al [2].

Klock et al. point out in *Tailored gamification: a review of literature*, that "tailoring the game elements according to the users' profile is a way to improve their experience while interacting with a gamified system" and hence, offers a significant improvement to system design [3].

An important and also challenging aspect of gamification design is the evaluation of the developed strategies, especially in terms of "correct tailoring" for a given use-case. Morscheuser et al. defined gamification design principles based on literature research and assigned them to the design phases. The design principle for the evaluation phase reads:

"Define and use metrics for the evaluation and monitoring of the success, as well as the psychological and behavioral effects of a gamification approach." [2]

As concluded by Klock et al. in most gamification design studies use empirical evaluation methods for evaluation such as surveys and questionnaires [3].

Besides the inherent disadvantages, such as the correspondence principle and the problem of basic statements, empirical methods are usually very time-and effort-consuming. Additionally, through biases due to study participants and investigator and the influence of external variables as well as the dependency on the boundary conditions the results of empirical evaluations may be questionable in terms of validity and objectivity [4].

In terms of gamification evaluation with empirical methods, this means that e.g. mapping of different user types in a representative distribution to the real use-case is difficult as well as the realistic representation of the use-case without external variables during play-testing. Hence, an objective, non-empirical evaluation approach would add significant value to the development of gamification strategies. Game balancing describes the adjustment of parameters, scenarios, and behaviors in video games to strike a balance between frustration due

to overchallenge or boredom due to underchallenge [5]. Machinations.io is a browser-based game balancing tool. Using flowcharts, video game contexts can be visualized and actively simulated. The goal is to optimize games in terms of user experience and to identify potential problems and errors, such as game scenes that cannot be handled by players [6].

This paper investigates the principal suitability of machinations.io as a simulation tool for gamification strategy projects. An exploratory study examines the relationships between user types, game elements, motivation, and the completion of desired actions. Implications for future simulations of gamification strategies are pointed out.

Theoretical Background

Gamification

The term gamification first appeared in 2002 in a paper by management consultant Nick Pelling, and over time it has gained more and more attention in many fields. In 2011, the first scientific conference on this topic was held [7]. Gamification is a relatively young approach that started in the field of software development. In the meantime, gamification methods are already being used successfully in many application areas [8,9,10]. The concept of gamification attempts to use the potential of video games in a meaningful and targeted way. The goal is to increase people's motivation by offering new incentives to increase interest in activities and make overcoming challenges more attractive. By systematically designing gamification strategies, the positive motivational potential is tapped and desired actions are triggered. Since gamification aims to influence user behavior, desired actions define the goal of a gamification project [11]. The theoretical background is provided by approaches from motivational psychology, such as Csikszentmihalyi's flow theory, which describes the optimal state of concentration between boredom due to underchallenge and stress due to overchallenge [12]. Deci and Ryan's self-determination theory describes the basic drives of human action represented by autonomy, competence, and relatedness [13].

Player and User Types

Player Types (in the gaming context) or User Types (for gamification) provide a characterization of the users regarding their attitude or core motivation to use a respective context.

Bartle set the foundation for this concept in 1996 with the Four Player Types [14]. He describes four different player types that typically occur in video games and are characterized by different primary play styles. The four player types *Killer, Explorer, Achiever, and Socialiser* can be represented in a coordinate system with the axes Players – World and Acting – Interacting [15].

To translate the player types in video games to user types in gamification, Marczewski combined Bartle's original four player types with Deci and Ryan's self-determination theory to create the user types HEXAD [16]. Marczewski describes the six different user types that have different underlying motivations. The intrinsically motivated types are “Achiever”, “Socialiser”, “Philanthropist”, and ”Free Spirit“. They are motivated by relatedness, autonomy, mastery, and purpose. The other two types, motivated by extrinsic rewards and change, are “Disruptor” and “Player”. The user types HEXAD model enables the classification of people in gamified applications. Through a survey on his website, Marczewski performed a distribution of people into user types HEXAD [17]. The results are: “Philanthropists” 27%, “Free Spirits” 22%, “Achiever” 17%, “Socialiser” 16%, “Player” 15% and “Disrupter” 3%. However, this list only represents the dominant user types of the test participants. For a detailed description, Marczewski presents further subtypes of the user types and also proposes a user type evolution. In addition, Marczewski defines mixed user types. Thus, people can be assigned to several user types by their answers in the test.

Game elements

Game elements form the basic repertoire for gamification design. Game elements are elements derived from video games, which are used there for a specific purpose. Classic examples are points, rankings, and badges. These elements have already been categorized in various frameworks and described as solution-

neutrally as possible for use in gamification projects. Based on a previous analysis in a gamification project, suitable game elements can be selected and then designed for the individual use case.

The MDA (Mechanics – Dynamics – Aesthetics) framework of Hunicke et al. [18] describes the interactions between players and the system in game design. The Mechanics represent the particular components of the game, Dynamics are the behavior of the mechanics depending on the player inputs and Aesthetics describe the emotional reaction of the player to the system. While players perceive a game from the aesthetics side, the game developers focus on the mechanics first. For gamification applications, the MDA framework provides an orientation on how game elements shall be designed to influence the behavior of users in a gamified system.

Marczewski's "Periodic Table of Game elements" consists of 52 game elements assigned to the six user types HEXAD and two general categories [16].

Tailored Gamification

The consideration of different user types and the adaptive design of gamification strategies, called *tailored gamification*, is a current topic in scientific research. Tailored gamification offers significant advantages compared to one-fits-all gamification solutions [19] but at the same time increases the complexity of the developed strategies and consequently impedes empirical evaluation.

Santos et al. have also shown that it is possible to assign specific game elements to user types [20]. Rodrigues et al. conclude in their literature review on personalized gamification that users with specific player types are more likely to enjoy specific game elements [19]. Several studies observe the relationship in tailored gamification between user types and game elements as mentioned by Hallifax et al. [21] but also offer heterogenous results due to limitation to specific areas (e.g. health or education), the use of different user type frameworks, and different abstraction levels of game elements and motivation. Hallifax et al. discover numerical results for relations between user types (among three user typology frameworks) and twelve game elements, which are mainly not significant, nevertheless, the authors propose to use the user types HEXAD in future studies. Tondello et al. [22] describe the relationships of game elements (gameful design elements) to the user types HEXAD in an exploratory factor analysis. In an online survey, participants were analyzed in terms of their user type and then asked about their preferences for specific game design elements. They find significant correlations between 49 game elements and the user types HEXAD by using eight cluster components.

Game Balancing

Game balancing describes a continuous process in video game development to optimize the game experience. On the one hand, the balance within and between game elements is considered to identify possible dead ends and faulty interactions. For example, the points required for level advancement might be too high, blocking game progress or leading to player frustration. On the other hand, the balance between players must always be adjusted. For example, if one character class is clearly superior to the others in an online role-playing game, players will exclusively play that class to succeed. This inevitably leads to frustration and boredom among players, and thus a lower probability of success for the game. Therefore, even after a video game is released, so-called balance patches are often implemented to balance the gaming experience. This is particularly necessary for games that regularly provide new content for players, as the influence of the new elements can only be tested under appropriate test conditions. However, necessary changes often emerge only when the dynamics of the game evolve through a large number of players [5].

Machinations.io is a browser-based platform for designing, balancing, and simulating game systems (see fig. 1). It allows to represent arbitrary game systems in an interactive diagram, set parameters, define elements and their relationships to each other, and visualize how the systems work. This allows potential balancing problems to be identified and fixed before video games are released and without much programming effort [6].

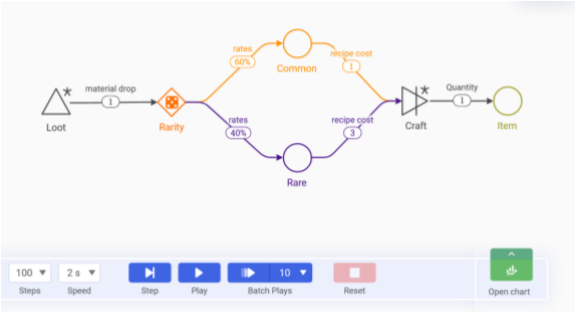

Figure 1: *Example flowchart on machinations [6]*

Several basic tools are available that can be combined to create complex logics. A source creates elements according to determinable conditions, a pool collects elements at intermediate points, and a gate can distribute elements. Resource connections route elements, while state connections represent conditions. Registers can be used to mathematically compute relationships. The end condition terminates the run.

Research Goal

The explanations above show that the evaluation of developed gamification strategies has so far been carried out using exemplary implementations in test environments with subsequent empirical evaluation. Empirical methods are usually time-consuming while the validity of the results is highly dependent on the boundary conditions. An objective, solution-neutral and effort-reducing way to simulate gamification strategies does not exist yet. Game balancing tools like machinations.io are not used because they are not designed for this use case.

By performing an explorative study in machinations.io the research goal of *evaluating gamification strategies in game balance simulation tools* will be addressed.

The approach consists of four main steps:

1. Defining the necessary elements to map motivational contexts in game balance tools based on a literature analysis.
2. Linking the identified elements with relationships from scientific findings to a theoretical model.
3. Implementation of the theoretical model in machinations.io as an explorative study
4. Basic evaluation of the implementation by an exemplary execution of the model

Modeling gamification

Elements definition

To find the necessary elements to be simulated, literature reviews on gamification frameworks are considered. The literature analysis at “web of science” and “google scholar” for open access review articles with “gamification” and “framework” in the title offers three results. Two of them did not fit the target of the analysis.

In their literature review on gamification frameworks, Mora et al. [23] identified the MDA framework [18] as the most referenced one. The MDA framework defines Mechanics (or **game elements**), Dynamics (or the interaction of the **user** with the system or **context**), and Aesthetics (emotional response of the user or **motivation**). The authors also mention a clear win condition (or **desired action**) that has to be fulfilled by the player. To address the current stage of research regarding tailored gamification, the user taxonomy **user types** HEXAD of Marczewksi [16] is added to the list of simulation elements as suggested by Hallifax et al. [21].

Relationship definition

The relationships between the elements are defined following the explanations in the MDA [18] and user types HEXAD framework [16]. The users in the gamified context are divided into different user types according to their characteristics and the user spectrum of the context to be gamified. The user types have an average baseline motivation value to perform a desired action, which is defined by the goal of the gamification project. This motivation is influenced positively, negatively, or not by game elements. Game elements have an individual impact on different user types. The adapted motivation influences the probability to perform the desired action.

To complete the theoretical model, the following questions need to be answered:

- What is the percentage distribution of users among the user types HEXAD?

- What is the relationship between a change in motivation due to game elements and user types?
- How does a change in motivation affect the decision to perform the desired action?

The distribution of users among user types depends on the individual use case of the respective gamification project and cannot be answered generally. Therefore, this distribution is taken as given. In this study, the survey results of Marczewski [17] are used because they have a high participation rate and do not relate to a specific context (see chapter "Player and User Types").

The correlation of whether a motivational change is triggered by a gamification element among user types is numerically extracted from Tondello et al. [22] as the study provides the broadest data on different game elements and significant correlations to the user types HEXAD. Tondello et al. describe the correlations of 49 game elements and the user types HEXAD to eight psychological components (Socialization, Assistance, Immersion, Risk/Reward, Customization, Progression, Altruism, and Incentive). For example, the game design element “Guilds/Teams“ is defined by a socialization value of .668 and an altruism value of -.430. The user type “Free Spirit“ shows correlations of .003 to socialization and .149 to altruism. The Socialization and Altruism values are each multiplied and then added to the direct correlation factor. In this example, the “Guilds/Teams“ element has an impact of -.062 (or -6.2%) on the ”Free Spirit“ user type. The steps of this exemplary calculation are illustrated in figure 2.

A negative influence on motivation does not automatically lead to a decision against the desired action, a logical connection must be established between the change in motivation and the decision for the desired action. Since there is no concrete scientific knowledge about this relationship yet, a statistical distribution is considered here. The basic distribution is modeled as a Gaussian distribution on a scale from 0 to 100 percent around the predefined motivational baseline value with a sigma of 10 percent. Thus, if the motivational baseline for the desired action is 50%, users have a probability between 10% to 90% of performing the desired action, with a sigma 1 interval between 40% and 60%, a sigma 2 interval between 30% and 70%, and so on. If a user is positively or negatively influenced by a gamification element, this is distributed only on the respective positive or negative half of the Gaussian distribution. For example, a “Free Spirit“ user is negatively influenced by the “Guilds/Teams“ element. The baseline value for taking the desired action is set to 50%, so the user has a 68.2% chance of being distributed on the Sigma1 interval. This results in a 50-40% chance of performing the desired action.

After this step, the users' performed desired actions are summed up and put into a relative ratio to the total number of users. The difference between this factor and the average baseline motivation value gives the percentage increase (or decrease) in the performed desired actions due to the influence of the game elements.

Components	User Type „Free Sprit“	Game Element „Guilds / Teams“	Calculation
Socialization	.003	.668	.003 * .668 = **.002**
Assistance	.126		
Immersion	.406		
Risk/Reward	.120		
Customization	.117		
Progression	.013		
Altruism	.149	-.430	.149 * (-.430) = **-.064**
Incentive	.030		
Correlation Factor Free Spirit x Guilds / Teams			.002 + (-.064) = **-.062**

Figure 2: *Exemplary calculation of the correlation factor for the “Free Spirit“ user type and the “Guilds/Teams“ game element*

The theoretical model and an example user journey are shown in figure 3. This exemplary user gets assigned to user type 1 (with a motivational baseline value of 50%), gets influenced negatively by game element 1, and hence assigned to the negative half of the Gaussian distribution. With a probability of 28% the user takes the sigma_2 interval and thus has a 30% chance to take the desired action, which he finally does not.

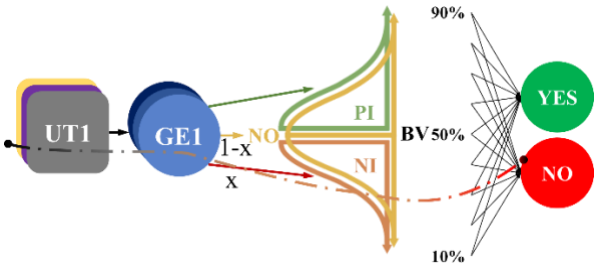

Figure 3: *Theoretical model and example user journey (pointed line) (UT = user type, GE= Game Element, x= calculated influence of GE1 on UT1 based on [22], PI= positive influenced users, NI=negative influenced users, NO= not influenced users, BV= motivational baseline value (here 50%))*

Model implementation

The previously described theoretical model is now implemented with machinations.io. The complete model is attached in Appendix 1.

The simulation model includes five sub-steps:

1. Distribution of users to user types.
2. Calculation of motivation direction influence through game elements
3. Calculation of motivation change distribution
4. Calculation of the decisions for the desired action
5. Calculation of final evaluation factors

Distribution to user types

This step defines the characteristics of the users in the context of the simulation. As this is highly dependent on the context, a user analysis is necessary to determine the real existing distribution. For simulation purposes, the distribution of Marczewski's survey is taken here [17] (see chapter Player and User Types).

The distribution is realized in the simulation by a random gate with probabilities of the paths according to Marczewskis survey results (see fig.4).

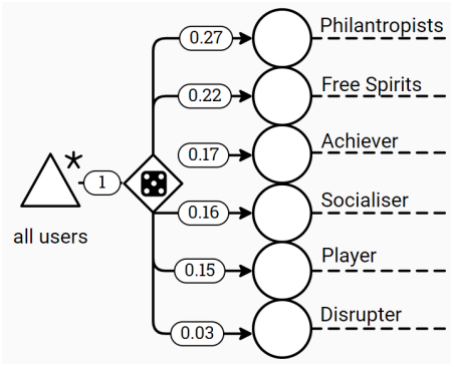

Figure 4: *Distribution of users to user types acc. to the HEXAD model with the results of Marczewski [17]*

Impact of game elements

This step determines whether the game elements have a positive, neutral, or negative impact on the user's motivation concerning their user type. In this particular example, the user type "Free Spirit" is considered. The two game elements chosen are "Guilds/Teams" with a calculated value of -6.21% (see chapter relationship definition) and "Unlockable or Rare Content" with a value of 16.18%. The user type is implemented as a source representing the users. Each user interacts with the two game elements implemented as random gates. The probabilities of the paths to positive, neutral, or negative influence refer to the calculated values based on Tondello et al. [22]. The motivational changes are each represented by a pool (see fig.5). Since a user generates two simulation elements, the pools must be normalized later in the simulation.

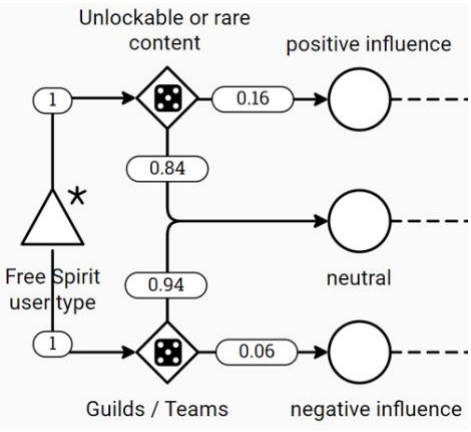

Figure 5: *Relationships between User Types, Game elements, and Motivation Change*

Motivational change

This step defines how much the motivation changes based on a Gaussian distribution.

Users who are positively influenced by the game elements are distributed on the positive half of a Gaussian distribution, while negatively influenced users are placed in a negative half. Neutrally influenced users are randomly distributed positively and negatively in the Gaussian distribution, which is realized by a 50/50 chance of negative or positive distribution. Each simulation element that represents a motivational change in the pools triggers a source that distributes the elements to a Gaussian distribution via a random gate (see fig.6).

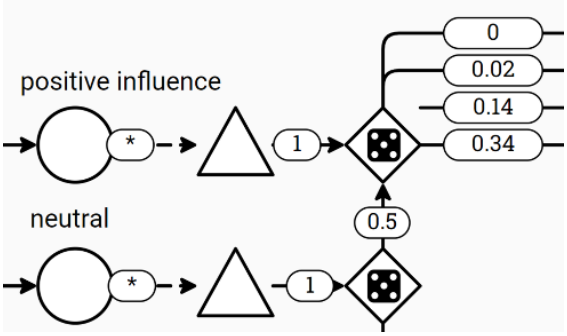

Figure 6: *Calculation of motivational change distribution via Gaussian distribution*

Decisions for desired actions

This step determines how the change in motivation affects the user's decision to perform the desired action. A scale from 0 to 100% is used for this purpose, representing the probability of performing the desired action. For each user type, a context-dependent baseline value can be preset, which can be manually adjusted during the simulation using an active slider. The sigma value of the Gaussian distribution is fixed at 10%. If a user is distributed to the respective interval, he will be assigned to the middle value. The formulas in the simulation diagram also take into account that the Gaussian distribution does not generate probabilities above 100% and below 0% (see fig.7). Thus, a user with positive influence from a gamification element has a 68% chance of being distributed into the interval +sigma*1, with an assigned probability of taking the desired action of base value + 5%. In this example, with a base value of 50%, this results in a 68% chance of taking the desired action with a 55% probability, a 28% chance of achieving the 65% probability, a 4% chance for 75%, and a 0.04% chance for 85%.

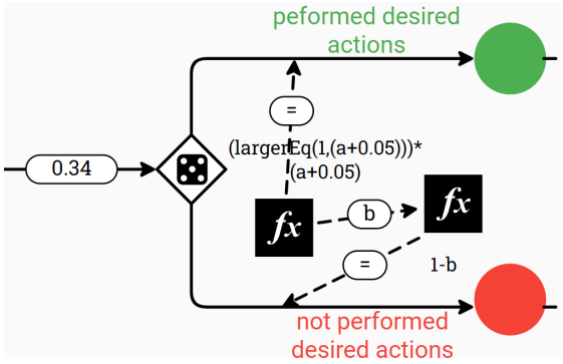

Figure 7: *Calculation of decision for desired actions in the sigma_1 interval on the positive half of the Gaussian distribution*

Factor calculation

Finally, the calculated values are combined and analyzed. With different combinations from the pools of performed and not performed desired actions, the success rates of the game elements for the user types can be calculated (see fig.8)

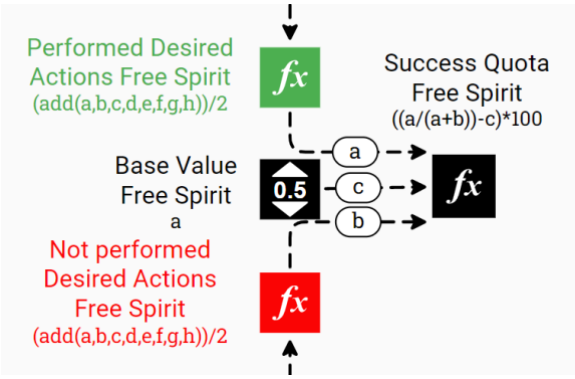

Figure 8: *Calculation of evaluation factors*

In the present exemplary implementation for the user type “Free Spirit“ with a base value of 50% and the game elements “Guilds/Teams“ and “Unlockable or Rare Content”, the simulated success rate leads to generally more performed desired actions compared to the baseline value.

The success rate of all user types is simulated 50 times with 600 steps each simulation. The data indicates a combined success rate of about 5% compared to the average baseline value of all user types with a standard derivation of 2.1%. The

results of machinations.io can be plotted in an execution chart and exported (see. Fig. 9).

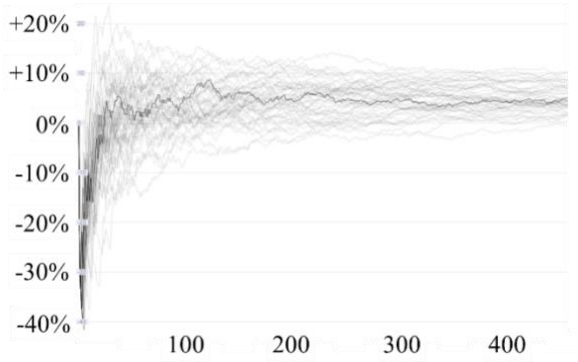

Figure 9: *Execution chart from machinations.io (x-axis: performed simulation steps, y-axis: improvement compared to baseline value)*

Discussion and future research

The possibility to simulate gamification strategy results with game balance simulation tools can possibly extend existing research regarding tailored gamification. While empiric studies (e.g. [3,20,22,24] show the influence of game elements on user types, the presented approach relates these results to the performance of the desired action and puts them into the bigger context of a gamification strategy with combined game elements, a specific user type distribution, and context influence.

The results of the simulation model presented in chapter 4.3.5 have to be interpreted carefully, as an exact transfer to real gamification application can possibly result in other outcomes. The goal of simulating gamification strategies for evaluation purposes is not yet to accurately predict the effects of game elements on the performance of the desired action, but to provide objective guidance on how various game elements might affect a given context. The number of identified simulation objects provides a basis for simulation purposes, but can certainly be expanded. In particular, the elements representing individual context influence need to be explored and analyzed in more detail in future research to create the possibility of better consideration in simulation contexts.

Tondello et al. [22] give a direct way to generate numerical relationships between user types and game elements, but this has to be considered as an approximation since people on average do not correspond to only one user type [17], and also user types may change over time [25].

The Gaussian distribution on the extent of motivation change is an approximation, as research findings in this area are lacking. As soon as findings are available, they need to be implemented in the simulation model to describe this relationship more realistically.

In general, the validity of the simulation model must be verified in comparison to empirical results to ensure that the simulations represent reality within the necessary limits, otherwise divergent results between the simulation and the real implementation of gamification strategies may occur. Extending the simulation with more scientific findings will possibly enable a more realistic outcome and hence, a more consistent evaluation method for gamification strategies.

Hence, future research should focus on empirical evaluation of the model to ensure validity, the extension with more scientific findings, and the implementation of the context impact.

Conclusion

In conclusion, this study shows that in general with some limitations, the simulation of the influence of game elements on motivation and thus the decision for or against the desired actions is possible. Gamification strategies can be simulated in game balance tools, yet there is a lot of potential to extend this research, especially in the empirical validation of the model.

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A Canvas Framework for Gameful Design Concepts

Max Höllen and Thomas Voit

Abstract

Elaborating effective gameful designs efforts a deep understanding of game design elements and "game literacy". The most gamification endeavors are therefore very complex, especially for individuals with less experience in game design. The research results of the project EMPAMOS provide a toolset and a pattern language with high potential for developing new concepts for gameful designs that foster motivation ("gameful motivation") in diverse contexts, but at the same time demand for an elaborated design process to create these concepts meaningful and tailored. Thereby, it is crucial to find out how to make use of potentials of game design elements and how to find a structured way to choose and combine them to new gameful design concepts, embedded in the context and accepted by the target group. This paper presents a framework consisting of four canvases for the systematic AI-aided development of gameful design concepts. It considers the use of existing likewise the inclusion of new game design elements as well as element combinations. In particular, the canvases lead game designers through an iterative process of briefing, exploration, creation and fit. Using a design-science approach to research, this paper shows how the canvas framework is iteratively developed, applied and evaluated. The designed artefact, the macro-canvas, enables gamification designers to systematically analyze, improve and develop gameful design concepts by bringing target groups, target behavior, context and game design elements together in one compact framework

Introduction

The use of game design elements has an enormous potential to create new motivational designs and innovations in various contexts (business development, culture, social work, education, government) and on diverse levels (individual, team, organization, environment). Opposite to a lot of innovation methods that focus on the development of products and services with a predominantly technological or business focus, methods that work with game design elements – commonly described as gameful design or gamification [1] – consider the motivational needs and behaviors of people and their interaction with each other. Working with the game metaphor allows to integrate elements of collective fun, voluntariness and self-motivation into a design process. In other words: The expected outcomes of the most innovation methods are new products and services with interaction and motivation as a value added. The expected outcomes of gameful design methods are new ways of interactions and (self-)motivation, usually delivered as the core of a product or service (in a broader sense) [1]. Thus, it can be concluded that gameful design concepts foster real *social* innovations [2], mostly in form of motivational innovations.

For this reason, working with game design elements should not be reserved for the gaming industry and professional game designers, but be accessible for diverse professionals in the social, cultural, educational and business sector.

In order to establish this, it is important to become acquainted with "game thinking" or "game literacy" to work with game design elements and to apply the right vocabulary and mindset.

The project EMPAMOS [3,4] has analyzed games in the German Game Archive, the biggest collection of boardgames, and lifted round 100 game design elements and 25 so-called game design misfits. They were taken together with methods into a game design toolbox that enables individuals and teams with different levels of game design expertise (from the first use of game elements to the professional work in the game industry) to create effective and fitting gameful design concepts. These concepts consist of

game design elements that are provided by an empirically buttressed collection. Additionally, the project explored the connections of game design elements. Combining game design elements leads to specific configurations that help to generate solutions that are as a whole more than the sum of its parts. Configurations of game design elements can be conceived as “game design molecules” analogous to chemistry, where several elements form molecules. If these molecules are again connected with each other, they form greater clusters of game design elements that can be conceived as “game design networks”. These terms base on the concept of Christopher Alexander’s pattern theory [5,6] that was applied on game design firstly by Björk and Holopainen [7].

However, as useful a collection of game design elements in form of a pattern language is, it still affords the learning of new concepts and competences in multiple dimensions. For instance, it is necessary to learn and understand all game design elements as a vocabulary, to comprehend the concepts (e. g. that of game design misfits), to moderate a creative team and to apply the right methods. Applicants of a pattern language have to cope with both, the complexity of the practice case they want to tackle and the newness of the method. In such a situation, it is helpful to have a structured design process and the documentation of a concept development for all parties involved. A structured process and a visualization of the connection of game design elements helps unexperienced innovators as well as game design experts to wield this complexity. The development of a common method and process of the implementation of game design elements into non-game contexts is also helpful for gamification researches, as it provides an easily comparable step-by-step structure and empirical evidences for gamification projects that can be conceived by analyzing the artifacts of the process. These artifacts can be provided by canvases. Canvases are conceptual structured templates that show the connection and the interrelatedness of complex process steps and concept parts on a two-dimensional surface. This visualization helps to perceive a complex topic and follow a predefined design process intuitively.

The process of EMPAMOS ameliorates the design process and tackles certain shortcomings in recent gamification approaches. First, the simple superimposing of elements on a context to make it more superficially pleasing (“chocolate-covered broccoli”) [8] is prevented by the intense analysis of existing elements in a context. Second, by establishing the concept of game design misfits a bridge is offered between the (motivational) problem faced and the subsequent choice for certain elements.

Third, the ideation phase of the development of gameful design concepts is assisted. Morschheuser et al. [9] found out that the creative ideation phase in particular is not methodologically covered, as it mostly relies only on creativity methods such as brainstorming. Mora et al. [10] show in their literature review that several gamification frameworks try to integrate the essential core concepts of game design into the gamification process, for example by referring to the MDA framework [11] or Schell's Game Lenses [12]. Deterding positions his concept of skill atoms also as “brainstorming triggers” [13]. But, gamifiers are still looking for a methodical answer to the question of which game design elements must be selected with regard to the users’ motivational needs. A related, equally important aspect is, how game design elements have to be combined in order to address these needs precisely. It is hence not surprising that gamification designers today still rely on points, badges, and leaderboards, and that many of them will be reluctant to use the full variety of game design elements due to uncertainty and risk aversion [14].

Fourth, the careful and iterative check of context, target group and behavior in a FIT phase allows for sustainable motivating concepts that preclude “motivational straw fires” [4].

The following sections give more information about the underlying project EMPAMOS, explain the theoretical foundation for the creation of design canvases, the research method and the explanation of the canvas framework as an artefact of the research. It concludes with the application of the framework in practice contexts and the limitations and implication that can be concluded therefrom.

The project EMPAMOS

In the following, the basic building blocks that are necessary for the specific design process will be introduced (see [3] and [4] for details). These have been worked out in the context of the EMPAMOS project.

The project consists of two phases, where the second is an ongoing progress. EMPAMOS uses the German Games Archive, which contains today about 40,000 games. In the first project phase, the games were qualitatively researched by playing 208 games and searching for recurring patterns in them. From these patterns, 97 game design elements were described and their occurrence documented with a total of 4,206 text annotations in 961 games and their text instructions. Starting from this empirical basis, the second phase was focused on the quantitative analysis of the games. We trained machine learning algorithms to automatically recognize the game design elements in the text instructions [3]. By February 2022, a total of 49,135 pieces of empirical evidence had been found to support the use the game design patterns within 8,300 games. This catalog of empirically proven connections shows how game design elements are combined in games to solve motivational problems. This creates a pattern language for game design analogous to the work of Christopher Alexander in the field of architecture [5–7].

Further, the analysis was not restricted to game design elements but also took so called misfits into account. Whereas game design elements are very common in the gamification literature and practice, game design misfits are a new form of patterns, namely circumstances that render games dull or less (re-)playable. Game design misfits were revealed by counterfactual reasoning via mental removal: What would happen, if a game design element was missing in the game? Which negative effects, such as boredom, imbalance or ambiguity, are kept in check by the elements? These negative circumstances were documented leading to a set of 25 different game design misfits.

A first artefact of this research is the game design toolbox. It contains the game design elements and misfits as playing cards supplemented by methods to apply them in order to create concepts that use game design elements to foster motivation. To dissociate clearly from the merely superimposing of game design elements on a context, the term “gameful motivation” as alternative to “gamification” was established. It should make clear that motivation is not generated by a manipulation of the target group by exposing them to game elements, but by helping them to motivate themselves with the power of gameful design.

A second artefact, the EMPAMOS web application, allows for a more rational and calculated approach: Game design elements, misfits and their connections are in turn the basis for another machine learning algorithm that can suggest further elements in case of a certain incidence of game elements, misfits and connections. These suggestions of the web application allow users to structurally find out new connections and elements for a game design network [15].

To wield these powerful tools, it was necessary to develop a structured, logical and comprehensible design process that helps implementing the game design elements into non-game contexts.

The present paper consequently asks the following research question:

How can the empirically developed game design patterns be used to systematically develop meaningful and tailored gameful design concepts as solutions for motivational problems?

A framework for the systematic development of gameful design concepts is therefore designed and evaluated.

Concepts behind the design process

As a conceptual foundation, we draw a promising analogy to another discipline, which uses design-based processes and canvases frequently, namely entrepreneurship and value proposition design. The gamification process can be seen analogous to a business [16]. Just like entrepreneurs, gameful designers have to deal with a complex environment, have to analyze the needs and pains of their target groups and need to work iteratively on a product or service, which is in our case a gameful design concept.

Three important conceptual frameworks from entrepreneurship and value proposition literature were used as theoretical piles for the conception of the canvases: the design thinking process, value proposition design and the use of canvases as a design tool.

Design thinking and digital innovation

Design thinking can be conceived as a human-centered approach, toolset, mindset and strategic principle [2]. As a toolset it can itself make use of gamification and gameful/playful methods, such as Lego Serious Play [2]. As an approach and process it can inspire the process of game design generation.

First and foremost, human-centeredness, empathy, visual communication and interdisciplinary co-creation are fundamental design principles that design thinking and our approach to game thinking have in common [17–19]. Besides this, three main features of the design thinking process were important for our conception: the macro framework of the process, the specific process segments, and their iterative connection.

The macro framework of the design thinking process is commonly described as “double diamond”, which means that there are two main spaces (diamonds). The first is the problem space, the second is the solution space. Each of the spaces has a divergent phase and a convergent phase. In the divergent phases the space is opened widely and deeply to generate a lot of opportunities. In the convergent phases the space is streamlined and focused [17]. Between the two diamonds lies a “point of view”, where a “how might we … ?” question is formulated that guides the solution generation. Hence, a design thinking macro process consists of discovery, definition, development and delivery [17].

Based on this macro structure the design thinking process is divided more or less fine-grained into phases, depending on the grounded model. One common model is described by the Hasso Plattner Institute and contains the phases “understand”, “observe”, “point of view”, (first diamond), “ideate”, “prototype” and “test” (second diamond) [20].

Specifically, the process for the present canvas framework was inspired by the EXPLORE-CREATE-EVALUATE model from the innovation agency Dark Horse [21]. Their process adapted the build-measure-learn circle by Ries [22] for challenges in bigger organizations.

All process models have in common that despite their definition of concrete steps, they do understand a process not as linear, but as iterative. Hence, it is possible and even necessary to go back and forth between the phases and inform preceding phases with data from later stages. Hypotheses and critical assumptions are formulated, tested, validated or dismissed, which is again outset for new hypotheses.

Design thinking is an approach to generate human-centered and innovative artefacts that can be products and services. If game design concepts are understood as innovations based on the interaction and activity of humans, an even more specific discipline in the context of digital innovation and design thinking is applicable, namely service design [23,24].

Value proposition and service design

From the perspective of a product-dominant logic game design elements gamify products or services. In this view, gamification has the role of a feature, value-added service or annex to the value proposition. In contrast, if gameful designs are conceived as service systems with regard to a service-dominant logic (“S-D logic”), they are themselves the value proposition [25,26]. Gameful design concepts have more in common with service systems than with products, as they are usually intangible, based on knowledge and relating to activities. The representatives of the target group are part of the service and integrate their views and perceptions co-creatively [26]. In a gamified setting, not the product or its feature, but the activities of the individuals are a source of value [27]. Gamification concepts are therefore not only social innovations but also service innovations.

When it comes to developing services, the literature recommends starting with the value proposition first, as it is the core of the offering [27]. Hence, value proposition design seems to be promising as a key for the design of new gamification concepts. A very common

framework for the design of value proposition is provided by Osterwalder [28]. Here, a value proposition is segmented into users' pains, gains and jobs to be done, that are mirrored by pain relievers, gain creators and features that a value proposition has to offer.

Design thinking and value propositions in service design benefit from a visual approach to discussion, idea and prototype generation. Therefore, canvases as visual design tools are very promising.

Canvases as a design tool for gamification

Canvases are visual design tools to capture insights, track hypotheses and discuss concepts within a team. One of the most known canvases in management and information technology is the business model canvas by Osterwalder [29]. Canvases relate to the design science approach as they help to create artefacts visually (in opposite to a pure verbal documentation). This helps to perceive complex ideas more quickly and intuitively, creating a basis for discussion that can be changed flexibly. Interviews with gamification experts in a study of Morschheuser et al. [9] reveal that canvases are already frequently used in gamification projects.

A research into gamification canvases showed that there are already tools, such as the *Gamification model canvas* [30,31] that bases on the business model canvas by Osterwalder and combines it with the MDA framework (mechanics, dynamics, aesthetics) [11]. This was also further developed to a *Lean Gamification canvas* [16].

Although the MDA framework offers a useful structure for gamification projects, the canvases presented here provide an alternative way of structuring by the game design pattern language. They play on the level of game design elements, whereas the MDA framework plays on the level of overall, middle-range concepts of a gamification model. Furthermore, the gamification model canvases do not allow for the inclusion of game design misfits and the service design thinking process is insufficiently mapped. Therefore, our objective was to create new game design canvases for meaningful and tailored concepts.

Research method

Based on the data of EMPAMOS, the artifact developed in the present study is a canvas framework for the design of game design concepts. The artifact is evaluated through its application in EMPAMOS workshops and work with customers.

Thereby, this paper is following a design science research (DSR) approach [32,33]. Originated in information systems and design research, DSR is a promising approach to advance the development of design processes and therewith social and service innovation such as gameful designs. DSR is considered as a suitable approach due to its focus on designing methods and frameworks for the development of new solutions for complex problems.

DSR includes the evolvement of new artefacts. While gamification practitioners may create new gameful designs that solve specific motivational problems for a target group in a specific context, DSR generates novel models and frameworks that advance the process of game design through iterative circles of conceptualization and validation.

DSR encompasses two main activities that are performed iteratively: building and evaluating [34]. In the building phase, a new artefact is constructed. The evaluation phase assesses the performance and fit of the artefact. Both processes require an iterative approach which involves design science and social science [32,33].

According to Peffers et al. [32], a DSR research project can be divided into six steps: (1) identification of problem and motivation, (2) definition of the solutions objectives, (3) design and development, (4) demonstration, (5) evaluation and (6) communication.

The *problem* was identified in the practice of the application of EMPAMOS methods, where we became aware that individuals faced with the game design toolbox appreciated its value and potential but struggled in learning and applying the methods. That motivated us to lower the complexity and provide applicants with a structured framework.

The overall *objective* of the canvases is to support practitioners in their gamification projects.

The third step, *design and development*, was done within the interdisciplinary research team with backgrounds in business informatics, system theory, gamification and entrepreneurship. In several workshop sessions, the canvases were iteratively sketched and optimized. Experiences from former EMPAMOS workshops with more than 70 participants from the business, cultural, social and educational sector ensured a link to the practice. In sum, it took five iterations to create the first versions of the canvases. First, the four steps of the process were defined. Second, the most important concepts and terms were collected and mapped to the process steps, third the team decided for a rough order of the fields, fourth the canvases were separately designed. Lastly, the team gave each other feedback to the current draft of the canvases, suggested further scales, reformulation of terms and rearrangement of fields.

The *demonstration* of the canvases happened by the concrete application in four gamification projects, where customer of EMPAMOS (a therapy software provider, a publishing house, a e-learning platform and an economic promotion agency) were let through the whole process in two or three workshops each. Additionally, the canvases were implemented in EMPAMOS workshops and used by 17 advanced participants to develop their own gamification models. The project team documented their usage of the canvases as visualization and consulting tool. After each workshop with the clients the team held a reflection meeting where thoughts were collected about what worked well and where the canvases should be adapted. The reflections were stored in a common working platform and led to new iterations of the canvases that were used and tested in the next project.

Whereas the success of the assignments were first hints to the positive *evaluation* of the canvases, subsequent interviews with the customers and the participants gave additional qualitative data for the evaluation. They were asked whether they could understand the process clearly and if they had questions at certain steps. In the first project with the therapy software, the client was asked to write down the concept in their own words, so that the team could estimate whether the principle of the canvases was free of ambiguity. A discussion with the clients about the results of the workshops revealed further insights, how to clarify the procedure. For instance, the ranking of the motivational dimensions in the EXPLORE phase offered several interpretations. The team had to clarify which questions are to pose at this point and how the fields are connected with each other. This led also to a manual that described in detail how the canvases are meant to be used. The manuals were again presented to the workshop participants that wanted to learn the method by themselves. By assessing and discussion the game design concepts of the participants that were created with the canvases, several more iterations of the designs were made.

Finally, the canvas is going to be *communicated* in the scientific communities by research papers and conference talks.

The next section introduces the structure of the canvas framework.

The canvas framework

Figure 10 gives an overview of the whole EMPAMOS design process, which should be facilitated by the canvases.

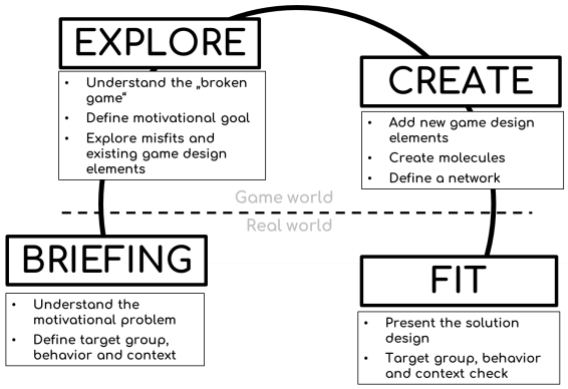

Figure 10: *EMPAMOS Design process*

The design process from design thinking and the double diamond model propose a procedure consisting of *discover, define, develop* and *deliver*. Therefore, first of all an exploration phase for the analysis of the setting is important for a design concept. After exploration, the context and the target groups are concretely defined and

understood, which transfers to the phase of creation. At the end of the process the concept has to be implemented and evaluated. This was mapped with the three phases EXPLORE, CREATE and FIT. The FIT phase is positioned before the implementation and has to check whether the network actually fulfills the target of the project. It transfers the game design concept from the game world into the real, non-game world and is therefore the exit of the process. On the start of the process, it is also important to give an entrance from the real world into the game world. Therefore, a BRIEFING phase was positioned before the EXPLORE phase. It represents the "zeroth diamond" in the double diamond model and makes sure that the assignment for the project is concretely clarified using the language of the non-game world.

In the following the creation of the four canvases is explained with more detail.

BRIEFING

BRIEFING relates to the project preparation and the analysis described by Morschheuser et al. [9]. According to their literature review and exchange with experts, the context is often less emphasized in gamification projects. The BRIEFING alleviates this common shortfall by allowing for a closer look at three important piles of each gamification project: 1) target group, 2) context and 3) target behavior.

A deep analysis and clarification of the target group is strongly emphasized by design thinking and value proposition design. Many gamification projects fail because of an incomplete definition of the humans that have to benefit from the game. The BRIEFING phase demands a definition of the target group(s) and their description by facts (age, demography) and emotional, cognitive and personal needs. At this stage, the value proposition canvas by Osterwalder [28], user interviews and personas help to list up facts about and traits of the people that have to be motivationally affected.

As important as the target group is the context that is going to be gamified. A certain behavior of a certain target group depends strongly on the specific context, e. g. if it is a vocational or private setting. The canvas requires to define important key data about the context. In the evaluation through the DSR process, the research team found out that not only the context of the target group, but also the context of the project have an influence on the gameful design. The former describes aspects such as stakeholders, organization, processes, branches, the latter focusses on data about the boundary conditions of the project, such as time, space and budget of the assignment.

Target group and context together make up the situation that is targeted by the project. A target group shows in a situation in a given context a certain behavior. This central field of the BRIEFING canvas compels to define the *observable* target behavior that should be achieved by the project. Here, we provide a continuum loosely based on the behavioral grid by Fogg [35]: Two poles are the most challenging in this nexus: To cease an undesired behavior or to rise a new desired behavior. Apart from this, a designer of gameful concepts can decide to decrease an undesired behavior or to stabilize or increase a desired behavior that is already shown by the target group. Making clear and unambiguous decisions at this point helps to improve the feasibility and the fit of the game design network.

Based on the notion of realities as "broken games" [36], the BRIEFING phase ends with the question, what is actually the broken game to be repaired: Who should be motivated for which behavior in which context? The broken game can be seen analogous to the "wicked problems" that are starting point for design science and design thinking [2,37]. Figure 11 shows the final BRIEFING canvas.

EXPLORE

The EXPLORE phase reveals the assets in the context and the target groups and sets the stage for the gameful design project. It precedes the ideation phase, which is assessed as to some extent blurry in current gamification practice [9]. Here lies one important difference of the EMPAMOS approach in comparison to other gamification design processes: Instead of starting immediately with creative ideation (e. g. with brainstorming), the EXPLORE phase firstly analyses the context and the target group as if it was already a game – an incomplete game that is

poorly designed, therefore lacks motivation and engagement and feels broken for the target group as its players. Information from the real world in the BRIEFING is transferred into the game world and translated into game language created by the game design patterns. This procedure is important for individuals with less game design or gamification experience, as it helps to look at the familiar context through "game glasses". The EXPLORE phase identifies the misfits and analyses existing game design patterns in the situation, understood as a "pantry": Which elements are already there and can function as a basis for the concept?

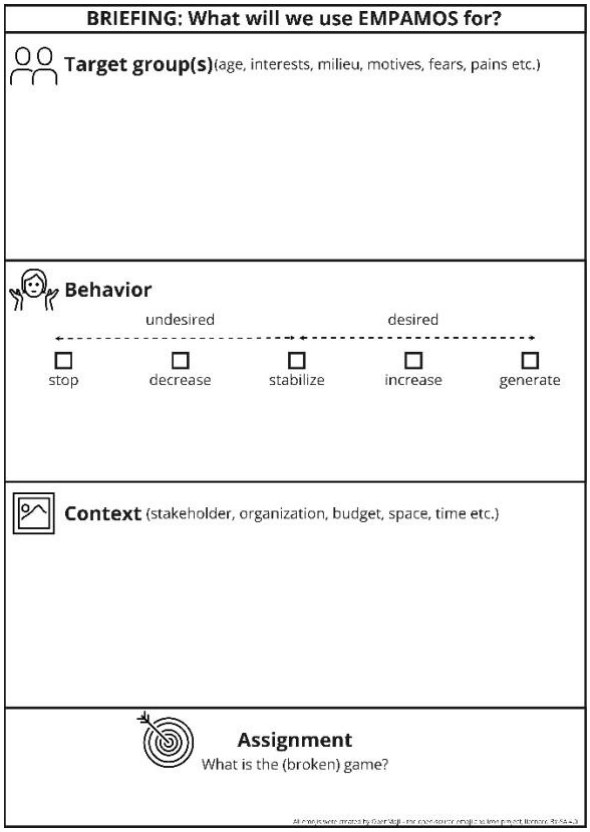

Figure 11: *BRIEFING canvas*

A first question in the EXPLORE phase is whether the game design network is going to lift a current status to a next level and to exploit potential (chance) or whether a desired state, which is missing, is to be established (problem).

Based on this, the motivation goal can be determined. The game designer has to assess, which motivation dimension is key for the target group (in case of a chance) or in which dimension the biggest deficits are (in case of a problem). The dimensions are based on self-determination theory (*competence, relatedness, autonomy*) [38], supplemented by the dimension of *meaning* proposed as a supplemental dimension by Rheinberg [39]. At this important step the user of the canvas has to prioritize what kind of motivational effects the gameful design should create. This gives another clarification and concretization for the ideation and makes sure that the concept tends in the right direction.

The next step deals with the game design misfits, which are provided as playing cards by the toolbox. Based on the insights about the target group and the context the current situation is analyzed concerning existing misfits. Problems and challenges that render the non-game context a broken game have to be analyzed and transferred into the game world by building analogies. This gives first findings, why the current situation is demotivating or why the target behavior is not observable. The misfits can also be classified into context- and behavior-related misfits and how intensely they occur, thereby leading to a first mapping of the broken game in terms of potential for game solutions.

Analogously, the existing game design elements in the context can be analyzed and structured. By looking through the "game glasses" aided by the game design element card deck, the designer can transfer non-game features of the context into the game terminology. Hence, they recognizes the existing game potential in the project and what the target group is already familiar with. That makes it easier to build gameful design concepts that are rooted in the context and are accepted by the target group preventing the "chocolate-covered broccoli" approach. This view into the "pantry of game elements" is neglected by other gamification processes so far.

Game design elements can also be behavior-related or context-related – and they can have positive or negative effects in the current situation.

The EXPLORE phase ends with a hypothesis concerning the chance or problem that sums up the insights from the transfer and catches the functionality of the current (broken) game. Analogous to the "how might we …" question in design thinking, this hypothesis clarifies the target and finalizes the definition.

Figure 12 shows the EXPLORE canvas.

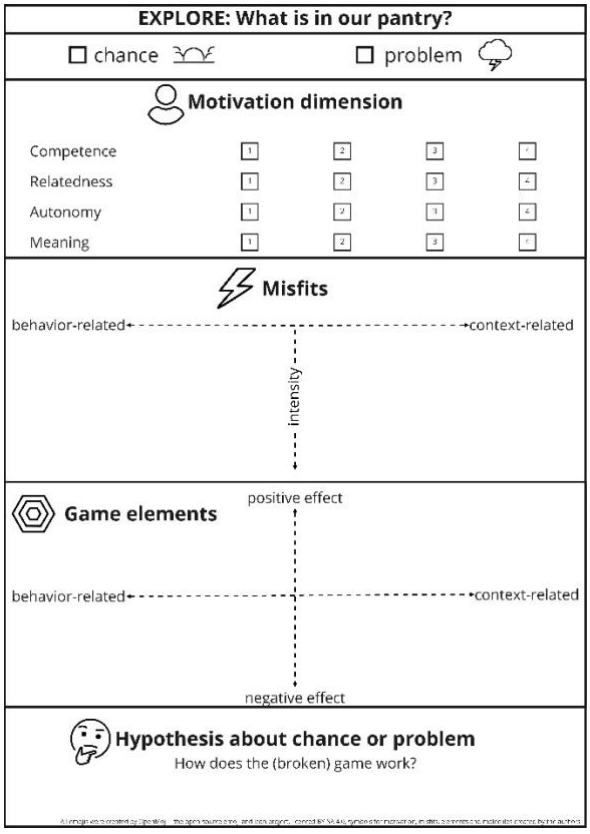

Figure 12: *EXPLORE canvas*

CREATE

Not until then follows the CREATE phase that is the ideation part of the process. It uses the artefacts (misfits and existing elements) as the outset for a holistic framework. In the CREATE phase three levels in a continuum between intuition/randomness and rationalization/calculation are possible: The most intuitive and most random approach is to just draw cards from the pile of game design element cards and to intuitively decide, whether the game design element fits for the concept and connects with the other elements or not. The most rational and most calculated approach is the use of the web application, where an algorithm suggests new elements based on artificial intelligence. Between these two extremes are other methods, such as the design along predefined concepts, e. g. the control loop from “assignment”, “action”, “story world” and “reaction” [40], process models or player journeys. Concepts such as the *Gamification model canvas* or the MDA framework might also be helpful scaffolds at this stage. These methods will come up with a great number of new game design elements that have to be connected with the existing elements. They will also cluster with each other and build higher-order configurations (molecules). Molecules are game design elements that stick together and influence interaction concordantly. The final game design network is lastly defined by the different molecules that came to existence.

At this stage, the value of the pattern language becomes obvious. Ideation phases are inherently demanding, as diverse ideas and thoughts with different levels of maturity and abstraction have to be collected, clustered, ordered and streamlined. Especially in teams, where various perspectives and experiences clash, these tasks are challenging. In the worst case, the sheer infinity of possible solutions stifles creativity. The pattern language restricts the potential parts of the solution to the round 100 game design elements. Every element has a number that can be notated on the canvas. This leads to a common language in a team and structures thoughts. Having the choice among a collection allows to order the thoughts of the explorative minds and inspires those who are not good at retrieving ideas out of nothing. Hence, by pinning the elements at the canvases (for example with sticky notes) and rearranging them together, the ideation phase becomes more efficient.

Further, elements can be transferred from the EXPLORE canvas to include also the pantry elements.

The CREATE canvas formulates a solution hypothesis and is shown in Figure 13.

FIT

The last phase, FIT, immerses into the real world again. It stands before the prototyping, implementation and evaluation of the game design network and checks, if the game design network matches with the objectives, the target group, context and behavior defined in the BRIEFING phase.

The target group fit looks back at the target group from the BRIEFING and the motivational dimension from the EXPLORE canvas. It is meant to analyze the whole network, if it addresses the target group’s needs, pains or gains and whether

the target motivation dimensions are really tackled by the concept. E. g., it might happen that the concept is very thoughtful and creative, but does lead to strong relatedness, whereas the target group actually strives for autonomy.

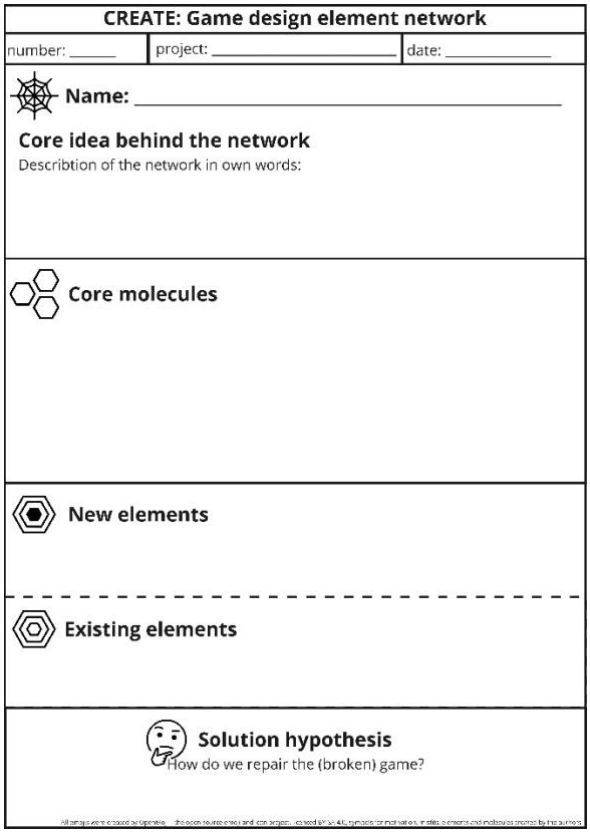

Figure 13: *CREATE canvas*

The behavior fit looks back at the target behavior and the misfits and checks, whether the targeted desired or undesired behavior is actually stopped, decreased, stabilized, increased or generated by the network. Additionally, it tests for eventually occurring new misfits that arise from the solution.

Finally, the context fit checks the boundary conditions defined in the context field in the BRIEFING phase. It also examines whether the game design elements already present in the pantry and the new game elements work well together or, alternatively, whether they lead to new disruptions. This might be the case, if there is an inappropriate balance between the game design elements already present in the context and the new game design elements. New game design elements have to be carefully embedded into the context.

The FIT phase closes with the first considerations concerning the implementation of the game design element network, starting with features of a potential prototype that can test the solution.

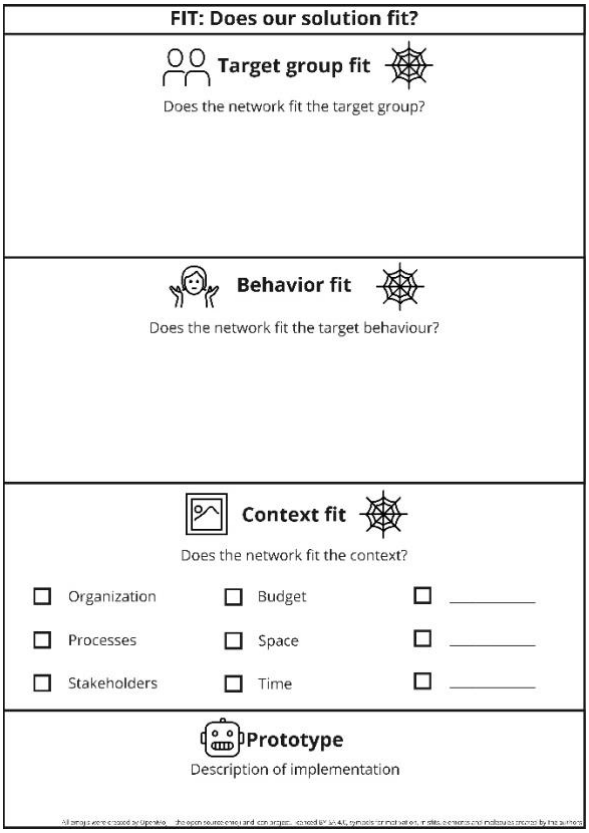

Figure 14: *FIT canvas*

After this conceptual design work, the implementation, evaluation (e. g. by user testing) and monitoring has to follow to finalize the gamification process [41]. However, the EMPAMOS design process stops at this point, as the pattern language with its game design misfits and elements have defined the building blocks of the solution. The implementation bears different challenges that have to be tackled, but they go beyond the scope of the search for the right elements. However, it is always possible to come back to the FIT phase and check, if the concept harmonizes with target group and context. Here again, negative feedback by users can be analyzed with the game design misfits. It might happen that a gameful design concept produces new misfits that were not considered before the process. Based on the knowledge about combinations, game design elements that show negative effects could be easily substituted by alternative elements.

The meta canvas

All four canvases can be filled-out step by step and stand for themselves. Furthermore, all four taken together create a meta canvas, where the upper, the middle and the lower parts are horizontally connected (see dotted lines in Figure 15). These four horizontal "streamlines" make it possible to jump back and forth in sense of the iterative procedure. The upper part deals with the target group: In the BRIEFING canvas, their facts and traits are retrieved, in the EXPLORE phase their motivational needs are analyzed in the game world, the network of the CREATE phase describes the surface of the concept that is addressed to the target group, checked finally by the target group network FIT.

The middle part of the meta canvas deals with the behavior that is shown when a target group meets a certain context. Whereas the BRIEFING canvas defines the target behavior, the EXPLORE phase identifies current negative influences on the behavior with a game perspective, followed by concrete molecules of game design elements in the CREATE phase that should keep these misfits in check or decrease their effects. By checking the behavior FIT, these assumptions are tested.

The second lowest part of the meta canvas is concerned with the context, as it starts with the boundary conditions in the BRIEFING phase. The EXPLORE phase identifies game design elements in the context and transfers them into the CREATION phase, where the context is enriched by further game design elements. These are again tested via context fit in the FIT canvas.

Lastly, the lowest part of the meta canvas summarizes the whole project.

The whole canvas can be traversed like a large playing field, with different methods helping to move from section to section. For beginners a recommended path is provided (see dashed line in Figure 15), experts can also shortcut at certain points with more complex methods.

Application and Evaluation of the Canvases

To proof the canvases in practice, the following sections illustrate three occasions where the canvases were used. Two of them are assignments, where a customer asked the research team to design a gamified service. The closing occasion describes, how participants of the EMPAMOS design workshops worked with the canvases.

Application for a sleep therapy software

A provider of a therapy software for people with sleep disorders asked the EMPAMOS team to integrate game design elements into an online therapy process. The users of the software have to go through a process about several month, where they have to fill out questionnaires and dairies about their sleep, supplemented by message exchange with a personal counsellor. The dropout rate in this process was rather high. Therefore, the objective of the project was to decrease an undesired behavior, namely the exit during the process. The BRIEFING canvas helped to clarify this objective, as focusing on the undesired behavior affords other concepts than the opposite, i. e. increasing the interaction. The EXPLORE phase helped to define concrete motivational needs (competence, relatedness) and identified three core misfits (e. g., "game is hard to win", because external circumstances, such as the work conditions, decrease the therapy effect). The exploratory discovery revealed that many game design elements already exist in the context, such as *arrival, player progress bar, collecting* or *positive event*. Most of them already had a rather positive effect, which was not exploited so far. In order to raise their potential, they were supplemented by new elements, such as *play phases, game progress bar, feedback, avatar* and *badge*. With these elements, four interesting molecules could be created: a clear positioning via progress bars and arrivals, a storytelling molecule consisting of an avatar and a story, a passion for collection molecule that enriched the dairies that could be collected by badges and fourth, a cooperation molecule, where the interpersonal connection between client and counsellor was deepened by positive collective events and feedback.

In this case, the canvases were filled out together with the customer. The concrete briefing helped to clarify the assignment and the visualization of the network was a foundation for deeper discussion of the game design concept.

Application for a publishing house

A more complex network was created for a publishing house that wanted to develop a software for pupils who are considering career choices for the first time. Here, the BRIEFING and FIT canvas were filled out together in two customer workshops. The immersion into the game world was done only by the research team to create a meaningful solution.

The EXPLORE phase helped to identify the most important motivational dimensions for the pupils, namely meaning and competence. Based on this, it became clear that two misfits are the main roots for the pupils' low engagement: "the game seems meaningless" and "success is too dependent on individual skills".

Aided by the web application, a complex concept consisting of four molecules was generated. It contained a mystery that consisted of a riddle and storytelling, a collection play field, a protocol and an avatar that was connected to skill points.

With the canvases it was possible to explain the customer the procedure precisely and to let them participate at the design process without going to deep into the gamification and game design matter. It further allowed for a connectivity to other business projects by starting with a target group and context description that had to be signed off by the customer.

The design team recognized in the EXPLORE phase that a lot of misfits were applicable in the context. So, it was necessary to decide for a few of them to prevent fuzziness and overcomplexity. Having the concrete case present it became obvious that some misfits produced other misfits and other were just effects of other misfits, leading to two or three core triggering misfits that were the root of the others. Subsequently, the canvas was elaborated as such that it was possible to draw connections between misfits in terms of cause-effect-relationships to find out where the core misfits lie, and which misfits are produced by another. This gave the applicants again more clarity.

Application in workshops

The canvases were provided for participants in two advanced EMPAMOS workshops as design tools, so that they could use them for their projects.

It became obvious that especially in the first phases (BRIEFING and EXPLORE) the canvases helped to formulate concrete and unambiguous objectives for their concepts.

The CREATION canvas was used for several iterations, which is why a line was included where the number of the iteration could be indicated.

Both, in analogue and in digital settings, it proved useful to work with sticky notes in different colors. The colors can indicate, whether a hypothesis is just formulated, validated or rejected. Additionally, the different origin of game design elements ("pantry" or new) could be indicated by colors.

Discussion and Limitations

The aim of this paper is to design a framework for the development of meaningful and tailored gameful design concepts for non-game contexts. A DSR field-based research process was used to design the artefact and to identify the best fitting process steps. The designed framework is the first to consider game design misfits and already existing game design elements in a context ("pantry"). It includes the target group, the target behavior and the context as three main pillars and considers them in every stage of the iterative process. Through its visual clarity, the meta canvas is fostering the discussion in academia and can be applied easily by practitioners.

Gamification research benefits from the design-based development of this artefact, as it builds a bridge between design thinking, value proposition design, service innovation and game thinking. By using the canvas in further gamification projects, we will gain additional knowledge about what kind of game design misfits and elements occur in which contexts and are connected to which target group. We also learn more about the design process in gamification and how an ideation phase can be structured and well-organized between the both poles of pure randomness and AI-aided rationalization.

The social and service innovation perspectives give also a theoretical underpinning for gamification in the contexts of business and

innovation. Further scientific work could elaborate, how gamification connects to recent business theories and methods, e. g. in innovation and entrepreneurship research.

With regard to practice, the EMPAMOS meta canvas is a very powerful tool to reduce complexity of gameful design for non-game contexts and increase the fit of a concept with target and context. Through the discussion with project partners and workshop participants the framework could be enhanced and tailored to the special needs of game design developer on all levels of expertise. Additionally, it could be fruitful to connect the EMAMOS canvases with the *Gamification model canvas,* e. g. in the CREATE phase, by mapping the MDA framework on the game design pattern language and classify the game design elements to create a middle-range classification. Though, a one-to-one classification will not be possible, as single game design elements might impact more than just one dimension of MDA.

However, there are also limitations that should be addressed in the future. The term “target group” on the canvas implies a one-way direction between the designer and the individual that benefits from the game design concept. To align with the service design and human-centered design perspective it might be appropriate to speak about the “user” or the “recipient” of the gameful service; even “customer” could be an appropriate term [27].

Further, the canvases present a framework for the conception phase of gamified solutions and support the encompassing development of meaningful and tailored concepts. However, following this, the developed designs have to undergo the subsequent steps that are also part of the design thinking and lean start-up process, e. g. protoyping, developing and programming, implementation, testing, piloting and exploitation or commercialization (dependent on the context). Therefore, further canvases, e. g. IMPLEMENT and TEST / EVALUATE are considered as the next steps of the design-based research. This does not mean that canvases combined with the pattern language only lead to theoretical, abstract concepts. Already in the EXPLORE phase the game design elements are connected with the non-game world. In the CREATE phase every game design element has to be transferred in the specific context with at least a rough idea for the implementation. That is why the boundary conditions of the context (for example, the use of a specific software) are listed in the BRIEFING. Hence, the pattern language provides also a foundation for the implementation. In further research the different ways of implementation are collected and connected to the game design elements, leading to a list of possibilities, how a game design element could be used in practice.

Acknowledgements

The authors wish to thank the organizers and board members of the Start Play conference, two unknown reviewers for their great comments. Further, the authors thank Laila Hofmann and Thomas Bröker from the EMPAMOS team for their helpful contributions to the discussion.

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Appendix

Game design patterns

Table 1: *Game design elements*

#	Name of the element
1	Arrive
2	Badge
3	Reward
4	Constrained Communication
5	Event
6	Remember
7	Feedback
8	Question
9	Common Playing Field
10	Information Asymmetry
11	Competition
12	Cooperation
13	Resources
14	Roles
15	Collecting
16	Victory Condition
17	Victory Points
18	Player Progress Indicator
19	Storytelling
20	Penalty
21	Swap
22	Team
23	Loss Condition
24	Time Limit
25	Chance

Table 2: *Game design misfits*

#	Name of the misfits
1	Own performance not assessable
2	Decision uncertainty too great
3	Rules are too complicated
4	Game does not encourage cooperation
5	Game is too easy
6	Game is too hard
7	Game seems meaningless
8	Game duration too long
9	Success depends too much on skills
10	Game situation is unclear
11	Gameplay is too predictable
12	Competition is too strong

Meta Canvas

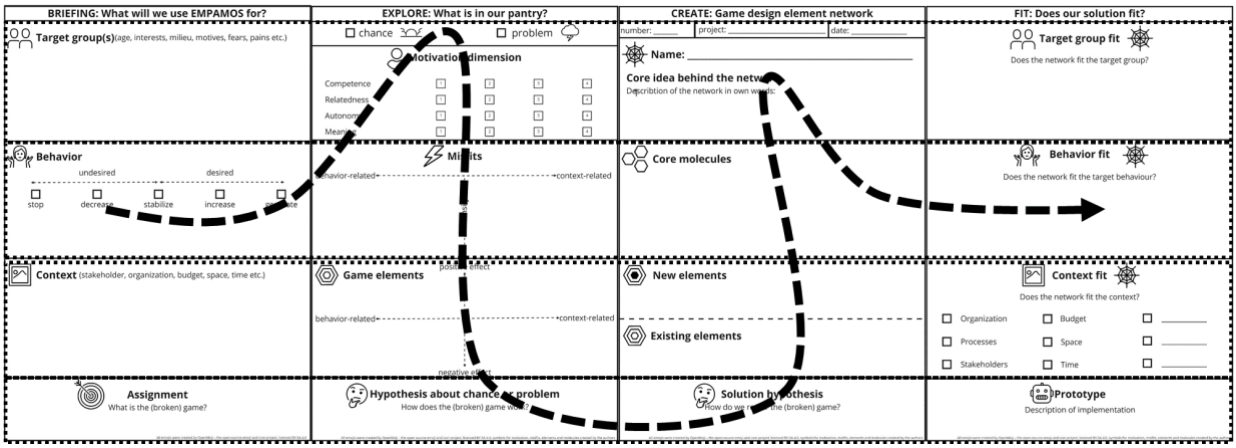

Figure 15: *Meta canvas: recommended path (dashed line) and horizontal thirds (dotted)*

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Gamified Sustainable Entrepreneurship Education – A digital Educational Escape Room for economy classes in German High Schools

Jürgen Frentz, Marie Tuchscherer and Claudia Wiepcke

Abstract

Digitization is a megatrend that affects all domains of everyday life. Dealing with digital media and tools is therefore a key competency that should already be mastered in schools. In the field of Sustainable Entrepreneurship Education in High schools, playing digital Educational Escape Rooms might be a motivating activity to acquire sustainopreneurial competencies as well as digitization-related competencies. After an introduction to the fields of digital education and gamification in economics education along with Sustainable Entrepreneurship and Sustainable Entrepreneurship Education, this work-in-progress paper presents an example how to design, create and evaluate a digital Educational Escape Room to learn about Sustainable Entrepreneurship in German High Schools. Finally, a prospect of future research in this field is presented.

Introduction

'We live in a world of dramatic global changes', wrote Secretary-General of the UN António Guterres (2020) in the foreword of the World Social Report even before the pandemic crisis showed its impact [1].

Hence, Sustainable Entrepreneurship Education in schools can make important contributions to solving social and economic challenges, as it enables young students to approach these problems with entrepreneurial acting and thinking [2, 3]. Sustainable Entrepreneurship Education is linked to Education for Sustainable Development that interconnects the economic, social and environmental domains and encourages learners to make autonomous decisions and act proactively [4, 5]. Therefore, it seems obvious that dealing with digital media and tools in Sustainable Entrepreneurship Education can strengthen the learners' ability to interactively and independently use technologies and special knowledge, as well as change the way they access information [6].

The use of digital tools and media is a key competence that should be mastered by all people, since the transformation of society through digitization manifests itself in all areas of life [7, 8]. Based on this, the European Commission on an European level as well as the Standing Conference of the Ministers of Education and Cultural Affairs of the countries in Germany calls for competence-oriented and cross-grade learning with and about digital media in German schools that should be thought of as an integrative part of all subjects [9, 10].

The gamification approach offers the possibility to design learning environments with digital media in a playful and motivating way [11, 12]. One method here is the digital Escape Room, referred to as an Educational Escape Room in the pedagogical context. The competency goals of the Educational Escape Room can be well related to those of Sustainable Entrepreneurship Education.

Although digital Educational Escape Rooms for Sustainable Entrepreneurship Education in schools may offer great learning potential, these digital games do not exist. This raises the research question of how such a competence-oriented digital Educational Escape Room can be designed and implemented for Sustainable Entrepreneurship Education. In line with this, a project designing a digital Educational Escape Room in Sustainable Entrepreneurship Education in schools has been brought forth, which is presented in this article.

In chapter 2, the domain of digital education and several key digital competencies are presented. Here, the relevance of gamification followed by the integration of a digital Educational Escape Room is explained. In chapter 3, the fields of Sustainable Entrepreneurship and Sustainable Entrepreneurship Education are presented. Chapter 4 brings together the two domains of digital education and Sustainable Entrepreneurship Education in the form of a digital Educational Escape Room for teaching Sustainable Entrepreneurship in German High Schools. Based on the Star model [13], the intended competency goals are presented as well as the design and possible forms of validation of the digital Educational Escape Room are described. This papers ends with an outlook to further research in this area.

Digital education and gamification (in economics education)

This chapter introduces the subject of digital education. Thus, central competencies of a digital world are presented. Finally, an overview of the domains of gamification and digital Educational Escape Rooms is provided.

Digital education

Digital education is considered the key to participating in a digital world [9]. Digitization-related competencies are currently indispensable for a successful participation in social life [14]. Several models already deal with digital competencies, e.g. the 'Computer and Information Related Competencies' model of the ICILS study (2018) [15] as well as the competency framework 'DigComp' from the European Commission (2022) [16]. These competency models have been validated several times and continuously developed in international studies [e.g. 17, 18, 19, 20]. In Germany, digital competencies were presented by the Standing Conference of the Ministers of Education and Cultural Affairs in 2017 by means of a framework, which is based on former versions of the competency models DigComp and that from the ICILS study [10].

The following domains belong to the digital competencies: s*earch, processing and storage* describe the act of searching, filtering, analyzing, evaluating as well as securely structuring and storing data, information and digital content. To *communicate and cooperate* means using digital media and tools for communication, collaboration, content sharing as well as document co-creation. The competency *produce and present* is about the understanding of different digital editing tools and their usability for different targeted purposes, e.g. present, publish, or share, and considering legal requirements. To *protect and act safely* describes knowing risks and dangers in digital environments, developing and applying strategies to protect, among other things, personal data, one's own health, nature and the environment. *Problem solving and acting* is about the identification of technical problems, as well as determining and finding solutions to them. Finally, *analyze and reflect* is about recognizing, analyzing and reflecting the opportunities and risks of media used in different areas of life [10].

The transformation of digitization strongly impacts the field of education. Hence, new possibilities in the context of digitization are being developed, such as digital didactic tools, dissemination channels, and new access to knowledge [9]. Other examples include multimedia and interactivity, self-directed learning as well as the adaptability to users [21, 22, 23].

Gamification (in economics education)

A complementary potential of digital learning environments is the increase of learning motivation. Children and young adults have grown up with digital technologies that develop different learning styles, new attitudes toward the learning process, and higher demands on teaching and learning. For high school teachers, this means they must constantly adapt the learning process to the needs, preferences and requirements of the students in the best possible way [24].

Regarding the learning motivation, modern pedagogical paradigms and trends in education, reinforced by the use of information and communication technologies, create conditions for the use of new approaches and techniques to support and implement active learning. Gamification in education represents one of these

trends [24]. It describes 'the use of game design elements in non-game contexts' [25], such as classrooms in schools. Gamification relates to the term 'games' and not to the term 'play'. Whereas 'to play' denotes a more improvised and free form of behavior, 'to game' refers to achieve fixed goals and also to concrete structures such as rules [25]. Various research studies show that the use of digital gamification increases the motivation of learners, as the level of difficulty can be adapted to the level of the player [11, 12].

In gamification, various digital game techniques and mechanisms can be integrated into the learning process as an activity. The purpose of these is to achieve specific learning goals, promote an increase in learner motivation, and create advantageous competition with other learners. In addition to this, gamification is an effective option to positively change students' behavior and attitude towards learning: on the one hand, students have control over learning outcomes and understanding, and, on the other hand, games create the conditions for an effective learning process [24].

In economics lessons, games are suitable for the development of almost all content and learning areas of economics. For example, they can be used to acquire or improve basic economic knowledge, communication, cooperation, creativity, observation and assessment [11]. For this purpose, (digital) Escape Rooms seem to be an appropriate type of game.

Escape Rooms and (digital) Educational Escape Rooms

Escape Rooms are defined as live-action games that are played primarily in teams, where players are expected to solve puzzles, discover clues as well as complete tasks in one or more rooms. Here, a specific goal (usually to escape from the room) has to be achieved within a limited amount of time. Participating in Escape Rooms involves several valuable pedagogical elements, including teamwork, communication, delegation as well as critical, systemic and lateral thinking [26]

Escape Room are used as a fun experience or game-based activity to achieve learning enhancement. This type of game focuses on game features and thinking skills that increase motivation and improve the competency of problem solving [27].

Incorporating these qualities into educational contexts is seen as an innovative pedagogical method to engage students accustomed to traditional classroom settings. Thus, Escape Room are seen as Educational Escape Rooms [28, 29].

According to the Star model, five elements have to be considered for the creation of an Educational Escape Room [13]:

- the learning process
- the gameplay - the structure of the game
- the equipment (physical or digital)
- the narrative - the story
- the puzzles

When creating a digital Educational Escape Room, logistical and time challenges may be overcome by using a variety of available platforms [30]. Numerous online platforms already exist that allow options for designing different types of digital Educational Escape Rooms: the platforms Genial.ly, Google Forms, or an E-book Creator offer the ability to design an Educational Escape Room and show simple steps for teachers to create puzzles and codes [31]. Digital Educational Escape Rooms allow the integration of a variety of digital tools to organize treasure hunt activities based on the structure shown above. Content delivery may take place through e-books, video or audio files, digital newspaper articles, etc. Puzzles may include various tools such as digital crosswords, memories, quizzes or search puzzles. Physical or digital equipment may be any form of worksheet as well as the use of Quick Response (QR) codes [29], encrypted PDF or text processing files. Various puzzles and challenges can be used which offer excitement and rewards [32] and relate to a topic covered in economics classes [33].

Sustainable Entrepreneurship (Education)

Entrepreneurship is understood as a creative process of disruption and destruction of traditional entrepreneurial structures and the development of innovative start-ups.

Entrepreneurs as visionaries and innovators promote this process. Thus, the question arises how entrepreneurial activities can be related to the idea of sustainability [34, 35].

In its original meaning, sustainability provides for the preservation of a current state [36]. In its current understanding, Sustainable Development is interpreted as something that has to be permanently preserved and developed, while the economic, social and ecological perspectives are considered at the same time [37, 38].

In the course of sustainable development, entrepreneurship represents a mechanism for maintaining and developing services and products in the long term [39]. The connection between entrepreneurship and sustainability is known as Sustainable Entrepreneurship or Sustainopreneurship [40, 41]. Sustainable Entrepreneurship is driven by a socio-ecological mission that contributes to sustainable development and corresponds to a process of solving societal and environmental problems by exploring and exploiting market opportunities generated with innovative business ideas [42, 43, 44].

Sustainable Entrepreneurship Education promotes the teaching and learning processes which are necessary to grasp the complex connection of entrepreneurship and sustainability [45, 46]. Entrepreneurship Education in general promotes entrepreneurial acting and thinking [47] and creates a mental attitude defined by entrepreneurial characteristics such as motivation, creativity, innovation and the will to take risks [48]. Besides this, Sustainable Entrepreneurship Education also integrates approaches known from Global Learning and Environmental Education [2, 3].

A key element of Sustainable Entrepreneurship Education is to foster the sustainopreneurial intention. Here, the theory of planned behavior by Ajzen (1991) might be a robust model for explaining and predicting entrepreneurial intentions and behavior [49, 50]. According to the theory of planned behavior, intentions are influenced by one's attitudes toward behavior, subjective beliefs and norms as well as the perceived behavior control. Therefore, the degree of self-efficacy and empathy of the learners and their perceived social support have a crucial impact on the intention to act in a sustainopreneurial way [51, 52, 53].

Promoting the sustainopreneurial intention does not mean that Sustainable Entrepreneurship Education primarily focuses on founding a sustainability-driven start-up. Sustainable Entrepreneurship Education rather creates an entrepreneurial and sustainability-oriented mindset [54]. Therefore, Sustainable Entrepreneurship Education makes use of the repertoire of skills and methods which are known in the field of Education for Sustainable Development [55, 56]. It also creates awareness that there are limits to natural resources that need to be respected in the course of entrepreneurial activities [2]. Sustainable Entrepreneurship Education is also a 'place for ethics of change' [44]. Thus, in the sense of transformative learning, Sustainable Entrepreneurship Education supports the transformation process of personal values towards a sustainability-oriented way of life and economy [57].

A Sustainable Entrepreneurship Education competence framework for Middle or High Schools is still pending. The only existing and validated competence framework for Sustainable Entrepreneurship Education is aligned to Higher Education and combines frameworks from Education for Sustainable Development and Entrepreneurship Education [58]. It distinguishes between six competencies: *systemic thinking* describes the ability to identify, analyze and combine the different domains along the Triple-Bottom-Line. *Foresighted thinking* is the ability to foresee and evaluate decisions on the environment, society and the economy. *The normative competency* is the ability to identify, apply and combine sustainability-oriented values. *Promoting diversity and interdisciplinarity* describes the ability to include stakeholders in the entrepreneurial process and to take into account different perspectives on social, economic and environmental problems. *Interpersonal acting* allows learners to motivate others and to informally lead collaborative interactions. Finally, *taking action and strategic management* supports active participation in responsible actions along with the ability to design projects and advance interventions in terms of sustainability-oriented practices [58, 59].

Sustainable Entrepreneurship Education is only weakly anchored in German high schools' curricula [60, 61]. However, the sustainability perspective seems to support a better standing of Entrepreneurship Education in schools and is therefore a promising approach to foster entrepreneurial thinking and acting in economics lessons [60].

A digital Educational Escape Room for teaching Sustainable Entrepreneurship in German High schools – a case study

This chapter introduces the design and the possibilities of validating a digital Educational Escape Room for Sustainable Entrepreneurship Education in schools. In the first part, competency areas of digital education as well as Sustainable Entrepreneurship Education in combination are discussed, which are promoted by the use of a digital Educational Escape Room. Then, the various elements of a digital Educational Escape Room for Sustainable Entrepreneurship Education in schools are presented. The second part shows a design for validating the digital Educational Escape Room.

Designing a digital Educational Escape Room for teaching Sustainable Entrepreneurship Education

The goal of the designed digital Educational Escape Room in Sustainable Entrepreneurship Education is that students should acquire competencies and skills both in digital education [10, 14, → chapter 2] and Sustainable Entrepreneurship Education [58, 59, → chapter 3]. The competencies that can be fostered are explained in this chapter. In addition, the key components of the design of the digital Educational Escape Room based on the star model [13, → Chapter 2] are outlined.

Learning process and outcomes

The focus of Sustainable Entrepreneurship Education classes are students of the 10th grade. In the following case, students work in groups of three and do not need to have prior knowledge of Sustainable Entrepreneurship or special technical skills to use the digital Educational Escape Room. Therefore, playing the digital Educational Escape Room is suitable as an introduction to the subject of Sustainable Entrepreneurship. The processing time is approx. 130 minutes (about three lessons).

The selection of the following competencies is based on the students' promotion to participate actively in a society influenced by digitization [9, 10, → chapter 2.1] as well as fostering their sustainopreneurial intention [51, 52 → chapter 3].

Therefore, playing this digital Educational Escape Room supports the acquisition of the following competencies:

1. *Systemic thinking*: Students are able to identify, analyze and combine the different domains of SE. Breaking through linear ways of thinking might be crucial to emphasize one's subjective beliefs and norms. Thus, systemic thinking has a pertinent impact on sustainopreneurial intentions [51, 58, 62].
2. *Searching and processing*: The ability to search and process can be seen as information literacy, which is a fundamental competence for participating in the digital world. This is promoted by using a digital Educational Escape Room [7]. Students are able to research, filter and evaluate data, information and digital content.
3. *Communication and interpersonal acting*: Students are able to interact and cooperate. Active participation in heterogeneous groups promotes the students' confidence in their abilities and competencies to act and think in a sustainopreneurial way (self-efficacy) and enhances their empathy [52, 53]. It also enables them to reflect on their interaction with social groups [63]. In addition, students are able to interact through digital media and to share information and data [7, 10].
4. *Problem solving*: The goal of a digital Escape Room is to improve the competency of problem solving with digital media and tools [27]. By playing a digital Educational Escape Room, students are enabled to learn, work, and solve problems creatively in the domain of Sustainable Entrepreneurship.
5. *Analyze and reflect*: Dealing with a digital Educational Escape Room in Sustainable Entrepreneurship Education is linked to a subsequent reflection. Analyzing and reflecting the learning process should enable students to better understand and reflect the contents of Sustainable Entrepreneurship as

well as a meaningful use of digital media and tools [7, 8, 10].

The structure of the game and the equipment

The main requirement for playing the digital Educational Escape Room are tablets, computers or mobile phones with internet access. The digital Educational Escape Room has been created by the E-Book generator www.bookcreater.com [33]. E-books enable an appealing design. Texts, pictures, audio and video files and links to different quizzes can easily be embedded. A disadvantage of this tool is that it does not always correspond to the character of Escape Rooms, as puzzles can be skipped.

Based on a frame story, for every topic of Sustainable Entrepreneurship a specific E-Book page is designed and different puzzles are inserted (Figure 1). By solving a puzzle, a code is obtained, that enables the students to go to the following topic or chapter.

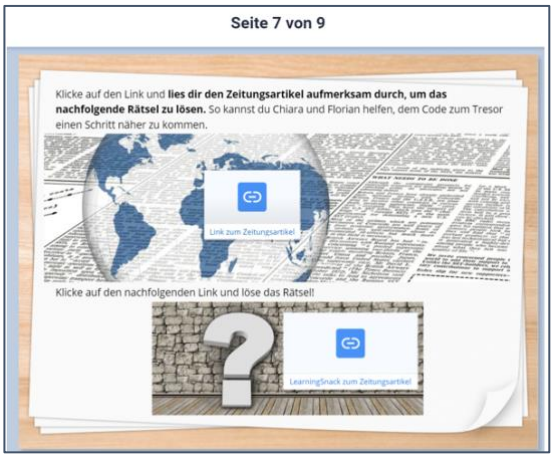

Figure 1: *Creating an E-Book*

As support, the students receive an analogue worksheet on which they can write down their notes and record the codes. In addition, the teachers are provided with a handout including a sample solution for processing the digital Educational Escape Room and recommendations that include the systematic reflection of the contents of Sustainable Entrepreneurship and the game.

The story – 'Granny's secret about the future of entrepreneurship'

At the beginning of a digital Educational Escape Room, a frame story is told that introduces the importance of solving several puzzles. Enclosed is the frame story of the created digital Educational Escape Room in Sustainable Entrepreneurship Education:

Granny's secret about the future of entrepreneurship

Chiara and Florian want to found a start-up, but they do not know where and how to begin. Their grandmother is their role model, as she worked as a successful entrepreneur for decades. Unfortunately, she passed away a few years ago, so they can no longer consult her. However, Florian remembers that she talked a lot about taking greater account of sustainability in the field of entrepreneurship as the world was changing rapidly. Their grandmother wrote down her thoughts on this topic in a notebook that is stored in a safe. Chiara and Florian are keen to know how sustainable entrepreneurship can work, so they want to rely on their grandmother's knowledge. However, they do not know the code of the safe…

The puzzles

The creation of puzzles that can be integrated in digital Educational Escape Room ranges from the use of text processing programs to web-based puzzle generators.

PDF and text files can be encrypted with passwords. To decrypt the files, the students need the codes from the puzzles. One possibility to find out a code is to combine questions/claims and answers via several hints [64] (Figure 2).

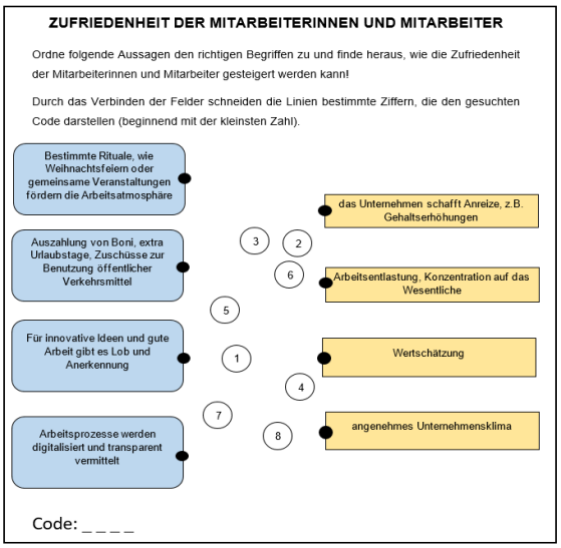

Figure 2: *Matching Puzzle about employee satisfaction*

Web-based puzzles have the advantage that functioning puzzle generators already exist on the internet. Here, the quizzes had been designed using the tool www.learningsnacks.de. It has a question-answer format in a messenger style [31], which is motivating for the students' learning process due to its reference to everyday life.

This tool is suitable for asking specific questions about the content of an informative text, a video or a podcast and thus for playfully consolidating knowledge of the content (Figure 3). Once all the questions have been answered correctly, students will be given a code for the next puzzle.

Figure 3: *Learning Snack about the content of a newspaper article*

Another tool for creating puzzles in a single or multiple choice had been utilized which is called learningapp.org (Figure 4). Here, several interactive learning modules can be used to create a digital learning environment [31].

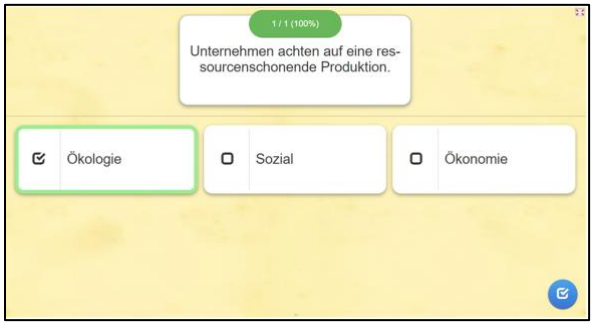

Figure 4: *Single Choice Puzzle concerning the three dimensions of sustainability*

Memories, crossword puzzles, drag-and-drop questions, as well as cloze texts are also among the types of puzzles that motivate students in their learning process. To create all of these, tools on the website puzzle.org had been used here and integrated in the digital Educational Escape Room.

Validating the digital educational Escape Room in Sustainable Entrepreneurship Education

To validate the effects of playing a digital Educational Escape Room in Sustainable Entrepreneurship Education, we involve students from economics classes of the 10th grade secondary school that participate in a qualitative evaluation study in at least two research cycles.

A self-reflection learning diary [65] is used as a survey instrument for assessing the promotion of the five competencies mentioned in chapter 4.1. The students are supposed to answer and reflect on several questions that are based on thematic categories.

The following sections will briefly explain how the reflection questions had been derived. The five competencies described in chapter. 4.1 can be further explained and assessed by defining learning objectives. Learning goals define a state in which learners should find themselves at the end of a school lesson in terms of their knowledge and skills. Therefore, learning goals are considered the most relevant benchmark for assessing the learning process [66, 67]

To determine a taxonomy of assessing the learning process, reference is made to the Taxonomy for Learning, Teaching, and Assessing [68, 69]. This taxonomy is directly and indirectly used in different competency models, e.g. for Digital Education in Dig.Comp 2.2 [16], for Entrepreneurship Education in EntreComp [70] or for Education for Sustainable Development in the Orientation Framework for the learning field of Global Development within Education for Sustainable Development [71]. Therefore, the taxonomy is rated as being a suitable instrument for assessing the learning process after playing a digital Educational Escape Room in Sustainable Entrepreneurship Education. This taxonomy distinguishes between three different levels of cognitive activation and learner autonomy: Level one: Foundation (knowledge generation: learners are able to remember, discover and explore certain content as well as to gather and to

process (digital) information) [16, 70, 71]. Level two: Intermediate (transfer of knowledge: learners are able to apply certain content, to experiment as well as to change their perspectives) [16, 70, 71]. Finally, level three: Advanced (reflecting and creating solution approaches: learners are able to apply and evaluate certain contents as well as to create newsolutions, to improve and to reflect their own and others' ideas. Therefore they participate proactively in problem-solving processes) [16, 70, 71]. Table 1 shows a taxonomy of achieving the learning goals in playing a digital Educational Escape Room in Sustainable Entrepreneurship Education.

Competencies (→ Chapter 4.1)	Learning goals	Level of achievement of learning goals
Systemic thinking	Students are able to name the different domains of Sustainable Entrepreneurship with digital media	Foundation
	Students are able to identify and analyze the different domains of Sustainable Entrepreneurship with digital media	Intermediate
	Students are able to identify, analyze and combine the different domains of Sustainable Entrepreneurship with digital media	Advanced
Searching and Processing	Students are able to research data, information and digital content concerning Sustainable Entrepreneurship	Foundation
	Students are able to research and filter data, information and digital content concerning Sustainable Entrepreneurship	Intermediate
	Students are able to research, filter and evaluate data, information and digital content concerning Sustainable Entrepreneurship	Advanced
Communication and interpersonal acting	Students are able to interact with social groups through digital media and to share information and data concerning Sustainable Entrepreneurship	Foundation
	Students are able to interact and cooperate with social groups through digital media and to share information and data concerning Sustainable Entrepreneurship	Intermediate
	Students are able to interact and cooperate with social groups through digital media and to share information and data concerning Sustainable Entrepreneurship. They are able to reflect on their interactions in social groups as well as with digital media	Advanced
Problem solving	Students are able to name and describe problems in the domain of Sustainable Entrepreneurship with digital media	Foundation
	Students are able to describe and analyze problems in the domain of Sustainable Entrepreneurship with digital media	Intermediate
	Students are able to describe, analyze and solve problems creatively in the domain of Sustainable Entrepreneurship with digital media	Advanced
Analyze and reflect	Students are able to describe the contents of Sustainable Entrepreneurship as well as the meaningful use of digital media and tools	Foundation
	Students are able to describe and analyze the contents of Sustainable Entrepreneurship as well as the meaningful use of digital media and tools	Intermediate
	Students are able to describe, analyze and to reflect the contents of Sustainable Entrepreneurship as well as the meaningful use of digital media and tools	Advanced

Table 1: Taxonomy of achieving the learning goals in playing a digital Educational Escape Room in Sustainable Entrepreneurship Education

Here, learning goals that are based on the acquisition of the different competencies described in chapter 4.1 are derived and graded according to the respective level of achievement.

Based on the taxonomy shown in Table 1, the following questions are asked in the students' learning diary for self-reflection:

Category - Systemic thinking

Q1: Name and explain the three dimensions of sustainability.

Q2: Explain the term entrepreneurship.

Q3: Reflect on what extent sustainability and entrepreneurship go together.

Q4: Characterize a sustainable business and a sustainable entrepreneur.

Category – Searching and processing

Q5: Explain how you dealt with digital information and data while playing the game.

Q6: Explain how you evaluated digital information and data while playing the game.

Q7: Have there been any difficulties in dealing and evaluating digital information and data? If so, explain them.

Category – Communication and interpersonal acting

Q8: Reflect on your communication and cooperation with your group members while playing the game!

Q8.1: How did you communicate and cooperate with the other group members?

Q8.2: What went well?

Q8.3: Where do you identify a need for improving communication and cooperation?

Q8.4: Describe your own interactions during the game and reflect on them.

Category – Problem solving

Q11: Name and describe issues in the field of Sustainable Entrepreneurship that were addressed in the digital Escape Room.

Q12: Compare at least two of these issues.

Q13: Explain in what way you would solve such issues.

Category – Analyze and reflect

Q13: Explain in what way playing the digital Escape Room helped you to understand Sustainable Entrepreneurship!

Q13: Name parts of the field of Sustainable Entrepreneurship you perhaps did not understand and explain why.

Q14: Explain further needs of improvement concerning the creation of a digital Escape Room in the field of Sustainable Entrepreneurship.

In the first research cycle, the questions from the self-reflection learning diary are validated with the Think Aloud method. One group of three to four students from 10th grade secondary school plays the digital Educational Escape Room. Afterwards, the students answer and reflect on the questions from the learning diary. They answer the questions by reporting their thoughts and feelings. Researchers take notes during this evaluation through participant evaluation or in a video analysis [72]. Thus, it is evaluated whether the questions are understood well or if there is a need to adjust them. This research cycle repeats until there is no further complaint by students on the content of the questions.

In the second and final research cycle, the digital Educational Escape Room is played by at least 30 students. Afterwards, students answer and reflect on the questions from the learning diary. As answering the questions takes some time, the students get three days to hand in their self-reflection learning diary. The different answers from the students' self-reflection learning diary are then analyzed with the qualitative content analysis [73]. For this purpose, the MAXQDA program is used as an analysis software. All the text passages will be analyzed (coded) according to the taxonomy in Table 1. To minimize misrepresentations, at least two different people analyze the same text passages. The coding process is based on super categories (the five competencies from Chapter 4.1) and their associated subcategories (learning goals and their gradation from Table 1). This process enables the determination of the level of achievement of the learning goals [73, 74]. In a next step, the coded text passages are compared

to each other, and it is analyzed to what extent students have achieved the learning goals in playing a digital Educational Escape Room in Sustainable Entrepreneurship Education.

Limitations and outlook

The ideas for a digital Educational Escape Room in Sustainable Entrepreneurship Education in German High Schools are based on the theoretical background of digital education and gamification as well as Sustainable Entrepreneurship and Sustainable Entrepreneurship Education. There has not been any research for these domains in combination, yet. The research project presented in chapter 4 shows first findings for designing and creating a digital Educational Escape Room in Sustainable Entrepreneurship Education and the promotion of related competencies. Nevertheless, several considerations and limitations follow this conceptualization:

First, the effectiveness of the different puzzles needs to be validated with reference to the competency acquisition in digital education and Sustainable Entrepreneurship Education. A possible way to validate the digital Educational Escape Room is listed in chapter 4.2. Based on the results obtained from the validation process, the effectiveness of gamification in the field of economic education can be derived. In this context, it is also of interest whether further competencies in digital education (e.g. *produce and present*) or Sustainable Entrepreneurship Education (e.g. *foresighted thinking*) can be fostered by designing and creating a digital Educational Escape Room or the creation of scenario puzzles.

Second, due to the digital format of the economics lessons, different teaching methods should be considered. For example, the flipped classroom model could be of interest here.

Third, it may be possible to integrate additional competitive elements that underline the gamification approach (→ Chapter 2.2). This can be realized by awarding points or a pre-determined speed limit to solving puzzles.

The fourth point to note is that the e-book creator has limitations in creating a digital Educational Escape Room. Thus, the use of alternative tools, such as Google Forms or Genial.ly, should be tested.

Fifth, in order to broaden the toolbox of educational escape rooms, hybrid and/ or blended media could be considered (for an overview cf. Wiepcke 2006 [75]).

Furthermore, there is the question of a possible increase to the immersion level. The combination of virtual reality with Educational Escape Rooms could be a promising field for further research.

Finally, existing providers may be consulted for further idea generation of possible puzzles and to find out whether there are questions for creating digital Educational Escape Room as well as for visualization.

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Playing Positive Psychology: The Development of a Positive-Psychological Board Game for Team Building

Leonie Kloep, Anna-Lena Helten and Corinna Peifer

Abstract

Today's work is mostly organized in team structures, which makes successful teamwork a key factor for organizational success. To maximize the potential of teams, organizations use team building interventions. These can take a variety of forms, and also serious games are applied as team building tools. The present study shows the development of a board game for team building. The development of the game is based on approaches of positive-psychological research, such as character strengths, PsyCap, mindfulness or the flow experience. It aims to help team members to learn about their own strengths and those of the team in a playful way, thus improving communication and cooperation. In addition, the already known positive effects of the positive-psychological constructs incorporated in the game are supposed to be transferred to teamwork situations and help teams improve their well-being and performance.

Introduction

Do you know what your key strengths are? And how you can use them best at work? For many people, these questions are hard to answer, and they don't feel confident about their strengths. Individuals often tend to focus on their weaknesses and problems and forget about their strengths. However, at work, these strengths can have beneficial effects on our wellbeing and job satisfaction and be decisive when it comes to stressful situations. Research on character strengths, a set of 24 different strengths that are supposed to be found in every individual in different intensity [1], confirms their positive relation with different job performance indicators such as task performance and job dedication [2].

Today's oftentimes team-based work environments can also make it especially helpful to know both one's own strengths and those of the team members in order to understand how best to accomplish common tasks as a team. In addition, other positive psychology approaches can have positive effects on people's working lives. For example, psychological capital (PsyCap), the interaction of the constructs hope, optimism, resilience, and self-efficacy, can help employees develop satisfaction and well-being at work [3]. Experiencing flow, i.e. feeling absorbed in an optimally demanding activity, or practicing mindfulness, a form of awareness of the present moment, is also considered beneficial at work [4, 5]. However, these topics are rarely discussed in everyday working life. The goal of this paper is to address this need with the development of a team building tool that aims to make teams get to know their own strengths and benefit from different positive effects. As the team building intervention is designed in the form of a board game, a creative and playful method is applied. Team members are encouraged to actively engage with various positive-psychological constructs and have the chance to get to know each other on a new level. In the game, various positive-psychological contents are introduced in a playful way, mainly regarding character strengths, psychological capital, flow experience and mindfulness, among others. Working on these topics by means of small tasks integrated into the game aims to improve variables of collaboration like for example well-being or flow experience at work. In the following sections, in which the positive-psychological contents are described, examples of tasks related to the constructs are included respectively. Within the game, these can be found in the form of playing cards with reflections, discussions and actions.

After a pilot study has already been conducted with the newly developed game, its potential but also its still existing weaknesses were revealed. In the context of this first study with the game, we

evaluated its effect on flow and team flow, i.e. the individual and shared experience of absorption and focus when performing a task [6]. We now continue to further improve the content and design of the game. The present paper goes into detail about the development of the positive-psychological board game and gives an outlook on possible future applications in research and at the workplace.

Team building

To strengthen the performance and well-being of teams, organizations use various approaches and methods of team building. Team building interventions include all types of activities that are meant to help maintain and improve teamwork, i.e. team performance, achievement of common goals, wellbeing in the team and interpersonal relations among team members [7, 8]. Thus, team building can be used as a support tool for newly formed teams in order to support the natural team forming process as well as for the development of potentials in existing teams or the solution of problems and conflicts among team members [7]. However, for an effective team building intervention, it is crucial that it is designed in an evidence-based way with measurable outcomes [9]. Thereby, team building interventions can take on a variety of forms like classical trainings, outdoor adventures or online workshops, and also board games.

Positive psychology

Evidence-based activities for team building often include approaches of positive psychology [10]. Just like that, the board game of the present study is developed by applying various positive psychology concepts in the form of tasks on the different types of playing cards. At the same time, the game aims to enhance positive-psychological factors that can have a positive effect on team-related variables like well-being, team climate or team flow experience at work.

The term positive psychology refers to a research field, which focuses on the strengths, resources, and potentials of individuals, organizations, and societies. Its central concern is to explore how to support well-being and positive development [11]. Especially in the work context, this approach can play a crucial role [10, 12]. Positive-psychological interventions can be used at both the individual and team level and research has been able to show a long-term positive effect of positive-psychological interventions on the general well-being of individuals [13, 14].

In the following paragraphs, different positive-psychological concepts will be explored that are applied to the game. These are examples of some constructs among various approaches of positive psychology that are incorporated into the design of the game. It will be explained how they can benefit teamwork and examples of usage in the game will be given.

Character strengths

A central concept in positive psychology research are the character strengths. A classification system developed by Peterson and Seligman [1] differentiates between 24 character strengths that are present in different intensity respectively in every person, like creativity, gratitude, humor, honesty or social intelligence [1]. These strengths are described as positive traits that are personally satisfying and associated with positive outcomes for individuals and their environment [15].

All character strengths show interindividual stability but can be changed over time, for example due to changes in a person's social role. Furthermore, character strengths can be trained and enhanced through interventions [15].

Therefore, key elements of the game developed in the present study are based on the concept of character strengths. Through various playing cards on character strengths, the players should become aware of their own strengths and those of the other team members. By displaying strengths cards with the own character strengths openly to everyone, players can compare their strengths to their team members' strengths and find similarities or differences. In addition, they are encouraged to make greater use of their character strengths and to develop them through different reflections and exercises. Different cards of the game ask players to think about past situations in which they actively used one or more of their strengths and reflect on how it felt to them. In addition, they are encouraged to reflect on how to improve the use of the own character strengths in future similar situations or even transfer further onto different situations. Figure 1

shows an example of a reflection card on character strengths that has been designed for the game.

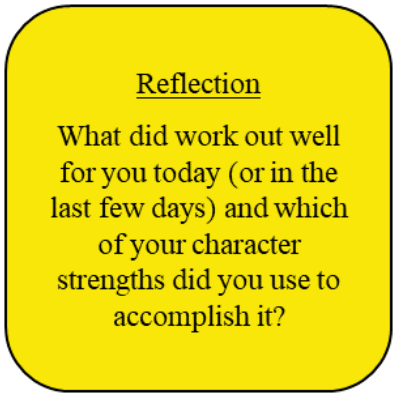

Figure 1: *Example of a reflection card on character strengths*

Psychological capital

Another central concept of the game is the psychological capital that marks an individual's positive-psychological state of development and competitive advantage. The constructs hope, optimism, resilience, and self-efficacy are combined under the umbrella term and second-order construct psychological capital (PsyCap), which does not only describe the shared variance of these four constructs, but also assumes that they interact with each other [16, 17].

PsyCap is gaining importance in human resource development due to its effects on individuals' attitudes and behaviors. For example, increased job satisfaction, commitment, engagement, well-being, and an increased performance were found to be associated with high levels of PsyCap [3].

Therefore, the concept of PsyCap is also taken into account and actively integrated in the design of the present game. Various game cards ask players to reflect on the different elements of PsyCap and to recall situations in which they were able to apply them or imagine future applications or challenges in which their PsyCap could be useful. Thereby positive thinking patterns may also be trained. Figure 2 shows a game card with a task that is intended to make the players reflect on their PsyCap.

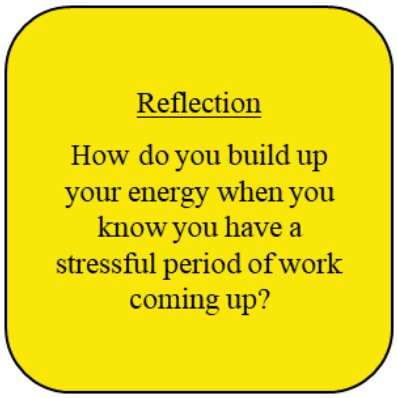

Figure 2: *Example of a reflection card on PsyCap*

Mindfulness

Mindfulness is a form of attention known from buddhist doctrine, which can be understood as a spiritual form of being present [18]. It is defined as the awareness that arises when one consciously pays attention to the present moment without judging it and fully indulges to that experience. Thus, mindfulness is characterized by experiencing a particular openness of body and mind, and includes a vivid experience of one's sensory impressions and mental processes [18, 19]. Mindfulness practice can be shown to have positive effects on mental health and interpersonal relations [20]. Furthermore, also in the work context mindfulness can be considered as a positive factor and is associated with well-being at work [5] and improved performance [21].

Therefore, the concept of mindfulness is also taken into account in the development of the game. For example, short meditation exercises are integrated into the game as tasks that are found on the playing cards and the players have the chance to try mindfulness together and feel the immediate effects. Furthermore, they are reminded of the importance of mindfulness and reflect on how to integrate it in every day work routines. Figure 3 shows an example of an action card on mindfulness.

Figure 3: Example of an action card on mindfulness

Figure 4: *Example of a reflection card on flow*

Flow and team flow experience

Flow experience can be defined as the absorption and merging of an individual with an activity that is perceived as a positive state when the demands of a task match with the individual's own abilities to accomplish it. It is a state of self-forgetting in which an optimal control of the process is felt. The attention is focused on the task and one step seems to follow the other fluidly while the perception of time is accelerated and the activity performed in flow has an intrinsically rewarding effect [6, 22].

Besides individual flow, flow can be experienced in social situations. Team flow is defined as a shared positive experience of team members while working on interdependent tasks and thus on achieving common team goals [23, 24]. A team experiences itself as a unit in team flow and team members perceive a shared feeling of control over the actions and processes [23].

Both flow and team flow are associated with different positive outcomes at work. Flow, for example, was found to foster engagement [25] as well as a positive mood [26]. Similarly, team flow was shown to be associated with a better mood [27], increased collective efficacy [28] and improved team performance [29].

In the game of the present study, playing cards on flow experience are included in the game, asking the players to reflect on their personal flow enhancing situations at work. Figure 4 shows an example of a reflection card on flow experience.

In addition, various game elements are included that in previous research have been shown to relate positively to flow and team flow experience. For example, flow is likely to occur when learning new things [30] and the information exchange within a team is associated with team flow [29]. As these conditions are assumed to be present during gameplay, we expect that playing the board game has a positive effect on the flow and team flow experience. In this regard, a pilot study has been conducted.

Games for team building

Games are defined as voluntary activities in a limited setting, providing breaks from daily life with rules that have to be followed [31]. Thereby, playing a game is meant to be fun for players [32] and can completely absorb them [31]. At the same time, the outcome of a game is not known before and is influenced by the players' interactions, their competition or based on luck [33].

Serious games are a specific type of games that combine the typical characteristics of a game with learning content and an intended transfer to other situations. Thus, they are more than entertainment and can be used for specific learning purposes. Hence, the goal of a serious game is not limited to the game setting itself but has to be transferred to a context outside the game, for example the workplace [34, 35].

In serious games, individuals work on realistic problems and decision making processes in a playful way while they receive immediate feedback from the game itself as well as from the other players [36]. In this way, serious games can

help groups to express emotions and reflect on their role structures and conflicts [32] and the interaction that is stimulated by the serious game can go on even after playing [37].

As a team building tool, serious games are used especially to train critical thinking skills, communication, and decision-making within a group [38]. In this context, often serious games in the form of computer simulations or virtual reality games are applied [32, 39, 40]. However, also non-technical games like conventional board games can show positive effects when used as team building tools. Board games can promote communication within the team as well as collaborative behavior [41, 42]. The present study therefore focuses on the development of a team building tool in the form of board game.

Development of the positive-psychological game

By developing a game as a team building tool, a creative approach to design a new and effective team building intervention was explored. When designing team building interventions, often conventional and well known methods such as workshops with trainers are applied. However, also an evidence-based game can be able to combine research findings with a fun approach and a relaxed atmosphere. We therefore consider that a board game can be an effective and at the same time fun intervention for team building. Our goal was to create a playful way of presenting and training positive-psychological constructs that can have a positive impact on teamwork.

Design of the game

The board game is designed as a team building tool based primarily on the positive-psychological constructs explained in section 2 in the form of an evidence-based serious game. Thus, its goal is not only to entertain the players, but at the same time to teach and practice new content and behaviors.

The format chosen in this study was a board game instead of a digital game. The game provides team members with an unusual environment in which they can freely express new and creative ideas outside of their work environment. Furthermore, a game can be a particularly motivating learning context due to its interactivity [43] and stimulate communication [41, 42]. To our current knowledge, no board game that explicitly incorporates positive psychology has been applied in organizations and at the same time investigated for its effect on flow and team flow. It is assumed that positive-psychological approaches are particularly suitable when it comes to the design of serious games, however, this is often associated with digital games [44]. The effects of games in training and team development contexts have so far been investigated primarily using online games and computer simulations [34, 38, 39]. By developing and applying the board game of the present study, we can evaluate the effects of a conventional board game in which players interact directly with each other.

The learnings the serious game aims at can be described on a cognitive, affective and behavioral level [45]. On the first level, players learn about different approaches of positive psychology, e.g. character strengths, PsyCap or flow experience. On a deeper, second level, the game stimulates an interpersonal exchange of attitudes and opinions and in consequence aims at strengthening the team members' relationships and trust. Lastly, on the third level, a practical application and training of new skills takes place. The game is set up in such a way that there is a constant exchange between team members and even long existing teams can get to know each other on a new level by playing the game. The tasks of the game are constructed so that team members have the flexibility to reveal only as much personal information as they want at any time. In this way, the positive atmosphere of the game can be maintained even during tasks that are subjectively perceived as more difficult by some players.

The game was designed in such a way that it can have a particularly flow-promoting effect, as described in previous literature [44]. For example, the open format of the questions made it possible to adapt the difficulty of the tasks to the players' skills. Moreover, players get constant feedback from their team, which can also promote flow.

To achieve the previously mentioned goals and benefit from the positive effects of the constructs incorporated in the game, different game elements are designed. At the same time, the

game is meant to be fun and absorb players while providing a break from the daily work routine. Thus, the game creates a positive atmosphere in which teams communicate naturally and share their thoughts and opinions about topics rarely touched in their everyday work. In this way, players get to know to each other on a deeper level than during work interactions.

The key component of the game is the colorful game board with different fields that encourage players to take actions by drawing playing cards from the center. To move forward on the game board, game pawns for each player and a dice are provided. Strength, reflection, action, and discussion cards are part of the game. The strengths cards explain the character strengths and help the team members learn about their own strengths and those of the team. Reflection cards contain questions to reflect on and invite players to tell their team members about their personal thoughts and experiences (e.g. Fig. 1, 2, and 4). Action cards encourage players for a certain activity, in most cases including other team members (e.g. Fig. 3). Discussion cards with open questions or controversial statements ask the team members to discuss briefly and exchange opinions on a certain topic. Other fields on the game board encourage players to think about transferring the learnings of the game to their everyday work as a team. To further strengthen the transfer from game to work, there are personal memo cards to take notes during the course of the game that can be kept by the players also after playing. Figure 5 shows the game setup of the first prototype of the game with its game board and different playing cards.

The game starts by the players identifying their own character strengths and displaying them with the corresponding strengths cards openly on the table. Thus, the whole team can see the strengths the different team members identify with during the course of the game. Then, players roll the dice and move their pawns the corresponding number of fields on the game board. According to the symbol on the field on which a player is standing, a playing card is drawn. This can be a reflection, discussion or action card, as described above and comprises a question or activity including one of the different positive-psychological topics, like for example PsyCap or mindfulness. The task described on the card is now performed by the player or, if the card calls for it, by the entire team.

Figure 5: *Game setup*

This takes, depending on the complexity of the task, between one and approximately five minutes. Then it is the next player's turn to roll the dice and draw the next card from the center.

This game mechanism is characterized by its randomness, which ensures that the team members perform the different task categories in a random order and that a certain feeling of suspense is maintained during the course of the game. The randomness of the game events, however, does not mean that the importance of the content of the game is disregarded. Whenever a card is drawn, the players pause a moment to process it. In this way, it is possible to engage in complex reflections on one's own strengths or small mindfulness exercises that require the players' full attention. However, complex reflections are varied and constantly interrupted by playful events in order to maintain interest and ability to concentrate on the contents of the game.

Pilot study

We already developed a first prototype version of the board game. An initial pilot study was conducted in which the game was played and evaluated by 12 work teams of different companies. These came from different industries, as the game was not developed for a specific

domain, and it was assumed that it would be applicable in different areas.

With the help of questionnaires one week before, directly after playing, and two and four weeks after playing its immediate and long term effects on flow and team flow were measured. In this case, flow and team flow are variables that are both addressed in the content of the game itself and served as outcome variables for evaluating the effect of the game. Also, the players' subjective evaluations of the game as a team building tool were obtained.

The results confirm that the players experienced flow and team flow during gameplay and an increased team flow two weeks after playing was found. In addition, the game received positive ratings in the players' subjective evaluation of design and outcome dimensions [Kloep, Helten & Peifer, under review]. Thus, the potential of the game for creating positive effects for team members was revealed. Nevertheless, the game and study design also had some weak points, e.g. a limited amount of topics covered in the tasks on the playing cards or the missing control group in the pilot study. Therefore, we are continuously engaged in its improvement and are preparing a revised version of the game.

Outlook

A first prototype of the game exists and has been tested with various teams in a pilot study. This first study has already shown that the game may be suitable for team building, as the significant increase in team flow two weeks after playing and the players' positive evaluation of the game confirm. The approach of positive psychology as the basis when developing a team building game can be seen as a useful and effective one. At the same time, the game can provide entertainment and pleasant moments a team spends together.

As a result of the teams' experiences when playing the game and their evaluations, in an upcoming project, the game will be further developed with regard to its contents and design. For this purpose, playing cards on various positive-psychological constructs like the ones described above are developed, especially focusing on communication patterns in the team as well as the team members' trust and openness. Moreover, new interaction and fun elements are incorporated and the design of the game board and playing cards is modernized. Thereby the players should engage more intensely and feel more absorbed into the game, making it feel like a conventional game one would play with friends or family. Another idea is to adapt the game to specific domains in order to better meet the different needs of teams from different fields, both in terms of content and design. In addition, further transfer elements should be integrated to facilitate the transfer of the experiences and learnings from the game to the work context.

A second study to evaluate the game is currently being planned. We aim at examining more precisely the effects of the game during gameplay and in the long term. In an experimental design with one group playing the positive-psychological team building game and a control group playing a conventional board game, the effects of the newly developed game on team performance indicators, e.g. team flow experience, can be demonstrated. Moreover, in a future study with an experimental and control group design, not only flow and team flow and the evaluation of the game in general should be measured. Variables such as team climate, communication and trust in the team could also be worth considering. Focus groups for a detailed analysis of the game design are also an option that should be taken into account.

For future applications in organizations it would also be interesting to embed the game in a team building process that is composed of different elements like team trainings in general, playing and reflection sessions. Furthermore, repeated applications of the game, that are possible due to the wide range of tasks on the playing cards and their randomness in the game, would be interesting to try and examine.

Conclusions

It can be concluded that positive psychology offers a useful approach to the design of team building tools and a wide range of applications is possible. For example, learning about one's strengths can have various positive consequences that can be beneficial in a variety of work contexts. Therefore, the integration of positive-psychological constructs is particularly suitable for the design of evidence-based team

building tools in order to promote positive effects on the individual as well as on the team level.

The development of future team building tools and interventions moreover should consider the openness of various teams towards a wide range of methods. In addition to conventional team events and online interventions, games also seem to be relevant for team building, given that their development is based on scientific evidence.

Acknowledgements

The authors would like to thank all the teams that played the prototype of the game and thus helped to develop and improve it.

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Gamification Design for Goal Activation and Goal Striving in Digital Marketing and Innovation Management

Jenny V. Bittner and Christian Wellmann

Abstract

Gamification can enrich applied contexts with a playful design that supports goal activation and motivates consumers to strive for their goals. This has much potential for digital marketing and innovation management by making the interaction with products and advertisements more enjoyable in online and offline environments. The success of game designs hinges on their adaptation to a situation that creates a unique user experience for the personal goals of a target group. Specific game elements make products more appealing by providing goal-setting instructions and feedback. Moreover, gameful instructions can support goal completion by assisting in self-regulation when striving for short- and long-term goals. We apply psychological theories to practical examples on the implementation of consumer goals in innovation, eHealth and app design.

Introduction

Gamification is a design tool to enrich various applied contexts with playful game elements. This is intended to support a positive user experience and motivate users to execute specific behaviors in non-game contexts. Gamification has much potential for marketing and innovation by making products more attractive and fun [1]. This can be addressed in sales management when advertising products in online and offline shopping environments. We highlight the specific game elements that make products more appealing by adding value to consumer goals, such as avatars, social media, leaderboards or challenges [1].

The effects of game designs hinge to a large extent on their adaptation to a practical situation that creates a unique user experience when interacting with the product [2]. Gamification at the point of sale is expected to make it more likely that consumers have a positive attitude and, thus, higher buying intentions [1]. Moreover, it can be used as a communication tool in service apps, websites or digital platforms that enable social interactions with friends, service personnel or other users online [2, 3].

Psychological theories on motivation and self-regulation inform us about the underlying consumer goals that have an influence to buy and use a product. In particular, self-regulatory processes, such as flow, intrinsic motivation and social comparisons are relevant indicators if consumers enjoy the communication with interactive technologies [1, 3]. Furthermore, gamification adds to innovative products by signaling novelty [4].

With an integrative perspective, we focus on goal-setting and feedback processes within gamification designs in applied contexts. In the end, practical examples are outlined, such as gamification of self-regulation in eHealth apps and innovation management. We conclude with an outlook on the potential of artificial intelligence in the real-time monitoring of self-regulation and livestreaming game play.

Motivation in gamified marketing communication

Gameful designs are based on elements of full games and stimulate user experience by increasing enjoyment and flow while interacting with a product [1]. Flow is a feeling of optimal engagement and the positive experience of challenge and focus while performing a specific behavior [5]. When developing new products, game elements make advertisements more appealing to the consumer and provide a unique shopping experience [1]. It is important that game

elements are implemented successfully in order to be useful instruments that motivate consumers to achieve desired outcomes [6].

Motivational elements can be gamified and employed even in normal advertisements, such as slogans in communication campaigns, on flyers, posters or TV-commercials. Game elements are increasingly used in marketing campaigns, as the consumer perceives them as useful extras. The aim is to stimulate buying intentions and fun when consumers interact with a product [1]. Moreover, gamification is often used to increase and strengthen engagement, participation and user behavior [7, 8].

It is much easier for marketers and sales managers to simply use parts of games when presenting advertisements online or at the point of sale. If intrinsic motivation is stimulated, the consumer may truly enjoy an advertisement, and the interaction with a product may lead to enjoyment and flow [1]. Intrinsically motivating elements of games are, for example, characters, avatars or storylines from real games that may increase flow and social interaction [1, 9].

Typically, however, externally motivating incentives are employed within game designs to persuade consumers to use technologies, applications and programs more frequently. These are usually points, bonuses and leaderboards, the simple extrinsic incentives [1, 9]. Bittner and Schipper [1] investigated game elements that provide an extrinsic and intrinsic value for the consumer and, consequently, increase the effectiveness of this technology. Extrinsic game elements were found to make a contribution to buying intentions and enjoyment if they were combined with intrinsic elements that induce flow [1].

Therefore, a combination of intrinsic and extrinsic game elements would be beneficial for the positive perception of gamified technologies and is described in 2.2. As a goal, the feeling of competence can be induced in the consumer to establish a sense of intrinsic motivation by additionally presenting extrinsic game elements, such as bonuses and rewards [10]. Because intrinsic motivation can be enhanced by extrinsic elements, both elements usually are important for gamified products [1].

Point of sale: Online and offline shopping and advertising

With the COVID-pandemic, we have reached the digital age, with more and more online-shopping and virtual chatbots replacing personal communication. The pandemic accelerated the trend towards new technology, and telepresence has become normal. Gamification has the advantage that it has much potential to enrich online and offline settings by making products more interesting for the consumer [1].

In the real world, gamification can be displayed within stores, at the point of sale or directly presented on a product or packaging. Furthermore, it can be embedded into advertisings and commercials in the conventional media as an interesting extra.

For online shopping, gamification offers additional value by directing users to websites, apps or social media platforms that make it possible to further interact with gamified options. Additional options can also be advertised in offline environments, by pointing out specific links to the gamified services of a product.

Thus, elements of games can be presented in a variety of settings in digital marketing and form a comprehensive design that adapts environments to the goals of the consumer. We now explain the different facets of game elements that are effective to support personal goal striving.

Goal activation with specific game elements

Goals are desirable end states that give direction to a consumers' behavior [11]. Consumer goals can be triggered by environmental nudges and result in automatic goal pursuit [12, 13].

To influence the behavior and motivation of consumers, specific game elements can be implemented that activate consumer goals and assist in goal-setting. For example, goals for achievement and competence can be activated by nudges [13] and subsequently influenced by positive feedback and rewards [12]. Earning points for specific behaviors, badges for special achievements or continuous benefits like game levels may reward consumers to stay motivated and continue to perform an intended behavior [6, 14]. In digital marketing, avatars and role playing characters are suitable game elements that

motivate continuous goal striving. They allow users to slip into roles of famous stars or complete different fictional missions while performing real-time achievement tasks that lead to goal completion.

Ultimately, this means that consumers should be supported to reach their personal goals when interacting online or offline [12]. Intrinsic and extrinsic motivational elements can be combined to make it truly enjoyable for an individual to perform a desired behavior [10]. More specifically, enjoyment and flow can be incorporated into game designs with storylines that create an optimal balance between challenge and fun. To reach this, challenges should not be too easy, but achieving goal progress makes an interaction with a product more enjoyable [5]. Interactive environments give the opportunity for feedback on goal pursuit in missions and challenges. In social contexts, achievement and power motives are triggered when users are able to demonstrate their skills and capabilities to others [14]. Specific game elements offer the possibility to present individual successes and progress, such as the current game level or rewarding trophies and achievements.

Another social approach within communities is to cheer and encourage each other in chats or online forums. Social attention can also be achieved within role playing scenarios or skill checks. Discussions on social media can activate social norms that may support sustained goal striving. Often overlooked social game features are team events, shared resources and interdependent roles [15].

Game design for specific target groups

Conventional communication campaigns use motivational slogans that differ depending on the target group. But gamified advertisings and products should also be adapted to the specific target group. An advantage of gamification is that for different contexts suitable game elements can be taylored to the consumer.

There is a need for adaptive and personalized gamification designs in a variety of applied contexts [16]. To make gamification successful, it should be personalized to the individual goals and preferences of the consumer [17]. For each campaign, there is a need to employ the elements that are most useful for the specified target group, but also most suitable for the desired media communication and corresponding product.

For example, personal experiences, such as the prior experience with games, was found to be beneficial for the understanding and enjoyment of gamified advertisements [1]. More specifically, gaming experience was positively associated with a focus on extrinsic incentives in the gamified product. This could also be the result of a longer training process in game playing, such that users learn the rules and check their earned points more frequently [3, 8].

Of practical relevance is the finding that the experience with games was associated with a higher perceived control of gamified products [1]. Gamified designs may lead to higher perceived control because games are based on rules and norms that can be acquired with training [18].

With demographic data, marketing communication can be targeted, for example, at young consumers. When looking at demographics of the target groups, the age of the consumer had a significant effect on the perception of gamification [1, 19]. Older consumers reported lower buying intentions of the gamified product, judged it as less useful and perceived less enjoyment and flow than the younger age group [1]. In another study, the acceptance of ambient assisted living environments for older users was related to the believe in making the game a habit, to envision using an exercise game on a regular basis [19]. Strengthening the belief in successful habituation when using gamification would increase the perceived health of the users [3]. Furthermore, older users might be highly motivated by social features, in particular by role models [19].

In sum, gamification might be most suitable for marketing campaigns targeted toward younger age groups with prior gaming experience [1]. For older target groups, non-game elements, such as the quality of a product and the subjective norm or perceived control in offline environments could be more important and, thus, should not be replaced by gamified designs.

Personal goal pursuit in consumer psychology

Personal goals can be self-set, but also activated by the consumption environment, such as features at the point of sale [13]. Consumers typically follow multiple goals [11] and need to self-regulate their focus and attention when interrupted during goal pursuit or distracted while multi-tasking [12].

To be motivating, a goal needs to have a subjective value or be of high priority for a person. If it is perceived as achievable and is associated with positive consequences, the possibility that someone is motivated to plan and initiate appropriate actions is quite high. To enable this, gamified applications can be designed to activate goals and comparison standards [15]. For instance, it is important that communication campaigns inspire the personal goals of the consumer for fantasy, inspiration and connectedness with others.

In their studies, Hamari and Koivisto [4, 20] aimed to investigate which factors motivate people to use gamified applications in the fields of physical training and sports. In their research they showed that in particular conditions of flow experience [5] were most influential, including clear and specific goal-setting, providing continuous feedback on goal pursuit, action control and appropriate challenges.

Technologies, such as apps or digital platforms may offer the opportunity for goal-setting by generating daily training plans and suggestions for individual performance levels [2, 3]. They can also provide assistance during goal pursuit with automatic reminders and calendar entries for users. Thus, game designs may offer cues and feedback to enhance the users' self-regulation in critical domains [21].

The advantage is that gamification as a technological tool may not evoke the reactance and resistance people hold against conventional instructions, as the playful design is experienced as positive in supporting goal pursuit.

Stimulating self-regulation with technology

During times of digitalization, goal-setting and self-regulation of the user gains importance in consumption and service settings. In online environments, the users need to be motivated to perform self-regulated behaviors, and technology may support them in their goal striving efforts [2]. Educational self-regulation also gains importance for lifelong learning across the lifespan [21] and could be enriched by gamified designs.

Gamification is particularly useful to make service material appear more relevant in routine situations where users need stimulation. As a practical example, gamification can be employed in boring contexts to raise engagement in e-learning [22]. Depending on their design, game elements can focus on learning and knowledge acquisition, but also on motivating task performance as a final goal. In sales management, goal-setting instructions can be embedded within a digital platform and direct the users' attention when searching for information. Feedback on goal progress can be more effective for the user if game elements enable continuous monitoring and self-regulation [12, 21].

Furthermore, it is expected that motivational instructions create a positive climate for the user. Bittner and Zondervan [2] demonstrated that digital platforms can display motivating instructions and corresponding pictures in line with activated goals. This was shown to lead to a positive emotion and perception of a website [2].

User experience in human-technology-communication

User Experience (UX) describes the positive perception of a user before, during and after using a specific product [2, 23]. This includes the ease of use and the subjective affective feeling during the use of a software, technology or product [24]. UX can be assessed with psychological instruments testing for positive affect, need fulfillment, product perception or buying intentions [23].

If a game design is implemented to fulfill consumer goals it may induce positive emotions with a product or marketing campaign [2, 24]. This was found to result in enhanced UX and also hedonic quality of assistive technologies, in this case advanced driver assistance systems [23].

Environmental cues, such as motivating pictures may enrich the marketing communication and

activate consumer goals [2]. Motivational pictures can be presented with congruent slogans on digital platforms to induce a positive UX. This can be used in digital marketing and advertising, for example via pop-up windows on websites [2].

To foster a positive UX, the design of a gamified advertising can also emphasize specific functions of a product. For example, users tend to focus their attention and adjust their behavior more to their achieved outcome scores rather than the frequency of their behavior, if this is what is reported by the gamified design [3].

A positive UX, thus, can be the result of a feedback environment providing continuous rewards when interacting with a product during goal striving. This can be crucial to strengthen buying intentions in the first place, but also to make the use of a product and the interaction with technology more satisfying [23, 24].

Feedback effects in game design

In his theory, Festinger [25] describes that people compare themselves to others to gain relevant information about themselves within a continuous comparison process. As an important game mechanism, social functionalities to compare with friends can be embedded into social media applictions. Using game elements could help motivate people to show intended behaviors, such as when users compare themselves with prior quantitative results or by comparing with other users [26, 27].

On the one hand, games can set single or multiple goals to be achieved by the user. On the other hand, there are specific rules and norms implemented into the game design [18] on how these goals can be achieved. There can be a feedback mechanism implemented within the game that provides information on the progress of goal pursuit and benefits on the users' achievements [15]. If feedback is monitored in live games and challenges, self-regulation can continuously be adapted by the user [21]. Using virtual reality, consequences can be simulated and learning from mistakes takes place – if possible even in real-time.

There can also be a competition suggested between users for certain outcomes, challenges or achievements within the game [3, 8, 27]. Depending on the game mechanics and architecture, cooperation or competition might show potential, even if taking place online [8]. The interesting question is whether it is more motivating for users to cooperate or compete? Although competition may sometimes lead to higher performance, most companies nowadays value collaboration and emphasize cooperation in their marketing strategy [28].

Gamification can be used to stimulate cooperation goals when people interact with others [29]. This can be implemented in a gamified design by embedding instructions and slogans highlighting cooperative goals towards other people, such as building a team and working together [11, 29]. This also includes social feedback from other users when working together, as in quizzes or crowdsourcing in digital environments.

Assuring social involvement or providing social support can also help users cope with distractions and interruptions during task performance [12]. Social comparisons can be employed in digital marketing to connect consumers to support each other, give recommendations on products and work towards a common goal [11]. Moreover, it has been demonstrated that multiplayer online games can stimulate learning and also solving scientific problems [30].

Most importantly, game elements may stimulate self-regulation and goal pursuit by highlighting content as relevant. Hamari and Koivisto [31] reported that the motivation of users can be influenced in a positive way by replacing long-term goals in gamified applications by short-term or sub-goals that can be achieved faster and easier. In addition, accomplishing sub-goals is rewarded with points, badges or progress bars, which again aim to increase and maintain the motivation.

The finding that progress bars, badges and points/levels are the highest ranked gamification functions is consistent with prior studies from Hamari and Koivisto [4, 20] who pointed out that these elements provide continuous feedback. This has consequences for the implementation of important regulatory elements in applied designs, as we outline next.

Practical examples in innovation management

Gamification can assist with finding and creating innovative solutions and support unconventional thinking. It can foster collaboration by activating cooperation goals, and critical thinking by providing situational cues to the user [11]. For marketing, it offers additional possibilities to present a new product with many details and appealing facets than conventional media [1]. In performance settings, goal pursuit can be enhanced by tracking accomplishments, as with completed service material or the tracking of health information [3, 31]. But game elements can also be used to reward innovative marketing communication and the creativity of marketers [11]. To stimulate novel ideas, intuitive mindsets and creative decision making can be supported when using gamification in innovation management.

In digital marketing, the attitudes towards an advertisement and the perceived usefulness of a gamified product were found to be significant predictors for buying intentions [1]. On the consumer side, Hamari and Koivisto [4] found indications for novelty effects of gamified applications with new products. They showed that gamification can trigger and increase motivation and new behaviors when interacting with innovative products, but that this might be more a short-term effect of novelty. Over time, this motivation might fade if consumers interact with a product or technology on a regular basis. In this case, it could be recommended to implement additional design features that make routine behaviors interesting again [22]. New gamified material could be provided as an extra link on websites or apps, for example when consumers follow long-term goals to maintain sustained sports and physical activity [3].

EHealth: Apps supporting self-regulation

Wellmann and Bittner [3] illustrated the influence of app design on self-regulation and motivation in public health. They examined the effect of game elements in sports apps on actual running behavior. In a pre- posttest study they compared two training groups using either a gamified running app or a non-gamified app for three weeks. One key finding of the study was that the group with the gamified app achieved a significantly higher increase in the running distance than the non-gamified app group. In addition, they rated the gamified app to be more motivating compared to the non-gamified app, being supportive for their running performance. More specifically, progress bars, badges, points and levels as well as rankings were perceived as motivating. These results demonstrate that specific game elements in apps can trigger and increase motivational and behavioral goal striving over a longer period of time.

This illustrates the importance of gamified apps in eHealth, as human-technology-communication can activate goals and stimulate actual health behaviors. It can be concluded that gamification technology can easily be implemented into app designs [3]. This extends findings that evoking a positive UX when interacting with technology can foster more adherence with health recommendations than direct slogans in conventional marketing campaigns [23].

Boosting innovation in digital marketing

Research has shown that it is possible to stimulate innovation by employing motivational instructions for goal-setting [11]. These communication tools could also be enriched by gamified designs that assist marketers in pursuing their innovation goals. For example, game characters and challenges could be used to emphasize imagination and fantasy for developing novel products. With avatars and storylines as a creativity technique, marketers could be stimulated to generate new ideas. Goal-setting and feedback by the technological and social environment may encourage innovation management and assist to improve projects.

Huizinga argued that play is a free activity [18]. Users behave in games in a way they would normally not do [32]. Marketers could use game environments as a staging ground to practice new performances. Features from virtual reality can be used to simulate innovative outcomes and test their success probability along with the concrete implementation of creative ideas. Gamification can then be a tool to explore a virtual reality without the usual fears of avoiding mistakes and real-world consequences [12]. This supports

learning new things and developing problem solving skills in situations where creativity is important.

With avatars, skill checks and role playing, marketers can practice to include diverse perspectives in their mindsets and elaborate on different strategic scenarios. In innovation management, they can even practice online idea generations together, or involve consumers to integrate their ideas in the early phases of the innovation process and branding [8].

An aim of gamification should, consequently, not be that users simply collect extrinsic rewards on their learning and success rates [1, 10, 31]. Instead, non-linear and divergent thinking can be emphasized in games and with game-like characters that make it easier to develop and generate ideas than in the real world. Game elements supporting intuition instead of rationality [13] could be implemented and may also activate goals for more originality [11]. By giving marketers a space to explore their innovative potential in a feedback environment supporting goal striving and rewarding achievements, this may provide opportunities to experiment.

Outlook: Artificial intelligence in real-time game play

Nowadays, games and digital platforms are oftentimes designed with real-time feedback systems. This can be provided within live games, and also with multiplayer games online. Such components within games can use artificial intelligence, which is typically based on neuronal networks or learning algorithms.

Monitoring real-time performance has the advantage that the platform can adapt the difficulty of levels and feedback to the skills of the user and thus provide adequate and appropriate challenges. It can also offer help in digital environments by providing direct assistance when problems or setbacks occur.

Dynamic components with artificial intelligence have the disadvantage for the seller that they are quite expensive to program. Furthermore, it is time-consuming to maintain a real-time environment that is always up-to date. In addition, these processes slow down the system significantly, using up bandwith and making tablets and smartphones rather slow.

Despite these setbacks of the use of artificial intelligence, gamified instructions could contribute to a successful live streaming experience. From a goal-setting perspective, real-time design elements may offer many additional assets. It would make it possible to assess meta-cognitions of the user, such as epistemic beliefs and metacomprehension during learning and performance [21]. This would enable the real-time modeling of goal progress and even the optimization of self-regulation and coping skills directly during goal pursuit [12]. By providing immediate feedback, such platforms may enrich not only goal activation, but also lead users to achieve goal completion in the end of the self-regulatory process.

Acknowledgements

Thanks to the students that assisted in the literature research and the preparation of the work. Also many thanks for the helpful comments of colleagues and reviewers.

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Gamification of Assembly Routines: Planned User Study Evaluating a Level System with Customized Feedback Elements

Jessica Ulmer, Sebastian Braun and Jörg Wollert

Abstract

Enterprise gamification is a promising approach to motivate employees and increase work output. Game elements, such as point displays, are added to traditional work environments, transforming them into game-like systems. However, user studies are mainly conducted in educational scenarios, while gamification effects in work environments remain unclear. This work-in-progress paper presents the background and the setup for a user study analyzing the impact of a combined level and feedback system on the users' motivation and work efficiency. An Augmented Reality (AR) workstation is used to assist an assembly routine with industrial profiles. Two groups are formed: The Non-Gamified-Group conducts the assembly training using static AR-projections on the work desk. The Gamified-Group executes the assembly training in four difficulty levels and can select feedback elements from a predefined list.

Introduction

Gamification, the use of game elements in non-gaming contexts [1], is on the rise in production environments. Researchers and companies aim to increase satisfaction and work output by offering more meaningful work content, individual feedback, and engaging elements [2, 3]. Different ideas exist on how to gamify work environments; for instance, leader boards replace traditional status displays, and points can be collected throughout work procedures [4, 5].

However, most studies analyzing the effects of gamification on user performance and motivation are currently done in the educational context [6–8]. Here, student groups are used to analyze specific game elements or complete gamification approaches compared to traditional learning scenarios. Often, online learning platforms are used to implement and evaluate gamification strategies. Although these studies show promising results regarding learning motivation and output [6, 9], it is unclear if these results can directly be transferred to industrial scenarios. Thus, novel studies focusing specific requirements of industrial applications are required to provide recommendations to companies.

This work presents a study setup used to analyze the impact of a level and feedback system on an AR-assisted assembly training. The selected assembly routine is seen as an exemplary application for manual work which is also found, for instance, in maintenance routines. Corporate online trainings, similar to the learning platforms of schools and universities, are not targeted.

For the study, display options of a traditional AR manual workstation are expanded by different game elements such as a timer, a progress bar, and a quality indicator. The feedback elements are selectable by each user to increase their meaningfulness and to raise the users' awareness. Moreover, four difficulty levels are implemented to stepwisely increase the assembly complexity according to the user's performance.

Related work

The following literature review focuses on current applications in education and production environments and approaches to adapt gamification elements according to the users' preferences.

Gamification in education

Gamification approaches have been applied widely in different educational scenarios [8, 10], showing the possibility to enhance learning

experiences and improve learning outcomes [9]. Cassells et al. [11] investigated the effects of feedback loops, onboarding elements, and an interactive interface on students' enjoyment during prioritization tasks. They found an increased intrinsic motivation and enjoyment of the students compared to a non-gamified prioritization process. Jurgelaitis et al. [12] examined the effects of a gamified UML modeling course on a virtual learning platform. Their gamification approach included a level system, different rewards, a leaderboard, content locking, and trading. The gamified course led to improved grades and increased positive motivation.

Although studies in the educational environment show promising results regarding the positive effects of gamification, applications and studies focusing on industrial tasks remain rare.

Gamification in production

Companies introduce different measures to increase work outcomes and motivate their employees [13], while enterprise gamification is seen as one possibility to create human-centered work environments [14, 15]. In production systems, game elements can provide real-time performance feedback to users or groups [16, 17]. This approach can be included easily in existing work environments by adding sensors and showing dashboards to the employees. Studies indicate that gamified feedback can push participants to evaluate their performance [16] and increase productivity [18].

Liu et al. [19] proposed to use gamification approaches for machining job preparations on smartphones. They included competitions for typical tasks, freedom of choice for the order fulfillment, and feedback using points and badges.

Bräuer et al. [20] applied a leaderboard and badges to an order picking environment. In their study, the leaderboard decreased the task completion time; however, it also reduced the test persons' feeling of autonomy and competence. The badges had no positive influence on the picking times and resulted in a decreased feeling of autonomy. Nguyen et al. [17] introduced points and a progress bar into an AR-supported assembly environment. Their study with 22 participants showed no significant engagement difference between gamified and non-gamified AR applications.

Customized Gamification

Often, gamification approaches are designed as a one-fits-all approach meaning that all users receive the gamification elements independently from their individual motivations and preferences [21]. Studies in the educational area show that the impact of gamification depends on several factors, such as personality, demographics, or individual traits [22]. Therefore, different ideas and methods exist to tailor gamification approaches to the needs of individual users. This approach should increase the positive effects of gamification and prevent negative outcomes. If gamification environments are changed automatically based on user information, the term "personalized gamification" is typically used [23]. If users adjust the environments according to their preferences, this approach is specified as "customized gamification" [24].

In this study, the customization approach is selected. Studies show that this selection method partially matches automatic selection strategies according to player types [24] and can increase work performance. Schubhan et al. [25] offered a group of end-users to design their preferred gamification concept for an image tagging task. Afterward, they compared this customized approach to fixed gamification settings and a non-gamified version. They found that the customized approach led to more generated tags, although the quality was lower than in the non-gamified group. Tondello and Nacke [24] compared the task performance of a group using selectable game elements to a group with generic game elements. As a result, the group using customized gamification had an increased performance regarding the number of tagged images but no significant difference regarding motivational aspects. Moreover, they found significant relations between user Hexad types and the selected game elements.

Study design

This study aims to evaluate the impact of a level system and selectable feedback elements on user performance and motivation using quantitative and qualitative data. In contrast to

existing work (section 0), an assembly process using industrial components in a manual work environment is targeted. For the analysis, a significance level α=0.05 is chosen.

Aims and hypotheses

According to previous work in non-industrial environments (section 0), it is possible to increase performance, engagement, and learning using gamification elements. Moreover, we expect that the level system increases the participants' learning and the perceived usefulness. Therefore, the following hypotheses are formulated for this study:

H1: Participants of the Gamified-Group conduct the final assembly faster than participants of the Non-Gamified-Group.

H2: Participants of the Gamified-Group commit fewer errors in the final assembly than participants of the Non-Gamified-Group.

H3: Participants of the Gamified-Group complete more assembly iterations than participants of the Non-Gamified-Group.

H4: Participants of the Gamified-Group are more engaged in the task than participants of the Non-Gamified-Group.

H5: Participants of the Gamified-Group rate their learning progress higher than participants of the Non-Gamified-Group.

H6: Participants of the Gamified-Group find the system more useful than participants of the Non-Gamified-Group.

Study setup

The study setup is based upon previous work regarding AR-supported work stations [26] and gamification of manual tasks [5, 27, 28]. Students and employees of the FH Aachen University of Applied Sciences of the department of manufacturing and mechatronics are targeted as participants. Participation in this study is not related to an incentive scheme; however, the students are allowed to substitute one practical session by participating in this study.

In general, the participants are asked to execute an AR-supported assembly routine at least three times before answering a questionnaire. They are free to execute the assembly routine more than the three runs. After answering the questionnaire, the participants are asked to assemble the structure one last time without any support.

Assembly task

For this study, an assembly routine using industrial profiles to create a dog-shaped structure is used (Figure 16). The dog-shaped structure is selected as it requires the handling of industrial items in combination with a tool, includes non-self-explanatory procedures, and offers the possibility to commit errors. In contrast to previous applications [28, 29], the participants are not asked to assemble the whole dog-shaped structure but only one side to decrease the assembly time. Thus, the participants must place and mount eleven parts which takes around 10 minutes. An Allen key is required for the mounting operation while the screws and nuts are integrated into the parts so that no small items must be handled.

Figure 16: *Dog-shaped assembly used for this study.*

Work environment

A standard manual workstation enhanced with AR projections, a monitor, and a pick-by-light system is used [26]. The AR projections present 2D information in the user's working area. The pick-by-light system highlights the next boxes using green LEDs and shows errors using red LEDs. The monitor is used to rotate a 3D image of the dog-shaped structure as a reference during assembly. Moreover, the picking of tools and grabbing objects out of small load carriers is detected. Therefore, a LiDAR sensor and a tool holder are used. A mounting for the dog-shaped structure simplifies the assembly operation and specifies the assembly position (Figure 17). The mounting also includes a white projection surface.

The evaluation system [28] compares the user's actions to the planned work steps. In case of errors, the user is notified by red warning messages, and error resolving strategies are provided [27]. Currently, the sensor system only detects pick operations. As place and mount operations cannot be identified automatically, manual checking of assembly operations by the participants is used. Therefore, a button is integrated to acknowledge finished assembly and mount operations.

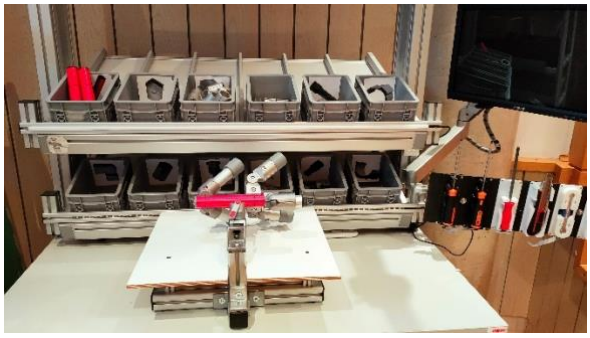

Figure 17: *Dog-Shaped assembly with mounting at the manual work station.*

Gamification elements

Two gamification strategies are combined for this work: The level system should adjust the work difficulty according to the user's performance. This way, users should neither be over- nor under-challenged during the assembly to keep the task interesting and increase engagement. The feedback system should provide information about the users' progress compared to predefined time indicators and quality rates. Moreover, the feedback system should highlight progress in comparison to previous runs.

For the level system, a successive reduction of assembly information is used during pick, place, and mount operations. Level changes are triggered after completing an assembly if the quality rate is over 80% and the time requirements are met in at least 80% of the cases. In level 1, the pick-by-light system indicates the box for the required item while the part's 3D image and name are shown in the working area. During place and mount operations, the targeted location and the location of the part in the whole assembly are indicated. In the case of complex tasks, animations are shown to explain the correct handling of objects and tools. In level 2, the part name and the highlighting of complex tasks are removed. In level 3, only the part's 3D view is shown during pick operations. For assembly and mount instructions, the users receive information about the part's location in the whole assembly but no further indication of the location in their assembly. In level 4, no support is provided to the users during the predefined time intervals. If the users exceed the target times, information is provided as defined in level 2.

The user performance is evaluated according to the time and quality of the assembly task. Thus, the game elements should represent these performance indicators as well as the users' general progress. As immediate feedback can increase encouragement for a task [30], a mix of immediate feedback messages and feedback for the whole assembly routine is used for this study.

For all participants, a progress bar indicates the number of finished steps in comparison to the total number of steps (Figure 18). After each correct action, green pop-up messages appear. Also, conclusions of each work task regarding time and quality as well as level up messages are provided. In addition, the users can create their personal feedback cockpit using different status indicators:

- Circular progress bar for quality rate,
- Circular progress bar for timely actions,
- Timer for remaining time,
- Point display,
- Level display.

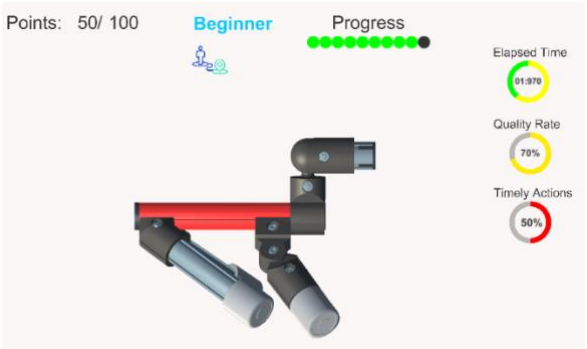

Figure 18: *Exemplary AR projection including feedback elements.*

Performance indicators

During the assembly routines, time and quality of each action are recorded. Moreover, the number of improvement actions and the number of assemblies per person are collected. These indicators are used to evaluate H1, H2, and H3.

Questionnaire

For all participants, statistical information about their age, gender, handicraft training, and personal estimation of manual skills is collected. Moreover, previous experience with industrial profiles is retrieved.

After the assembly operation with the AR projections, the participants' motivational aspects are accessed using an Intrinsic Motivation Inventory (IMI) with a 7-point Likert scale [12, 31, 32] to examine H4. For the IMI, the categories "interest/enjoyment", "perceived competence", "effort/importance", "pressure/tension", "perceived choice", and "value/ usefulness" are included. The personal view on the learning progress (H5) is accessed using a questionnaire with six elements developed according to the guidelines outlined in [33]. In this part, the participants rate their learning using a 5-point Likert scale, answering questions such as "How would you rate your learning progress during the assembly routine?" or "Do you feel that you have gained new skills during this session?". In order to analyze the usefulness of the gamified and non-gamified workstation (H6), the System Usability Scale (SUS) [34] with a 5-point Likert scale is selected.

After finishing the data collection phase, all categories of the IMI, the answers regarding the learning progress, and the SUS are checked for internal consistency using Cronbach's alpha [35].

Planned Procedure

The study starts with general information regarding the procedure and the voluntary nature of participation (Figure 19). Afterward, the Gamified-Group receives an explanation about the level system and selects their preferred status indicators. Before beginning with the assembly task, the functioning of the industrial connectors is explained using exemplary parts. Next, all participants are asked to assemble the dog-shaped structure at least three times while they are free to execute more times. For the Gamified-Group, the performance of each assembly routine is evaluated. If the requirements for a level-up are met, the level is changed accordingly. For the Non-Gamified-Group, the assembly information remains at level 1, independent from their performance.

After executing the assembly at least three times, the participants are asked to fill in the questionnaire. Finally, all participants should assemble the dog structure the last time without receiving support from the AR projections or the pick-by-light system.

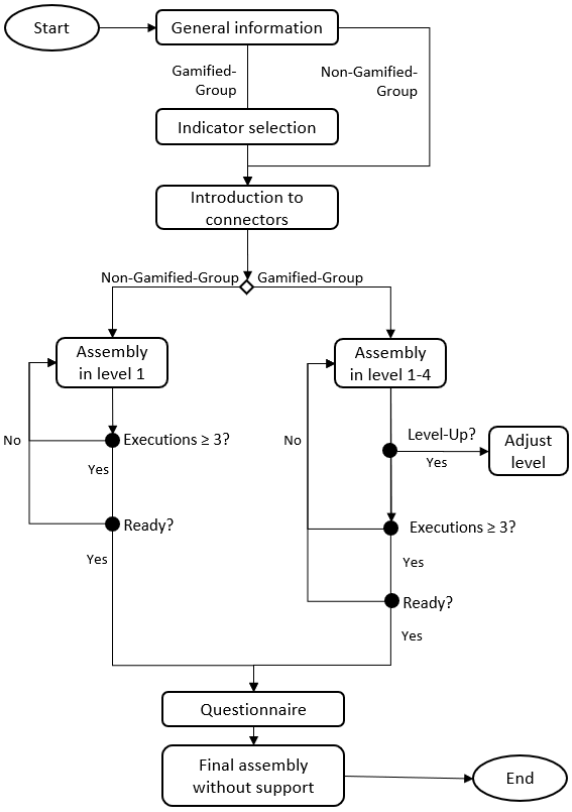

Figure 19: *Planned procedure of the user study.*

Conclusion and outlook

The presented user study aims to analyze the impact of gamification elements on users in industrial work scenarios. A manual workstation for the assembly of industrial profiles is selected as the use case. For the study, two groups are formed which must execute the assembly task at least three times.

The Non-Gamified-Group receives fixed assembly information regarding pick, place, and mount

operations. They do not receive indicators for time or quality requirements but information if they commit errors.

For the Gamified-Group, the presentation of assembly instructions is changed according to the performance. Users who execute the assembly steps correctly and timely receive a level-up message and fewer assembly instructions in the following sequence. Users who have difficulties completing the assembly tasks remain at the current level. This way, boredom, and overload should be prevented. Moreover, users of the Gamified-Group can select different status indicators for their work environment. This approach should raise the users' awareness regarding game elements and offer some choice to the participants.

In the next step, a pilot test with ten participants will be conducted to ensure the proper working of the manual workstation and the comprehension of the questionnaire. The user study with at least 70 participants should take place in April 2022.

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