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# Develop your strengths by gaming: Towards an inventory of gamificationable skills

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**Abstract:** This paper analyses existing gamification approaches to build a mapping between game genres and potential human skills required by and potentially trained by the specific genres. This mapping is then applied during an expert review of two typical game scenarios: an action- and reaction-oriented mini game and a collaborative group raid implemented in World of Warcraft. Both scenarios undergo an individual and detailed analysis to identify specific skill-related aspects. Relevant aspects characterizing each type are listed as a basis for a skill-mapping based on specific game mechanics utilized by each type. That is, the identified specific game mechanics require gaming skills which are then mapped to general physiological as well as cognitive and social human skills. This detailed game-mechanics-based skill-mapping is a first step towards a gamification index. Used in reverse order, from human skills to game mechanics, such an index will support the design of edutainment applications using gamification as a means to enhance skills required in real-world scenarios. The article concludes with a description of future work in the area of gamified skills as motivated by the work presented here.

## 1 Introduction

Computer games motivate users, in this context also known as *players*, using a variety of different techniques and game design strategies potentially resulting in a high feeling of immersion and a state of „flow“ [Cs10] for players [Mc11]. One key element is to constantly challenge players in a well-balanced way. By solving a challenge, a player trains the skills required by the particular challenges. After a task is completed, the player’s improved skills enable the player to deal with the next and even more difficult mission. A well-balanced game forces players to always play at the edge of their current skill levels. Hence, gameplay also involves a personal training process based on the required gaming skills.

Potential skill-transfers from virtual game worlds to real world scenarios provide an interesting alternative to existing training techniques. Hence, first approaches already use games for education and training of various sets of professional skills and/or human capabilities. For example, they have been utilized to train surgery skills [Ro07], leadership styles [SG10], as well as communication and cooperation skills [RL11]. Several other examples already identify skill-related benefits of typical computer game mechanics, which we will discuss in the upcoming related work review. This article

proposes an expert review evaluation of typical game mechanics to identify gamificationable skills. That is, required game skills are mapped to physiological, cognitive, and social real-world skills of humans, to acquire a deeper insight into how gamified skills can be used as training and learning tools for real-world skills and scenarios. The concrete goal started with this evaluation is a gamification index. Such an index would be greatly beneficial if not necessary during the design of edutainment applications, applications that enhance skills required in real-world scenarios by using game mechanics.

This article is structured as follows. First, we analyze existing approaches that already target skill acquisition and that identify skills trained while playing computer games. This review leads to an identification of potential target skills and an initial mapping of these skills to specific game genres. This initial coarse mapping serves as a starting point and guideline supporting the following expert review evaluation of two gameplay scenarios of World of Warcraft<sup>1</sup> (WoW): The mini game „Whack-a-Gnoll“ as well as a typical raid that requires coordinated actions by multiple players. The initial mapping is guiding the evaluation. Directed by their primary genre, both games are analyzed in terms of their principle game mechanics to identify potential target skills. This results in a detailed and more concise mapping not between game genre and skills but between game mechanics and skills. The evaluation provides the basis for mapping gaming skills to real-world counterparts or fields of application. Finally, the paper presents a prospect of future research directions.

## 2 Related work

Current computer games can be separated into six genres: action, strategy, sports, simulation, adventure, role-playing game / massively multiplayer role-playing game (MMORPG). Each genre, and in detail even each game, typically involves a unique style of play: Action games, for example, involve action/reaction cycles demanding short reaction times and highly developed hand-eye coordination, whereas adventure games demand increased problem solving skills.

Players actively use the demanded skills and hence train these skills due to repetition [Sa10] or due to the gain of experience caused by an increasing difficulty level. These „gaming“ skills are not restricted to computer game environments. For example, the ability of problem solving [Am99] can directly be used in the real world and visual attention [GB03] can increase the overall performance of certain tasks. Additionally, cooperative computer games support collaboration and increase the competences necessary during teamwork [Mc11] [RL11].

Computer games encode certain knowledge that can be learnt and mastered during active gameplay [Gu10]. This learning happens in a highly motivated way, which is always challenging without overstraining the player—the player can get into a state of „flow“ [Cs10]. Games in general provide a broad spectrum of problem-solving issues testing the potential strategies of a player. The player discovers new problems and multiple ways to solve them through his own actions [Ar06]. The immersive aspect of

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<sup>1</sup> World of Warcraft, Blizzard Entertainment, 2004 - 2013.

computer games can even help to introduce players to moral problems and encourage them to react in a way considered ethically appropriate [Sc09].

## 2.1 Gaming skills

Typical computer game genres require different skills and, hence, potentially improve different sets of skills. Adventure and strategy games require mostly imagination and problem-solving skills [Am99]. Action games require and improve the mental rotation skill [Ch08], visual attention, and the skill to handle a number of different tasks at the same time [GB03]. This has already been exploited during the training of laparoscopic surgeons [Ro07].

Players of MMORPGs increase collaboration skills by working together as well as by helping Non-Player-Characters with their needs [Mc11]. One key element of developing collaborative skills is the requirement of playing together to achieve end-game goals: the difficulty of the game and the strengths and weaknesses of roles [Ye09] evoke the necessity to form groups to successfully achieve end-game goals [Ye06a] that promise rewards important to increase the player's reputation [Kr09]. Thus, MMORPGs help to develop social behaviors by facilitating players, if not forcing them, to interact with each other in a structured and constructive way [DM05].

Certain games can also be used as training tools of so-called soft skills, e.g., to increase leadership skills [SG10]. Here, MMORPGs provide various game mechanics that require players to develop their behavior into a leading role [DM05][GW09][RMO08]. According to Williams et al. [Wi06], the necessity of leadership arises automatically if a critical mass of players is reached in a certain group. Every player has individual needs and motivations. Joint actions by these individuals require management and rules, e.g., to enforce equal rights necessary for players to not lose their motivation.

Additionally, the gameplay provided by MMORPGs like WoW incorporates different phases of leadership: an efficiency based phase, and a more member-oriented phase [Pr10]. Here, leaders experience short-term as well as long-term aspects of leadership [Ye06a]. Keeping a guild or a raid active is a complex task that needs substantial management [Du06] that often includes the skill to motivate people and to resolve conflicts between them [Ye06b]. Finally, by accumulating in-game experience, players can become advisors and mentors. They will share their knowledge with other players and will try to improve the gameplay of others [SBS09][Wi06].

An additional soft-skill fostered by several game genres is the communication skill. Players of multiplayer games are often forced to express themselves via text or voice chat, which often requires more effort compared to face-to-face encounters in the real world. Hence, they are training the skill to express themselves concise and in a clear way [Sc11].

MMORPGs have a lot of content and are played over a very long time. Keeping all the players active requires time management. Players are conditioned to work more efficiently by doing a high workload on a regular basis [Ye06c].

Games in general are rule-based environments [Hu09] in which the player learns to act under certain constraints. Players are forced to respect the constraints and, as a result, players learn to accept the rules. They develop a certain degree of ethical responsibility and they get rewarded for performing successfully within these boundaries [MEC09].

## 2.2 Advantages of the virtual gaming environment

Learning in a gaming environment has the advantage of giving the learner a safe way to try something new. MMORPGs offer a safe ground to learn social behaviors. They generate anonymity through the usage of avatars. The players thus do not have to fear negative feedback in their real-world life [RM06].

Role-playing games comprise highly immersive universes, in which entertainment and education are combined [RW06]. Players are immersed in different roles and positions [Hu09]. They learn through direct experience since they act as if they were directly involved in real-world tasks [PK07]. Hence, role-playing provides a higher degree of experience after a crises is solved [Ye09].

The relations between game genres and skills extracted from the existing work is summarized in a first genre-skill mapping as illustrated in Table 1.

Area	Genre	Human skill
G1	Action	Mental rotation ability Visual attention Ability to multitask Reaction time Hand-eye coordination
G2	Adventure	Problem solving Visualization
G3	MMORPG	Collaboration Leadership Conflict management Project management
G4	Multiplayer	Communication
G5	Strategy	Problem solving Decision making Visualization

Table 1: Mapping of game genres and human skills potentially trained by the given game mechanics of the respective genre.

## 3 Terminology and method description

We apply the following definitions of terms in this article:

- **Game characteristic:** the main game principles and game styles determining the type or genre of a game. Certain genres are determined by their unique set of game styles as implemented by certain game mechanics.
- **Game mechanics:** the technical principles utilized to implement certain game styles. Game mechanics can be fine grained (core mechanics), e.g., moving an entity forward by pressing a key, or coarse grained (general mechanics), e.g., jump-and-run. The latter is describing a set of core game mechanics, often associated with game genres.

- **Gameplay:** the performance-related aspects of playing as caused by executing the game mechanics.
- **Challenge:** the individual actions taken and performed by players during gameplay as provoked or forced by certain game mechanics.

The evaluation of potential skills trained by computer games based on an expert review can—in principle—be tackled from two different directions. The first approach is a review-based evaluation of identified game mechanics that challenge human skills. These game mechanics are then traced in the analyzed games to point out the challenged skills. The second approach is a review-based evaluation of human skills as connected to certain use-cases. These use-cases are then traced in the analyzed games, potentially requiring analogy mapping of the use-cases and the analysis of game mechanics causing them. A third option combines the two former approaches bidirectionally.

This article follows the first approach and traces skill-related game mechanics. Thus, the analysis will point out the implemented game mechanics and map them to human skills.

#### 4 Whack-a-Gnoll: Physiological and cognitive skills



Figure 1: Whack-a-Gnoll, an arcade-style reaction game in WoW.

„Whack-a-Gnoll“ is a mini game implemented in WoW. It is almost analog to the arcade game „Whack-a-mole“. However, the WoW version of this game has some additional features (see Figure 1): The player enters the gaming area with his avatar (1) where nine barrels are placed in a square (2). The player’s aim is to accumulate 30 points within a

certain amount of time (6). This is achieved by destroying the targets randomly emerging from the barrels.

The player can choose between three different targets: A minor gnoll (3) granting one point, a major gnoll (4) granting three points, and a baby gnoll (5) which grants no points and which additionally stuns the avatar for a few seconds.

To achieve 30 points, the player has to quickly decide on the target to destroy first since targets only appear for a few seconds. The player also needs to take the velocity of his avatar into account. He has to decide whether it is possible to cover a longer distance and catch a just popped-up major gnoll in time, or to go for a minor gnoll within close reach. If the player misses the major gnoll, he gains no points, destroying the minor gnoll will at least grant him one point.

However, the player has to be careful to avoid the baby gnolls. The resulting stun—as a consequence of hitting one of them—will restrain any player actions for the next few seconds.

Whack-a-Gnoll challenges players using different game mechanics that require several skills simultaneously. At first, players need to locate their avatar and the potential target on the gaming area. Afterwards they have to move their avatar to the target and hit it by pressing the „1“ key on the keyboard. Both actions require spatial orientation in the virtual and in the real world (H1.1.1) as well as a good hand-eye coordination (H1.1).

Before a player is going for a target, he has to choose a specific target by weighing the potential value of each available target type against the approximated time to reach it. This requires a fast decision-making process (H2.1).

Finally, the general reaction time (H1.2) and the reaction time of the aforementioned skills (H1.1.2 and H2.1.1) define a combined requirement: A player needs to achieve 30 points in a given period and the targets only appear for a few seconds. If the player reacts or decides too slow, he will run out of time.

The results of this analysis are summarized in Table 2. Here, in contrast to the genre-to-skill mapping as extracted from the related work, skills are mapped to game mechanics. This provides a more finely graduated mapping considered to be more in-line with current trends to merge and mix game mechanics from various genres into one game. In addition, this type of mapping accounts for the synthesis goal, i.e., to identify game mechanics to be implemented given the skills to be trained.

Area	Game mechanics	Human skill
<b>H1 Physiological</b>		
H1.1	Navigating on the playing field	Hand-eye coordination
H1.1.1	Orientation on the playing field	Spatial orientation
H1.1.2	Navigating in time	Reaction time
H1.2	Scoring points	General reaction time
<b>H2 Cognitive</b>		
H2.1	Choosing a target	Decision-making
H2.1.1	Choosing a target before it disappears	Reaction time

Table 2: Mapping of game mechanics to human skills identified by the Whack-a-Gnoll analysis.

## 5 The Thorim Encounter: Social skills

The following part analyzes the key game mechanics and required skills of the fight against „Thorim“, an encounter in the WoW Ulduar raid instance. The Thorim encounter incorporates two phases. In the first phase, a group approaching this task has to split up into two smaller groups. Both groups are separated from each other and have to rely on the other group to survive the fight. One group remains in the main arena (1) where it needs to deal with several minor enemies that are attacking the group (see Figure 2). During the first phase, Thorim cannot be attacked directly because he is standing on a higher ledge (3). Therefore, the second group has to fight its way through a narrow passageway (2) to force Thorim into the main arena (3). Once Thorim is pushed into the arena, the two groups reunite for the final battle against this „boss enemy“.



Figure 2: The map of the Thorim encounter.

The first collaborative aspect (H3.1.1) is evoked by the design of different classes players can choose for their own avatar. Each class has some specific strengths and weaknesses, but classes may complement each other. Therefore, if the difficulty level rises, players are encouraged to form heterogeneous groups to compensate their weaknesses by complementation, a game mechanic described as the „necessity of grouping“ [Ye09].

The game mechanic of different classes in combination with the encounter design leads to the next aspect of challenging collaboration (H3.1.2) while fighting against Thorim. Both groups need to be balanced in terms of weaknesses and strengths. Classes also determine roles: A healer has to keep his teammates alive while the tank has to protect his friends from deadly attacks [DM05].

Furthermore, the encounter design creates an additional coordination requirement (H3.2): Both groups need to be successful. If the arena group is overrun, the floor group will not survive for long. If the floor group does not reach Thorim in time, the arena group likewise has no chance to survive.

Finally, the connection between the game mechanics of the encounter and the class design leads to a third challenge to successfully win this fight: Each player has to fulfill a specific task. Thus, the skill of task distribution (H3.3) is challenged by the necessity of assigning a unique task to each member of the raid. A perfect execution of these tactics will give positive feedback of the collaborative aspects to all players.

The game mechanics of this quest require extensive coordination and collaboration as summarized in Table 3, again mapping game mechanics to skills as motivated before.



Area	Game mechanics	Human skill
<b>H3 Social</b>		
H3.1.1	Class design	Collaboration
H3.1.2	Encounter design	Collaboration
H3.2	Encounter design	Coordination
H3.3	Encounter / class design	Task distribution

Table 3: Mapping of game mechanics to human skills resulting from the analysis of the Thorim encounter.

## 6 Discussion and Potential Skill Transfer

The basic mechanics of the analyzed mini game Whack-a-Gnoll are typical for the whole WoW game. The game mechanics of the mini game are common to almost every situation of the main game: Players are challenged by the same requirements while questing, going on a raid, and dueling in Player-versus-Player situations. The game mechanics of these situations are almost identical to the the game mechanics of action games (G1). Players mostly have to react properly to spontaneous situations. They need a distinctive spatial orientation (H1.1.1) and hand-eye coordination (H1.1) to be successful. The same is true concerning the decision-making skill (H2.1). Every new situation has to be analyzed within seconds or players might be punished in some ways. Hand-eye coordination trained with games proved to be useful for laparoscopic surgery [Ro07]. A good hand-eye coordination is equally important for the control of many of today's transportation systems. Various steering systems use some kind of computer-aided interface or require to map spatial movements between different frames of reference. For example, a pilot completely relies on the indications of the flight control and navigation instruments during certain meteorological conditions. In addition, controlling a plane has some analogies to controlling an avatar [Pr10]. Both situations require a visual analysis of the situation by interpreting the information from the interfaces, and the pilot/gamer has to map potential degrees of freedom from the input devices to the designated target movements. Decision-making within a short time period can be helpful for any kind of steering situations. A player is used to analyze unknown situations and to react properly to them, a situation very similar, e.g., to driving a car. Both situations require a fast analysis of the given situation and an appropriate decision making.

The results from the analyzed Thorim encounter can be generalized and applied to the whole social gaming idea. Thus, gameplay in social games is combining the effects of the MMORPG (G3) and the multiplayer (G4) genre. The design of WoW encounters always calls for collaboration (H3.1.1). Furthermore, the game mechanics of the class and encounter design challenge the skills of task distribution (H3.3) and coordination (H3.2). All decisions made are crucial for the success of the group. Players rely on the outcomes of the collaboration. Over time, they start to build up faith in their teammates if a group is successful. While playing together, trust is evolving over time and a „shared mental model“ [SSB05] is developed among the teammates. Additionally, the game

allows to track the contribution of every player in the group, which provides the basis for feedback of the individual performances.

Training teamwork and collaboration is a viable approach to increase team performance [Sa08]. Organizations are strengthening the collaboration among their employees by group activities and policies encouraging group events [GE07]. Playing multiplayer games like WoW could be one of these activities. Every player has an assigned role and task in a particular group, thus, the player receives feedback about the contribution to the overall group performance. Additionally, the teammates are getting used to work together, even in critical situations.

The outcomes of teamwork training are not only increased in connection to a certain task work [Sa08]. Considering this, players can benefit from their teamwork-oriented gaming experiences during teamwork in the real world. Additionally, in today's business life teams are often spread over different locations. Using a virtual world is breaking the distance and allows players to collaborate even if they are far away from each other. Teammates can actively spend time together, get used to collaborate in the virtual world, and take this experience as an advantage in their real-world business.

Finally, the typical game mechanics as found in the example WoW game types train an additional multitasking skill: The capacity to handle different tasks under pressure and in critical situations at the same time while communicating mission-critical information [GB03].

## **7 Conclusion**

This article presented first a literature review which identified the potential of typical computer game genres to train human skills beneficial in real world scenarios. Although the results provided a general overview of possible training effects of certain game types, a genre-based analysis does not identify the particular game mechanic(s) which is/are responsible for the training effect. However, to efficiently use computer games for edutainment, it is important to create an inventory of gamificationable skills in terms of the game mechanics causing the training effect. Developers of edutainment software can then take advantage of the inventory by selecting appropriate game mechanics for their training goals.

Additionally, several of today's game designs combine elements of different genres, e.g., action-adventures or strategy games with role-playing elements. The two examples analyzed in this article combine game mechanics of the action (G1), multiplayer (G4), and MMORPG (G3) genre in WoW. This result is additionally indicating the importance of a game-mechanics-based instead of a genre-based approach: Analyzing genres is not accurate and can blur the training effects of a game whereas the game mechanics approach allows an in-depth analysis of computer games and their training effects.

Finally, the article illustrated an expert review method using a game-genre-to-skill mapping only as an initial starting point. The method provided a structured approach for the evaluation of the two example game types in terms of skill-related gameplay and mechanics. The method identified potential game mechanics that target specific skills. This mapping can now be used as a guide during the design of gamified applications which support skill transfer to real-world scenarios. The final goal of this approach is a

comprehensive index that maps game mechanics to real-world skills to design and implement edutainment applications to tackle the general research question:

(Q1) *„Which advantages and usability do game mechanics have for training (professional) skills or (professional) competencies?“*

## **8 Directions for future research**

Future research will be directed by the following core questions which outline the evaluation of potential positive effects of gamification as a more general research agenda:

(Q2) *„Which skills are required and trained during gameplay?“*

To be able to describe the gamificationable skills, it is important to create a mapping between the skills learnt during gameplay and the game mechanics requiring and developing these skills.

(Q3) *„Which skill is required and trained by which game mechanics?“*

In some cases, games can train additional skills during gameplay that are not directly predefined by game mechanics. Players come up with alternative methods to increase game success, e.g., using offline communication and collaboration. It is also important to take a look at these side effects too.

(Q4) *„Which kind of games and game mechanics favor developments of non mandatory requirements, which are not directly implemented in the game itself?“*

Having identified potential skill candidates, it is important to search for possible real-world applications of these skills.

(Q5) *„Which are possible fields of application for gaming skills in the real world?“*

The results of the comparison between gaming skills and real-world skills will show matching pairs of skills. However, it is unclear if skills learnt during the process of playing a game can be directly used in the real-world.

(Q6) *„Is it possible to use gaming skills without any adaptation in the real-world?“*

The daily working life is nowadays often based on the use of computer technology. Therefore, an additional examination of a general personal improvement in computer aided working areas will be carried out.

(Q7) *„Can playing computer games on a regular basis improve the use of computer technology performance?“*

Having identified potential skills and game mechanics, it is mandatory to evaluate the correctness of the assumptions, that is, to evaluate if real world skills can really be

trained using the identified target skills and game mechanics and how efficient the various training options will be.

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