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Gamification's impact on the intrinsic motivation for physical activity

Abstract

In the modern days physical activity among the children and adolescents have generally decreased and, in turn, increased the prevalence of obesity and different health issues caused by obesity. There have been several attempts to motivate the young to start exercising and having a healthier lifestyle by making it more engaging and fun. One of the methods of inspiring the young people to get moving stems from video games. Gamification has been trendy in the last century and it is still talked about. The primary objective of the gamification is to decrease the threshold of doing something and repeating it by implementing different gamifying elements like point scoring.

There have been many different attempts to implement gamifying elements into various activities. But in some cases the motivation to exercise wanes once the user's interest towards the game itself decreases. In this paper I explore the cases of using gamification to improve peoples' physical activity and promote better health. The objective of this paper is to use a systematic literature review to find out and map the amount of research that has been done about gamification and its impact on the intrinsic motivation for physical activity.

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1. Introduction

The lack of physical activity and everyday stress can be detrimental to the person's average health and can lead to various health complications like diabetes and depression (Chen, Pu, 2014). Lack of outside activities also negatively impact vitamin D production because of the lack of sunlight exposure, which in turn can increase the risk of diseases like rickets and tuberculosis (Kaczmareck et al. 2017). Zuckerman and Gal-Oz suggest (2014) that one of the main reasons for the lack of physical activity is related to the Western culture being determined by environments that promote physical inactivity (Zuckerman, Gal-Oz, 2014).

According to Lee et al. (2021), even though attempts have been made to inform people about the importance of physical health, almost 80% of Americans still are not physically active enough (Lee et al., 2021). One of the health problems linked to low physical activity, cardiovascular disease, is reportedly responsible for 31% of deaths and 37% of premature deaths globally (Davis et al. 2021).

The threshold of changing one's inactive behavior and having them start to live healthier and more active can be extremely difficult to pass. Thanks to the growing increase of human-computer interaction, people have developed different persuasive technologies that are used to support various behavior changes (Zuckerman, Gal-Oz, 2014). Persuasive technologies use various mechanisms like feedback and reward to motivate the user to achieve the goal and change their behavior (Matthews et al. 2016).

In recent years mobile technology has been booming, with the adoption rate of smartphones and technology's growth rate surpassing the other consumer technologies (Boulos, Yang, 2013). With the growing prevalence of smartphones and easier access to the Internet, mobile technology could offer an excellent opportunity for the healthcare industry to transform by providing new ways to implement health interventions (Matthews et al. 2016). There are also wearable non-phone technologies that are solely made to monitor one's physical activity. These devices can track many different physical activity metrics like step count, distance traveled and burnt calories (Zuckerman, Gal-Oz, 2014). Many health management apps tend to use gamification to motivate the user to upkeep their healthy habits (Chen, Pu, 2014).

With gamification the app developers can mix different persuasive mechanisms and game-related experiences like flow and mastery to provide a different approach to change the user's behavior (Hamari, Koivisto, 2013). One of the good examples of gamification of physical activity is the Ubifit project. Consolvo et al. (2012) describe Ubifit as a mobile application that uses phone's sensing technology to detect the user's physical activity. The main draw of the application is the virtual garden management. Different physical activities like cardiovascular activity, strength training and flexibility training are represented by differently coloured flowers and the goals set by the user are represented by differently coloured butterflies (Consolvo et al. 2012).

Another good example of a physical activity-promoting mobile game is Pokémon GO that became highly popular in the summer of 2016 even outside the Pokémon fanbase, with being installed by over 10% of the smartphone users in the USA (Shea et al. 2017). The main gameplay loop of the game is similar to the mainline Pokémon games: you capture different virtual creatures called Pokémon, raise them and battle other Pokémon. Pokémon GO, however, uses the phone's GPS system to place the Pokémon around the

world and the player has to physically move around to encounter them. Even though the players of Pokémon GO have better physical activity than those who don't play, the increase of physical activity wanes after the player loses interest in the gameplay (Lee et al., 2021). This thesis' objective is to look into the usage of gamification in physical activity and to answer the research question: Does gamification have a significant impact on the user's intrinsic motivation and how does it do it?

In this thesis I start by laying out the foundation for the research I conduct a literature review on the previous research. The objective of the literature review is to provide better understanding of the persuasive power of gamification and persuasive technology. It aims to figure out whether gamification has any significant impact on the user's intrinsic motivation and how this impact is made. With the information I gain from the literature review I can further improve the research methods of this thesis. After the literature review I will introduce the methodology of the actual thesis research along with the findings and the conclusive discussion. With the findings I can discuss gamification's effects on intrinsic motivation for physical activity and point out any shortcomings within research and suggest what research should be done in the future.

2. Previous Research

This thesis explores gamification, its uses to promote physical activity and its effect on intrinsic motivation. In order to better understand gamification and persuasive technology in general, I will perform a literature review on the previous research. In this chapter I will provide the background information about the subjects of this thesis.

2.1 Gamification

Gamification is one of the persuasive technologies. According to the Merriam-Webster dictionary (2021), gamification could be simply defined as *"the process of adding games or gamelike elements to something (such as a task) so as to encourage participation"*. Even though the concept of gamification is not new, it was not until the 21st century that the term itself was added in the English lexicon (Merriam-Webster, 2021). According to Deterding et al. gamification could be described as the use of game design and technology in a non-game context. (Deterding et al., 2011)

Kari et al. suggest (2016) that the discussion of gamification should be split in two: process of gamification and experience of gamification. The process of gamification is defined as *"using a set of activities with the aim to implement game elements to non-game context"* and the experience of gamification is defined as *"a use experience in non- game context that the user perceives as gameful"* (Kari et al., 2016).

According to Gerald Christians (2018) the gamification had its major rise of popularity in 2002 when the actual term was coined by Nick Pelling while he worked on a game-like user interface for ATM's and various vending machines. Later in 2005 a developer company Bunchball was founded, with a primary objective to implement gamification elements to increase user engagement on websites. Bunchball's first project, Dunder Mifflin Infinity was a gamified social network based on a comedy show The Office. The basics of gamification elements were there; the users were placed in teams, the teams were competing with each other by completing tasks and challenges and the users were rewarded with in-game currency by completing aforementioned tasks and challenges. Finally, the users could use the currency to customize their own virtual cubicle and show it off to everyone else. Dunder Mifflin Infinity was a success, with over eight million visits in the period of six weeks (Christians, 2018).

Gamified applications use different gamelike mechanics such as leaderboards, points and rewards to increase app engagement (Davis et al., 2021). However, gamification should not be confused with serious games. While the serious games may have a similar purpose as the gamified app, they may not use gamification elements to motivate the user to play the game (Rajanen & Rajanen, 2019). It is suggested by Deterding et al. (2011) that the game design elements gamification uses could be categorized into different game design levels. Game interface design patterns like badges and leaderboards are common design components to solve a known problem and game design patterns and mechanics like time constraints and turns concern gameplay, game design heuristics and principles like clear goals and enduring play are used to evaluate design solutions and approach the design problem. Game models like challenge and fantasy are used to define the game components and game experience and the last level, game design methods, are different practices and processes that concern game design. (Deterding et al. 2011).

Some of the game mechanics may have a different impact on different kinds of people. Gerald Christians introduces in his article Richard Bartle's research (1996, as cited in Christians, 2018) where the players are categorized into four groups. Christians then applies Bartle's categories into gamification. The first group, Socializers, belong to the people who prefer to interact and play with other players. Socializers are all about social interaction and aren't individually competitive. According to Christians socializers would be more accepting of gamification elements that promote social interaction and less accepting of elements like leaderboards (Bartle, 1996, as cited in Christians, 2018).

Fogg, however warns (2011) that the social element in the game can be a very risky design. If the attempt to implement the element is successful, the positive impact can be large but if it fails it may have a largely negative impact instead. Fogg argues that the abundance of social interaction and cues within the game can slow down the usage and the overwhelming or repetitive social cues with no variation at all can be a nuisance to some users (Fogg, 2011).

According to Christians, the second group in Bartle's research (1996, as cited in Christians, 2018), Explorers, prefer to interact with the game's world and discover secrets and new things in the game. Easter Eggs, hidden gags within the game, are one of such secrets. As for gamification, explorers prefer deep and detailed elements like puzzles and hidden objects and they don't care about social interaction or competition. The third group, Achievers, prefer action over interaction and they favor achievements and scoring systems. This group is considered more competitive than the previous ones. According to Christians, implementing gamification elements like leaderboards and badges would obviously win over the achievers but they could also scare off the explorers and socializers. However, he points out that elements like grading and leveling systems would be a fitting solution, especially if the players could benefit from these systems by social and exploratory means (Bartle, 1996, as cited in Christians, 2018).

The final group mentioned by Bartle (1996, as cited in Christians, 2018), gruesomely named as Killers, are all about player versus player activity. They share the competitiveness of the achievers but the killers differ in that they wish to see the other players lose. The high level of competitiveness of the killers may lead them to exploit the glitches and exploits within the game to gain an advantage. According to Christians, the killers are very difficult to cater to in a gamified environment without damaging the experience of the other groups. The explorers and the socializers are not interested in the competition at all and the achievers may find the player versus player mentality of the killers frustrating (Bartle, 1996, as cited in Christians, 2018).

Robson et al. further explain the design principles (2015) by introducing the MDE framework. The framework is split into three parts: mechanics, dynamics and emotions. The mechanics specify gameplay-defining aspects like the setup, rules, progression. The setup mechanics set the means of gameplay like the setting and objects required to play. The rule mechanics define the flow of the game by setting what the player is allowed to do in the game and what they are not. Finally, the progression mechanics are responsible for providing the player rewards and other incentives to repeat certain behaviors (Robson, 2015). It is, however, argued that the virtual rewards of gamification can reduce the user's intrinsic motivation (Zuckerman, Gal-Oz, 2014).

The dynamics in the MDE framework is defined by Robson et al. (2015) as "the types of player behavior that emerge as players partake in the experience". The players themselves create these dynamics as they go through the mechanics provided by the game designers.

The dynamics of the players in turn produce the emotions in the MDE framework. In order to retain the player's willingness to keep playing the game, the objective for the game designer is to provide positive emotions. The gamification dynamics are psychological and can be difficult to predict (Robson, 2015).
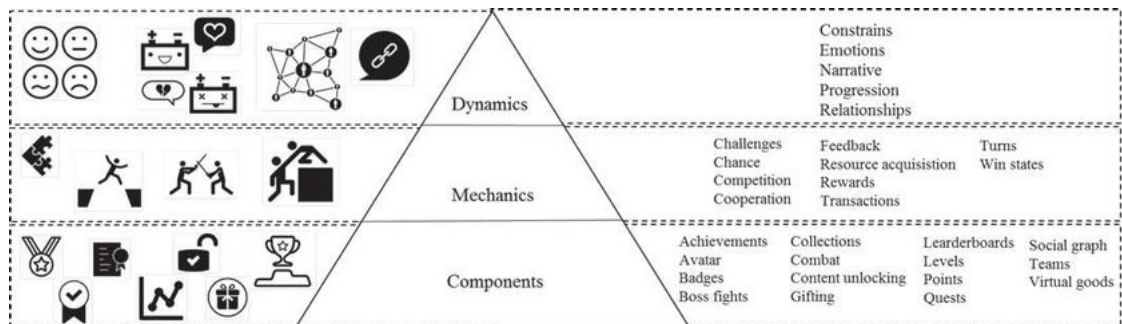
Figure 1. Pyramid of Gamification Elements (adapted from: Costa et al., 2017; Werbach & Hunter, 2012)

2.2 Criticism and Pitfalls of Gamification

Although gamification is a praised persuasive system design, it is not without criticism and limitations.

One of the pitfalls in gamification lies in the lack of understanding of gamification. Gerald Christians introduces in his article (2018) a hotel chain Marriott Hotel's gamified recruitment site, My Marriott Hotel. The players in the game would do tasks appropriate to the role they've selected. For the recruitment, the game would provide a link to the hotel's career portal. The game would also double as a training tool for the new workers. However, the users didn't find the gamification elements interesting and the training tool was extremely limited and did not cater to all job positions (Christians, 2018).

The study by Loughrey and Ó Broin (2018) discusses several psychology theories such as the Self-Determination Theory. According to the authors the SDT-based gamification may fail if the gamification designers lack a deep enough understanding of the theory. This failure can lead to a misuse of gamification elements. The authors suggest that the gamification approaches that try to combine intrinsic and extrinsic motivation can be psychologically harmful to the users who were already intrinsically motivated. They also suggest that the repeated provision of autonomy, competence and relatedness can cause addictions to the users with difficulties in self-control (Loughrey, Ó Broin, 2018).

Sometimes the problem may lie in the target audience. In the study by Amir Matallaoui et al. (2017) the authors performed a literature review on exergames. Although the results were fairly positive, they also report that adding the game elements may not have positive effects on older adults. The authors explain this by stating that the older adults are not familiar with the concept of game elements (Matallaoui et al., 2017).

Hanus and Fox created a study (2014) where they used badges and leaderboards to find out whether gamification improved student engagement. In the study the students would earn different badges by doing something specific like going over the minimum number of sources for their paper. The students could also earn tokens by doing smaller, easier tasks. These tokens could then be redeemed for different benefits like an extension of a

paper deadline. Finally, students could review their badges on the leaderboard and for the competition's sake, the top 3 students would be given a bronze, silver or gold star. Hanus and Fox, however, report that the results of the study suggest that their use of badges, leaderboards and competition do not improve the educational outcomes and in some cases could even harm them (Hanus, Fox, 2014).

Another aspect that could make a gamification application fail is the usability and functionality. Any additional effort of using the gamified technology, usage problems and technological errors like software failures and data loss may negatively affect the user's motivation. (Kari et al, 2016)

2.3 Social Aspect

Social interactions in gamification are very important. According to Hanus and Fox (2014), humans usually compare themselves to make it easier to assess their own abilities. One of the gamification elements, leaderboards, rely on social comparison. The leaderboard can motivate some players to get higher in the rankings, producing competition. However, competition can harm co-operation and can even tempt the players to cheat. Hanus and Fox point out that the negative effects of competition can differ from the type of competition. In constructive competition the competition is a fun experience and encourages growing relationships while in destructive competition there is at least one person who will be the loser (Hanus, Fox, 2014).

Leaderboards are one of the prime examples of social comparison in gamification. According to Hanus and Fox (2014) leaderboards provide players' scores for everyone to see and the players in the boards are ranked. With the leaderboards the players can compare themselves with either players above their rank or below. Hanus and Fox argue that leaderboards can provide satisfaction and positive feelings towards those high in the rankings but they can also give the high-ranking players high pressure to maintain the rank and some players may break under that pressure (Hanus, Fox, 2014).

Even though social aspect is a well-known component in gamification, it may not be useful in every situation. According to the research by Matthews et al. (2016) even though social learning was mostly positively perceived, there were circumstances where some users were not so happy with it. Matthews et al. also point out that most of the participants in the study did not consider social learning to be important at all, to a point where some participants even resisted using the social learning features (Matthews et al. 2016).

2.4 Applications of Gamification

The main objective of gamification is to change the target user's behavior. The gamification techniques are highly versatile and they can be applied into numerous aspects of life. Throughout the history of persuasive technology there have been numerous applications of gamification, some of them being either successful or unsuccessful.

In their study, Ilhan et al. (2021) provided a Flappy Bird-inspired mobile application Sleepy Bird which uses gamification to improve the user's sleeping behaviors. The application itself functions like a regular alarm clock app but with the gamification elements the app could provide feedback based on the user's use of the alarm clock. Initially the player is given 10 lives. If the player woke up according to the target time set by the app, they would be rewarded with extra lives. If they woke up past the target time,

they would lose 1 life for each 5 minutes past the target wake-up time. The application would further reinforce good sleep behavior by providing positive feedback and aesthetically pleasing design. The study was perceived as successful. According to the results, the application not only reinforced a good sleep behavior but also "helped raise awareness of waking up at ideal times on weekdays" (Ilhan et al. 2021).

2.5 Gamification and Physical Activity

In recent years smartphones have become a common thing for everyone and one of the most popular types of smartphone apps deal with health and fitness (Boulos, Yang, 2013). Yu Chen and Pearl Pu in their study (2014) investigated the aspect of social interaction and working in groups. For the investigation they developed a mobile fitness application in which the users work in pairs to exercise. The users could either compete with each other or cooperate with each other to achieve their fitness goals and earn badges and points. The users could also select to have a hybrid mode where cooperation and competition aspects exist. The pairs could communicate within the app by either sending a cheering emoticon or a taunting emoticon.

The research results suggest that both cooperative and hybrid settings can motivate users to exercise more. Competition, however, is reportedly beneficial when the pairs are at an equal ability level and can be demotivational otherwise. The authors conclude in their studies that social interaction can have a very positive impact towards the users' increase of physical activity if the interaction is collaborative rather than competitive (Chen, Pu, 2014).

Maged N. Kamel Boulos and Stephen P. Yang in their article (2013) explores the existing exercise games that use phone GPS. According to the authors the exercise games that are about exploring new locations could double as a good way for the players to learn more about their environment and geography. However, the authors also point out that the GPS games have their shortcomings. If the location-based goals are randomly generated, they may sometimes lead the player to dangerous or private properties. Additionally, the authors mention that the GPS games should adjust to the user's fitness level and warn them not to play too much and over-exert themselves (Boulos, Yang, 2013).

3. Research Methodology

Although gamification has been proven to be fairly effective to get a user into increasing their physical activity, this study's aim is to find out whether the gamification elements improve the users' intrinsic desire to exercise or will the activity slow down or even cease to exist after the loss of interest towards the app like what has happened with Pokémon GO. (Lee et al., 2021) To find an answer to this research question, this study presents a systematic literature review on existing studies that discuss gamification's effects on the user's intrinsic motivation to keep up with exercising.

3.1 Systematic Literature Review

The method of the research is a systematic literature review. I found this option of different research methods the most feasible considering that I will be conducting the research alone and I do not have time to conduct an empirical study.

According to Pearl Brereton et al. (2007), the increasing adoption of the empirical studies in software engineering introduces a new problem to the domain. As the studies have a limited scope, there has to be means to locate, assess and collect the outcomes of the studies in order to provide a summary of research evidence that could be used to find an answer to the research questions of a specific topic within the software engineering domain. As a means of approach Brereton et al. suggest a basic systematic literature review (Brereton et al., 2007).
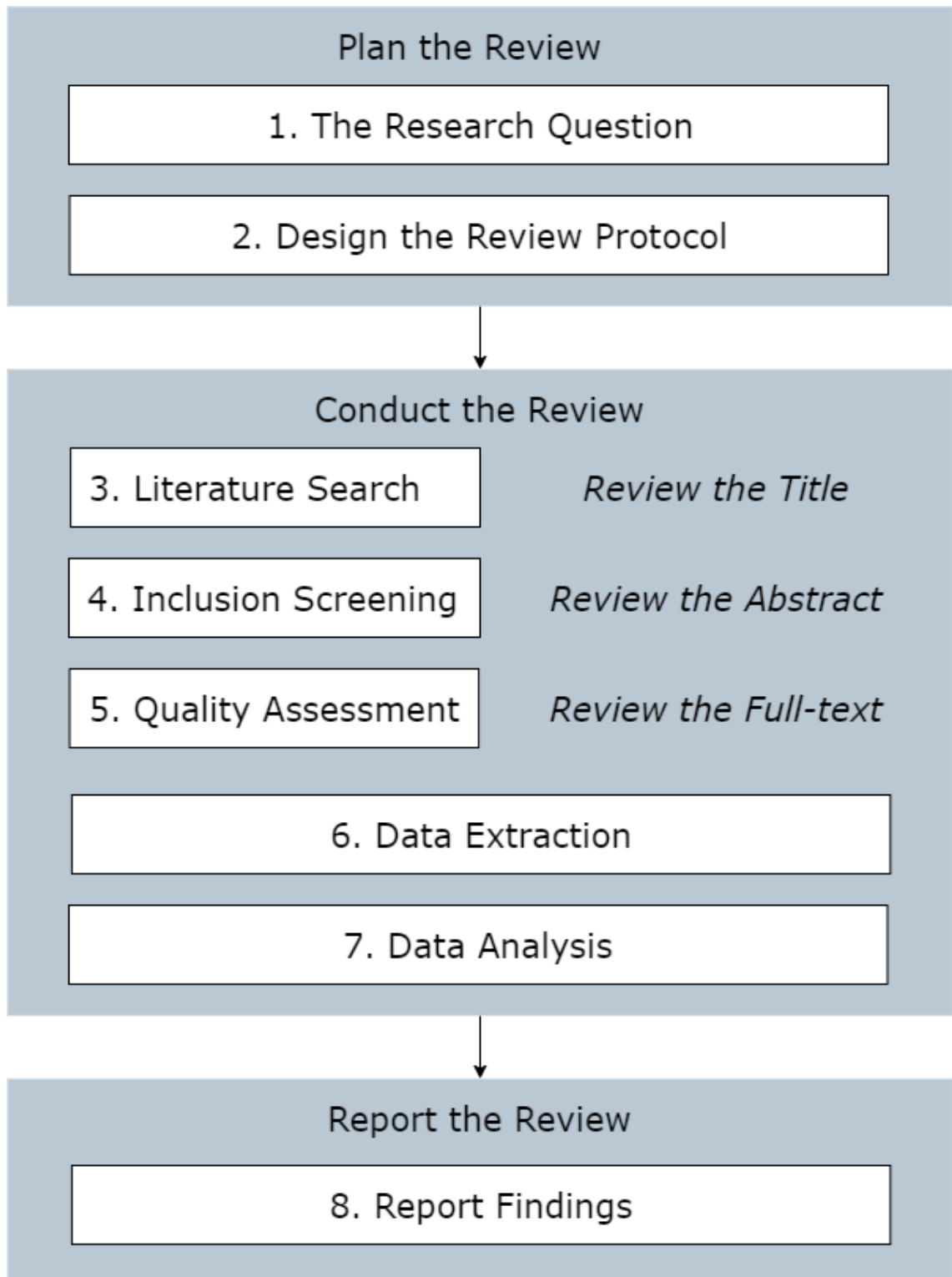
Systematic literature reviews are important, however. According to Yu Xiao and Maria Watson (2017) literature reviews establish a foundation for future research. With literature reviews researchers can summarize the research that is already done and pinpoint any possible gaps or data deficiencies within the research topic.

By summarizing and analyzing the prior work about the subject it is far easier to test hypotheses and even develop new theories (Xiao, Watson, 2017). The aim of this study's systematic literature review is to find those shortcomings and possibly suggest on how the future studies could proceed and how gamification could be improved.

3.2 Review Procedure

This thesis uses a systematic literature review process structure suggested by Xiao and Watson (2017). The review process has been split into three stages. In the first stage the review is planned and consists of two steps: formulating the research question and then designing the review protocol used in the next stage. After the steps in the first stage are done, the second stage, the conduction of the review, can be started.

The search starts with using the search string designed in the first stage, then the studies will be screened for inclusion. After the screening the studies go for one more round of evaluation, the quality assessment. After these steps, the data from the studies will be extracted and analyzed. The third, final stage will be reporting findings from the previous stage.

Figure 2. Systematic literature review process (Adapted from Xiao, Watson, 2017)

3.2.1 Plan the Review

According to Xiao and Watson (2017) the research question is the one that drives the entire review. All the studies included in the review should relate to the research question. Xiao and Watson also warn about a common mistake of making the research question too broad. If the question is too broad, the review may result in way too much data, making it very difficult to manage. The authors suggest that the researchers should use subtopics within the review's topic as potential research questions (Xiao, Watson, 2017).

The first iteration of the research problem was gamification's impact on internal motivation in general. This, however, was too broad. The next and final iteration of the research question specifies it into a field of physical exercise.

- Q1. Does gamification impact the person's intrinsic motivation on physical activity?
- Q2. How does gamification impact the user's internal motivation on physical activity?

Along with formulating the research question, it is also important to design the search protocol. According to Stapic et al. (2012) the research protocol is considered the most important part of the review as the entire flow of the review process is determined by it. A rigid search protocol also helps with preventing any research bias from occurring within the research process (Stapic et al. 2012).

1. Formulate the question
2. Select the sources
3. Define the search string
4. Source preferences & filters
5. Study selection
6. Data extraction
7. Findings & summarizing

Table 1. Search protocol

3.2.2 Conduct the Review

After the research question has been formulated, the sources of studies and the search string need to be determined. According to Xiao and Watson (2017) the literature search is a very crucial stage in the review as the review's quality is highly dependent on the quality of the literature used. There are three different approaches to literature search: electronic databases, backward searching and forward searching.

From these three approaches searching from the electronic databases is usually the go-to strategy. As a single database will not contain every single article available, it is recommended to have more than one database in the literature search. Xiao and Watson

also suggest using backward search to find the studies cited by the selected studies and forward search to find the studies that cite the selected studies (Xiao, Watson, 2017).

This systematic literature review's objective is to examine the benefits of gamification on the user's intrinsic motivation to exercise and upkeep their physical activity. It is crucial to select the correct electronic databases for the literature search. For this systematic literature review I will use electronic databases that contain studies related to software development, engineering and design. The studies in this review will be collected from the following databases:

- Scopus
- Web of Science
- ScienceDirect

This systematic literature review will use Scopus, Web of Science and ScienceDirect as the sources of data. Both of these databases will use similar search terms. As the databases' search options may work differently, it is required to change the options within the search limits. For instance, on Scopus the search will be limited to Title-Abstract-Keyword. I will also use the filtering settings offered by the databases to exclude articles of a type included in the exclusion criteria list.

To assess and acquire a rough understanding of the amount of studies potentially relevant to this study, a preliminary search is conducted. (Kitchenham, 2007) To follow the theme of the research questions, a search string 'gamification AND "intrinsic motivation"' was used. The following table displays the unfiltered amount of studies this preliminary search from all three databases previously introduced has yielded.

Database	Scopus	Web of Science	ScienceDirect
Preliminary search yield	317	435	544

Table 2. A chart of the preliminary search results

By analyzing the search results of the preliminary search, gamification and intrinsic motivation are more associated with education and learning. Scopus' keyword list in the keyword options displayed that keyword 'Students' is associated with 65 articles, 'E-learning' is associated with 38 articles and 'Education' is associated with 29 articles. Keywords related to this study, however, had few articles associated with them. For example, the keyword 'exercise' is only associated with 9 articles and 'physical activity' is associated with 8 articles.

Scopus was the only database out of the three to include keywords in the search results. However, the subject areas related to the articles could be determined on all three databases. In two databases, Scopus and Web of Science, most of the articles in the preliminary search results were classified under the "Computer Science" subject area.

Database	Scopus	Web of Science	ScienceDirect
#1 Subject Area (frequency)	Computer Science (210)	Computer Science (165)	Social Sciences (234)
#2 Subject Area (frequency)	Social Sciences (121)	Educational Research (159)	Computer Science (168)
#3 Subject Area (frequency)	Engineering (79)	Engineering (65)	Business, Management and Accounting (143)

Table 3. A chart of the three most frequent subject areas in the preliminary search results

This study's research questions are about the effects of gamification to internal motivation within physical exercise. The frequency of the learning-related keywords and the educational research subject area suggest that the search string used in preliminary search is not sufficient to answer the research questions. Therefore, the search string has to be modified to narrow the focus of the search.

(gamification OR "serious game" OR gameplay) AND ("physical activity" OR "physical fitness" OR "physical health") AND "intrinsic motivation"

This iteration of the search string attempts to include the terms "serious game" and "gameplay" in the string with the OR operators as they are both related to the subject area of gamification. The first part of the search string is followed by the string related to the physical activity. As the physical activity is synonymous to the commonly used terms "physical fitness" and "physical health", these two terms were included with the OR operators. The final part of the search string remains the same.

The second iteration narrows the focus of the search down to the subject area of the research question. However, the search string could be modified more by using other search operators supported by the databases used in the study. For example, the term "gamification" can be conjugated into several words such as "gamify" or "gamified" and "exercise" could be conjugated into "exercising". To factor in the conjugation of the terms within the search string, a wildcard operator can be used. ScienceDirect's search engine uses an exclamation point instead of an asterisk, so the search string has to be modified to suit the search engine.

(gamif* OR "serious game" OR gameplay) AND ("physical activity" OR "physical fitness" OR "physical health" OR exercis*) AND "intrinsic motivation"

(gamif! OR "serious game" OR gameplay) AND ("physical activity" OR "physical fitness" OR "physical health" OR exercis!) AND "intrinsic motivation"

These two search strings are the final iterations of the search string to be used in the literature search. The main structure of the string remains the same but the terms "gamification" and "exercise" have been shortened for the sake of the wildcard operator. For the previously mentioned reasons, a secondary search string had to be made to fit ScienceDirect's search engine's string format.
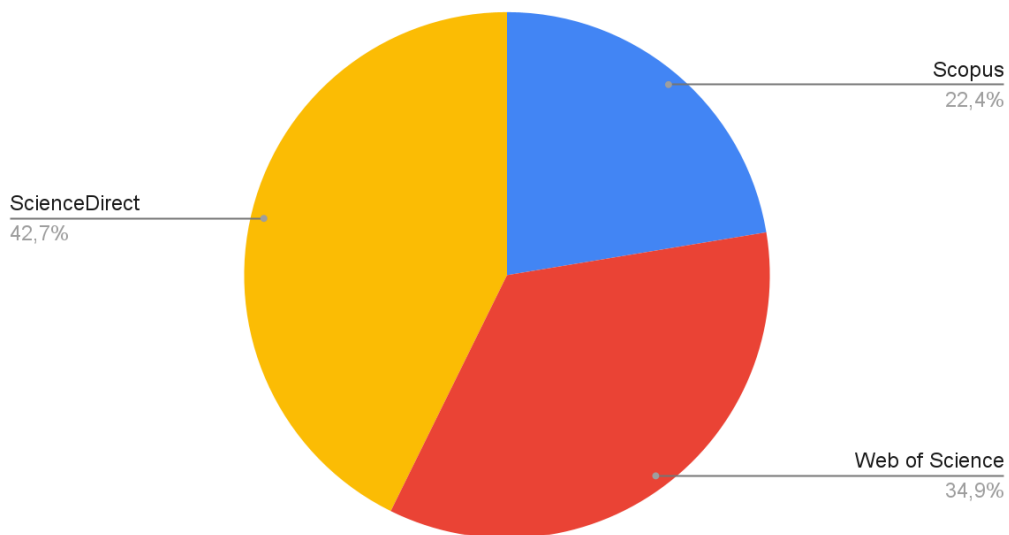
The flow of the literature search in this study is split into four phases. In the first phase, identification, the total number of records found during the search of all of the selected

databases will be tallied. After the identification follows the screening phase. In the screening phase most of the records will be either filtered out by using the database's filtering options or excluded by using the predetermined inclusion and exclusion criterias.

Database	Records retrieved
Scopus	43
Web of Science	67
ScienceDirect	82

Table 4. The number of records retrieved from the databases.

Figure 2. A pie chart of the record yield per database.

In total, the database search using the finalized search string yielded 192 articles.

Inclusion Criteria
- Available in full-text   - Written in English   - Empirical   - Discusses on gamification in physical activity   - Has findings on intrinsic motivation
Exclusion Criteria
- Not available in full-text   - Not written in English   - Discusses on gamification in something other than physical activity   - Only mentions gamification   - No findings on intrinsic motivation   - Low quality

● Literature reviews ● Duplicates

Table 5. A chart of the inclusion and exclusion criteria

For the sake of simplicity and to ease the workload, the study needs to be available in full-text and in English to be included. As this review focuses on results, the research in the studies have to be empirical. This also means that the non-empirical studies like literature reviews will be excluded. For the sake of quality, gray literature like proceeding papers and conference papers should be left out due to their unreliability, but Xiao and Watson suggest not to ignore these papers in case of publication bias occurring in this study (Xiao, Watson, 2017). However, I will exclude articles that are low in quality whether they're considered gray literature or not.
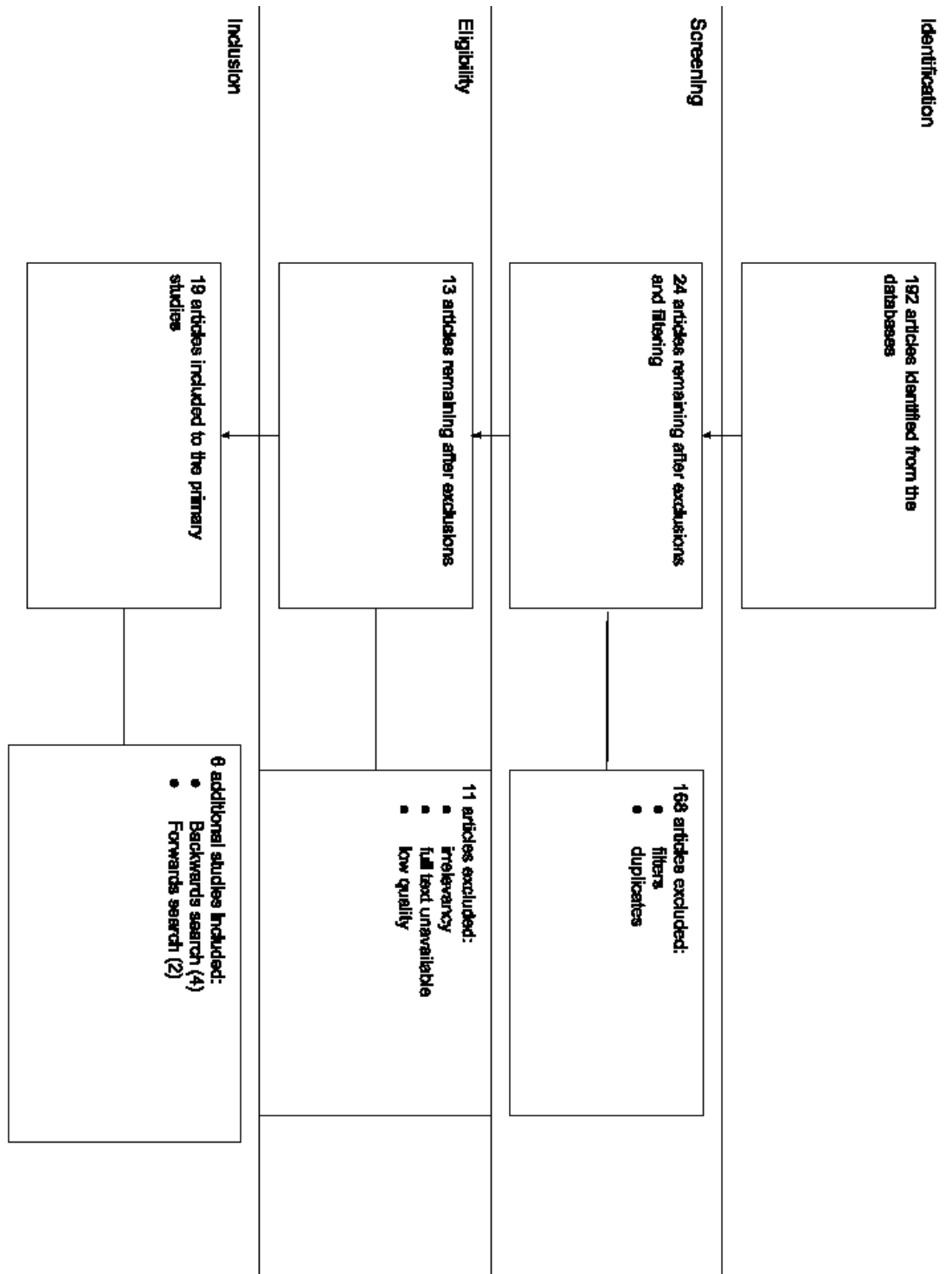
Figure 3. A flowchart of the study selection process.

Out of 192 articles only 19 articles made it to the primary studies. Most of the articles were excluded in the screening phase; a total of 168 articles were either filtered out or excluded due to being duplicates. In the eligibility phase, 11 articles were excluded due to being irrelevant to the subject of this study, not having a full text available or just being otherwise of low quality.

After the eligibility phase was complete, 13 articles remained. Out of these articles, a backwards and forwards literature search was made. For the backwards and forwards literature search I used Google Scholar. After reviewing the articles found in the searches,

I selected a total of 6 articles and included them in the primary studies. To compile the articles for the study selection process I used the Mendeley Reference Management tool.

3.2.3 Extract & Compile Data

After the primary study is complete, the data extraction process can begin. In the data extraction the main objective is to read through the studies and extract specific data to answer the study's research questions. For easier understanding, the extracted data will be compiled into a table. The table of extracted data will display the studies' authors, the motivational affordances present in the study, the study's research method and the results of the research concerning this intrinsic motivation.

In the results chapter, the findings from the data will be displayed in tables and different statistical graphics. The graphics will be generated by using Google Sheets. The necessary data will be input in the Sheets file and the graphic will be generated by using the data. The results are also explained in a textual form.

4. Results

In this chapter I will go through the results of the literature search and will include a brief analysis of the search results and a further analysis of the primary studies. I will also compare some of the data with the primary studies of previous similar studies to see if there are any major differences. A more detailed discussion of the results within the primary studies regarding the research questions will be disclosed in the next chapter.

In this study a total number of 19 articles were analyzed. From these articles I have extracted some of the metadata and the data related to the research questions.

4.2 Article publication

The majority of the articles in this primary study were published between the years 2019 and 2020 and the average number of articles per year is 2. The figure below displays the article frequency in a column chart. From this article it can be seen that the frequency of the articles took a sharp increase in the years of 2019 and 2020 and just as sharply decreased in 2021 and 2022.

The earliest published study was published in 2010. The frequency rose to two studies between the years 2014-2016 and then dipped back into 1 article in 2017. After 2017 there is a sharp increase in publication frequency. In 2019 there were a total of 4 studies published, followed by 5 published studies in 2020. After 2020 the frequency sinks back to 1 article per year. This literature search was performed in the spring of 2022 so there may be more studies by the time this study is published.
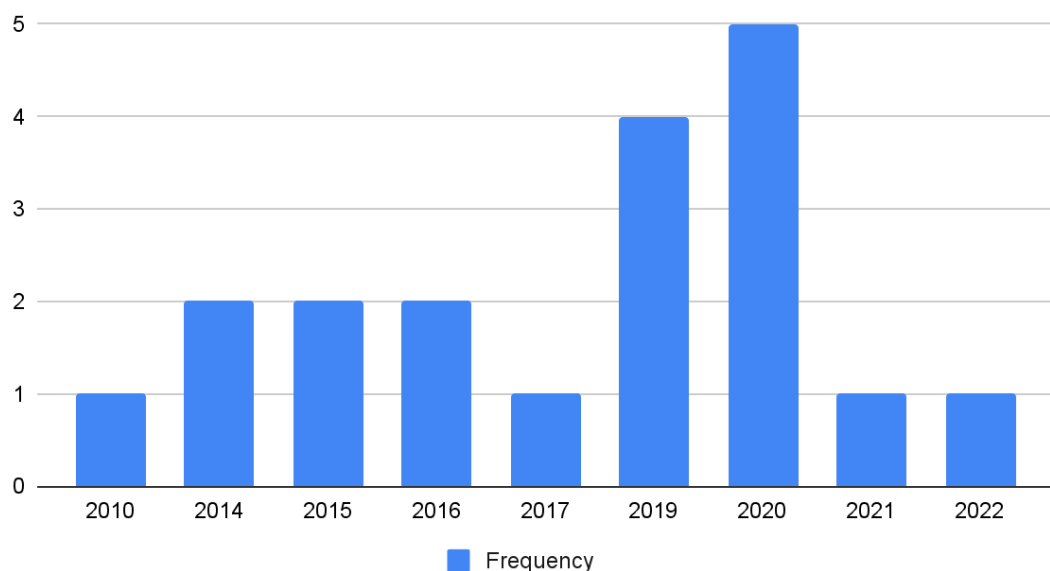

Figure 4. A column chart of the frequency of the primary studies' articles' publication years

The next figure displays the distribution of the types of publications of the articles in the primary study. Among the primary studies, 12 of them were published in journals, making

them the most frequent type of publication in this study. 6 of the studies were published in conference papers and finally only one study was a university thesis and was placed in the generic report category.
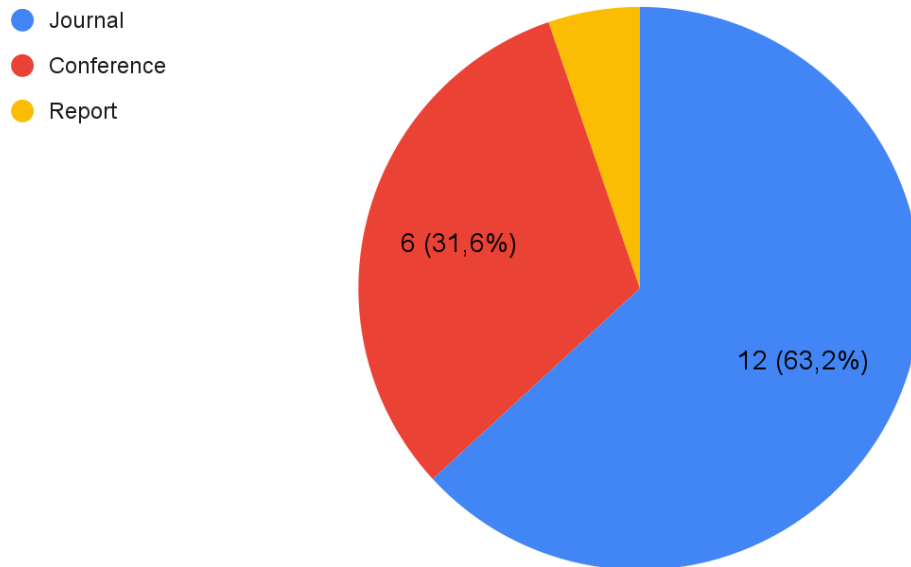
Figure 5. A pie chart of the publication types used by the articles in the primary studies

4.3 Motivational Affordances

In this subchapter I will go through the motivational affordances present within the primary studies. All 10 affordances present in the primary studies are listed in the table along with brief descriptions and the frequencies of the affordances in the studies with the studies including them in parentheses. The studies including the affordances are numbered according to the study list at the end of this chapter. Some articles may include multiple affordances.

The most frequent affordances within the primary studies were Competition, Social and Feedback. With Social and Competition affordances being so high it is quite surprising that Teamwork was less frequent than these two with only being included in 3 studies. Leaderboards were also surprisingly low on frequency, with only being in two studies.

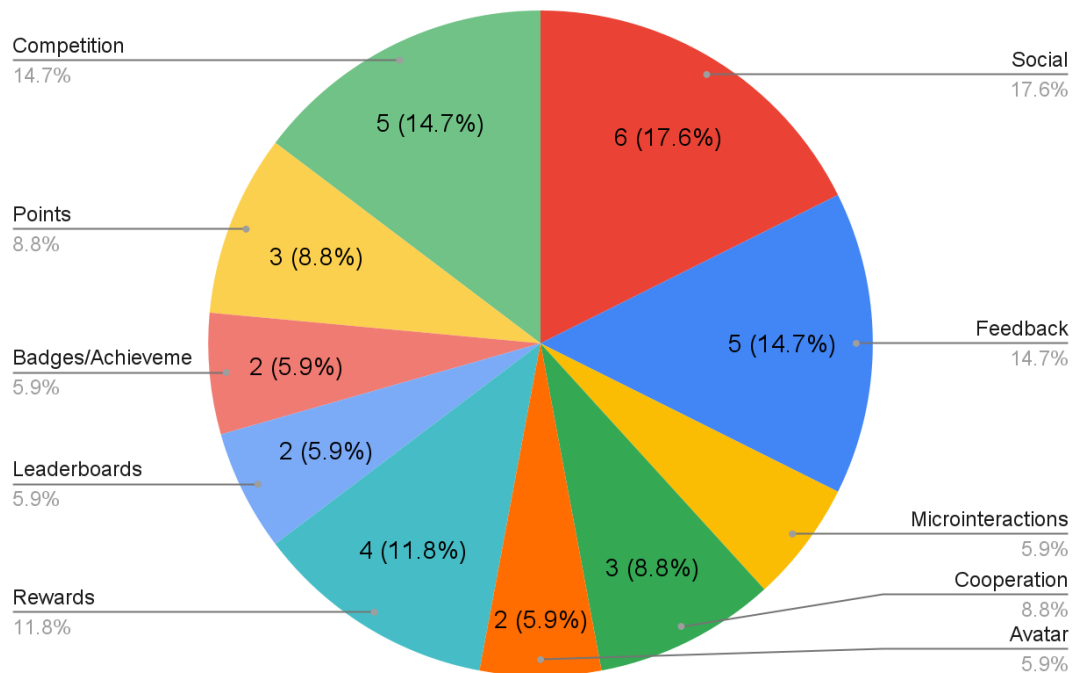| Affordance	Description	Frequency (studies including)
Avatar	A virtual representation of the player that is usually customizable.	2 studies (6, 14)
Badges/Achievements	Indicators of the player's accomplishments	2 studies (13, 15)

Competition	Setting of two or more players competing for a same goal	5 studies (1, 2, 7, 8, 16)
Feedback	Indicators of the player's actions which they can use to reflect upon	6 studies (3, 9, 10, 15, 17, 19)
Leaderboards	A descending list where players are ranked based on a certain value (e.g. points)	2 studies (8, 13)
Microinteractions	Interactable elements within the user interface	2 studies (3, 4)
Points	An indicator that increases from the player's actions. Used in different ways like leaderboards and in-game currency	3 studies (11, 13, 14)
Rewards	A reward the player received either by a certain action or purchasing with in-game currency like points	4 studies (10, 11, 12, 13)
Social	An element that lets the players interact with each other	6 studies (3, 5, 13, 15, 18, 19)
Cooperation	A setting of two or more players co-operating towards a shared goal	3 studies (2, 14, 18)

Table 6. A table of the motivational affordances present in the primary studies.

The frequencies of the motivational affordances are displayed on the figure below. The Social motivational affordance was included in 7 different studies, making it the most frequent affordance. Social is followed by Feedback with a frequency of 6 and Competition with a frequency of 5. The Rewards affordance was included in 4 different studies. Finally, the least frequent affordances in the main studies are Points and Teamwork with a frequency of 3 in both and Badges/Achievements, Leaderboards, Avatar and Microinteractions with a frequency of 2 each. Although the number of frequencies is not shown in the pie chart for Microinteractions and Avatar, the percentage is the same as the other affordances with a frequency of 2.

Motivational Affordances and their Frequencies

Competition
14.7%

Social
17.6%

5 (14.7%)

6 (17.6%)

Points
8.8%

3 (8.8%)

Feedback
14.7%

5 (14.7%)

Badges/Achieveme
5.9%

2 (5.9%)

Leaderboards
5.9%

2 (5.9%)

Microinteractions
5.9%

Cooperation
8.8%

4 (11.8%)

3 (8.8%)

Avatar
5.9%

Rewards
11.8%

2 (5.9%)

Figure 6. A pie chart of the motivational affordances included in primary studies and their inclusion frequencies

The primary studies are compiled and displayed on the table below. Starting from the left, the first column displays the authors of the primary study and the second one displays the publishing year of the study. The motivational affordances that are included in the study is shown in the third column. Finally, the last two columns give a brief abstract of the study's research and the findings of the research concerning this study's main concern, the intrinsic motivation.

Primary Study	Year	Affordance	Study	Findings
[1] Song H., Kim J., Elizabeth Tenzek K., Min Lee K.	2010	Competition	72 (38M/38F) divided into two groups, highly and lowly competitive groups and then again to competitive and non-competitive groups to play Wii Fit hula hoop game. Non-competitive members would enter into a random drawing for a $20 gift	Participants worked out harder in a competitive condition regardless of individual differences in competitiveness. However, the lowly competitive individuals enjoyed the exercise less. Competition

			card and the competitive members would compete for the card.	increases intrinsic motivation for the highly competitive individuals but decreases intrinsic motivation for the lowly competitive individuals.
[2] Novak D., Nagle A., Keller U., Riener R.	2014	Competition, Cooperation,	30 unimpaired, 8 impaired chronic stroke subjects, air-hockey game with ARMin robotics. Three modes: single player (player vs. computer), competitive (player vs. player) and co-operative (two players vs. computer). The participants filled out IMI questionnaires and a final questionnaire about game preferences and their personality.	The participants found the multiplayer modes (competitive and co-operative) more interesting than the single player mode as they could talk and play with another person. The preference between co-operative and competitive modes varied by person.
[3] Spiller F., Asimakopoulos S.	2014	Social, Microinteraction s, Feedback	Data was collected from 15 mobile app users and runners with an online diary study and short interviews.	Running apps with activity tracking can influence intrinsic motivation regardless of social or gamification elements. Authors claim that good quality social UX can improve motivation and poor social UX can damage the motivation.
[4] Garcia-Vergara S., Li H., Howard A.	2015	Microinteraction s	The researchers improved the game's graphics,	The participants found the newer version more

			added more features and gave more options to tailor the user's experience. 14 "able-bodied adults" were recruited to play both versions. The participants filled out the IMI questionnaires after each version.	interesting to play because of the options and better visuals. The IMI results indicate that the improved visuals improve the interest and enjoyment which then improve the player's intrinsic motivation.
[5] Hamari J., Koivisto J.	2015	Social	Data gathering from the users of Fitocracy using an online questionnaire, 200 respondents (98M/102F).	The findings suggest that social factors play an important role in sustaining behavior and continued use of motivational technology and exercise,
[6] Li B., Lwin M.	2016	Player avatar	322 participants, weekly exergame session for six weeks, the games include a player avatar, after the program the participants filled out a survey	The player avatar creates an immersion that the player is in the exergame environment, which makes the player relate to the avatar. This, according to the authors, positively impacts the player's enjoyment, which then positively impacts the player's intrinsic motivation to play the game. The authors finally conclude that the player's willingness to play the exergame is related to the exercise intention.
[7] Mackintosh K., Standage M.,	2016	Competition	36 participants (19m/17f) played	Men spent more energy in the

Staiano A., Lester L., McNarry M.			Wii Boxing for 30 minutes while wearing an Actiheart monitor. The participants were also assigned randomly to one of the two gaming orders: Dual-player game first or Single-player game first.	exergame compared to women but reported a greater negative effect and tension/pressure. Participants who played the dual-player game first spent significantly more energy compared to those who played the single-player game first.
[8] Shahrestani A., Van Gorp P., Le Blanc P., Greidanus F., De Groot K., Leermakers J.	2017	Leaderboards & Competition	Two pilots, 10 participants each. Teams were formed using the GameBus app during the testing period. The users competed with each other within the team or against the other teams by scoring points in sports apps and brain trainers. Points could also be collected by uploading pictures of activities that promote good health like drinking water.	75% of pilot A's participants were willing and interested in using the app within and outside the office hours. The remainder was unsure due to the state of the app during the testing. 63% of the group recommended the app to other colleagues, friends and family. Others would consider it after the usability limitations within the app are resolved.
[9] Attig C., Franke T.	2019	Feedback	210 users took a scenario- and questionnaire-based survey about the motivational effects of activity trackers.	Results indicate that the trackers create a dependency effect which is stronger for people with high extrinsic motivation for physical activity. The dependence effect was lower for the people with high intrinsic motivation for

				physical activity.
[10] Diefenbach S., Muessig A.	2019	Feedback, Rewards	Two studies about the counterproductive effects of Habitica's reward/punishment system 1) A qualitative interview study 2) A quantitative field study with 45 users in a two-week usage period.	All participants experienced counterproductive effects, some effects were more prevalent than others. The prevalence of these effects were correlated to the users' perceived inappropriateness of the reward system.
[11] Plangger K., Campbell C. Robson K., Montecchi M,	2019	Points, Rewards	Analysis of a health gamification system used by a major university. Users earn points from activities recorded by users' wearable fitness trackers which are connected to the system. These points could be redeemed for small rewards like hot beverages.	Users who redeem once or more lead to increases in point collection compared to those who do not redeem. The points collection rate increased on higher fitness levels.
[12] Smeddinck J., Herrlich M., Wang X., Zhang G., Malaka R.	2019	Rewards	A comparative study to determine whether the PACE with linked rewards can lead to an improved motivation in exercise performance compared to exercising and playing a game without linked rewards.	Traits related to intrinsic motivation like perceived competence, heart rate and willingness to perform exercises were increased when the game rewards were linked to the physical exercise.
[13] Feng W., Tu R., Hsieh P.	2020	Badges/achievements, Points, Levels, Leaderboards Rewards and	230 undergrads split into two groups, commensurate vs.	Findings indicate that the WeRun's users had higher intrinsic motivation than

			Social	incommensurate game elements. Group 1's app (Walkup) used badges, points, levels and rewards to motivate daily exercise and Group 2's app (WeRun) used roles, leaderboards and likes. Users filled out a survey after the period.	the users using Walkup. WeRun had higher levels of autonomy, perceptions of competence and evaluations of relatedness than Walkup.
[14] Ferriz-Valero A., Østerlie O., Martinez S., García-Jaén M.	2020		Points, Cooperation, Game Avatars	127 students were divided into two groups, gamified experimental group (62) and a control group (65). The participants filled out questionnaire to assess motivation before and after the intervention and performed a final exam to assess academic performance	Gamified implementation was deemed beneficial for academic performance but it did not increase intrinsic motivation
[15] Helmefalk M., Marcusson L., Sell A.	2020		Feedback, Badges/Achieve ments, Social	8 respondents took a questionnaire concerning the usage of digital coaches through the lens of Self-Determination Theory	Accurate measurement of exercise data helps the user to feel competence and the data makes it easier to decide the next step in improvement, making the exercises more fun. The virtual coach does not tell the user to do something, providing autonomy. Both competence and autonomy are an important part of Self-Determination Theory, which

					contributes to the intrinsic motivation. The gamification mechanics like badges and achievements did not increase intrinsic motivation as well as the feedback.
[16] Michael A., Lutteroth C.	2020		Competition	23 participants were split into two groups to play a cycling VR game. Group 1 had ghosts simulating their previous sessions and group 2 had none.	Beating the ghosts felt good but losing to them felt bad, making the experience more tense. Group 2 had no rewarding feeling of beating the ghosts but no pressure of losing to them.
[17] Nurmi J., Knittle K., Ginchev T., Khattak Fidaand Helf C., Zwickl P., Castellano C., Lusilla P., Costa-Requena J., Ravaja N., Haukkala A.	2020		Progression, Feedback	Behavior change app Precious was tested by 12 adults and they were interviewed. The participants' app interactions were video recorded.	The participants valued the autonomy supportive features
[18] Chan G.	2021		Social, Cooperation	3 studies, in the pilot study the author examined the prospect of matching players on personality. In the foundation study they attempted to find evidence to support the idea that matching players based on personality positively impacts motivation for continued play. Addon study examined player matching based on player types	Matching players using personal characteristics (personality & player type) can increase retention provided two conditions: persuasiveness of the features to engage player groups and commitment between players. Personality-based matching, socially satisfying features and tailoring gameful elements to

			and gamification elements that could support player group connectedness.	player type to increase social satisfaction can increase exercise motivation.
[19] Oc Y., Plangger K	2022	Social, Feedback	360M/240F filled out a survey concerning their motivational feature preferences, RAI and habitual usage.	Even though direct effect of motivation on habitual formation was not found, the relationship is found to be mediated by motivation technology characteristics. There is a significant direct effect of motivation on habitual use for female users however. Coaching, gamification and tracking are significant mediators with coaching being the most significant. Tracking and sharing is found to be more significant for older users.

Table 7. A compiled table of the articles in the primary studies with the data gathered from them.

5. Discussion

This study's main objectives were to find out if gamification could impact the user's intrinsic motivation for physical exercise and what kind of motivational affordances are used to develop such intrinsic motivation. In this chapter I will discuss the findings of the literature search from the perspective of this study's research questions:

- Q1. Does gamification impact the person's intrinsic motivation on physical activity?
- Q2. How does gamification impact the user's internal motivation on physical activity?

The discussion will be split into subchapters in which the motivational affordances present in the primary studies will be briefly introduced while highlighting some of the studies. The objective of the subchapters is to answer the research question Q2 by introducing the affordances then try to answer the question Q1 by evaluating the impact of the affordances according to the primary study results.

5.1 Competition & Cooperation

The analysis of the primary studies revealed the high difference of competition and cooperation. Within the primary studies, competition was among the most frequent motivational affordances with being included in 5 studies while cooperation was present only in 3 studies. Competition and cooperation could be considered a potent affordance for intrinsic motivation in gamification. However, while there was plenty of data to prove that competition has an impact on the intrinsic motivation for physical exercise, the data on cooperation was found inadequate and more research on that domain is required.

Novak et al. (2014) performed a study in which they wanted to find out whether two-player gameplay could be used to bolster a stroke patient's intrinsic motivation for rehabilitation exercises. In the study they provided an air hockey game that is played with two ARMin robot hands. The study included both competitive and cooperative play as well as single-player play.

According to the findings of the study, both impaired and unimpaired participants found two-player play more interesting than single-player play as they could talk with another player while playing. However, some preferred competitive play over cooperative play vice versa. The participants who preferred competitive play were shown to put more effort in their gameplay (Novak et al. 2014).

The results of this study suggest that competition and cooperation can be a powerful motivator thanks to the social aspect related to them. The preference between competition and cooperation seems to vary however and this preference could impact enjoyment and motivation.

In a study by Chan (2021) the participants were paired according to their personality types which was determined by a preliminary survey. There were in total of 10 different groupings: two pairs of Task-Oriented and Relationship-Oriented types (TO-RO), two pairs of Task-Oriented types (TO-TO), two pairs of Relationship-Oriented types (RO-RO) and four pairs of other unmatched types.

According to the results, the matched pairs were more agreeable to engage in challenges whether they were competitive or cooperative and their activity levels and retention remained consistent throughout the study whereas the unmatched group had high retention at the beginning but severely dropped by the end of the study. Finally, the results indicate that both task-oriented and relationship-oriented pairs enjoyed competitive challenges rather than cooperative challenges (Chan G. 2021).

Mackintosh et al. performed a study (2016) in which the participants played Wii Boxing on both single-player and dual-player settings. The participants were however randomly assigned to two groups. In the first group the participant would play the single-player mode first and then dual-player mode and the second group would do the opposite. The authors consider both modes inherently competitive. According to the results, the participants spent significantly more energy in the dual-player-first group compared to the single-player-first group (Mackintosh et al., 2016).

A study by Michael and Lutteroth (2020) explored the emotional impact of competition. In their study the two groups of participants played a virtual reality cycling game. In the first group the participants had ghost players within the race. These ghosts would simulate the player's previous cycling sessions. The second group had no ghosts. According to the findings, the participants on group 1 felt very satisfied when they beat the ghost players but felt bad if they lost to them. This fear of losing made the cycling experience more tense. Group 2 with not having ghosts at all didn't have the satisfying feeling of beating the ghosts but no pressure of losing to them either. The authors suggest that both of these scenarios should be combined to cater to both competitive and non-competitive individuals (Michael A. Lutteroth C. 2020).

Song et al. (2010) performed a study in which they wanted to find out whether competitiveness had any effect on intrinsic motivation. The 2x2 (competition vs non-competition x high competitiveness vs. low competitiveness) between-subjects design study consisted of 72 participants who were split into two groups: highly competitive groups and lowly competitive groups. Half of each group were then assigned to either a competition or a non-competition. Participants were tasked to play Nintendo Wii Fit's Hula hoop game. The members of the non-competition group would enter into a random raffle for a $20 gift card and the members of the competition group would have to compete for the gift card (Song et al, 2010).

Even though competition could be regarded as a powerful motivator, according to Song et al. (2010) it is not that simple. The research findings indicate that the competition made the participants work out harder regardless of the competitiveness but the lowly competitive participants worked only for the reward and found the exercises less enjoyable and evaluated the experience more negatively. This was also indicated by the lower exercise self-efficacy among these participants. In contrast, the highly competitive participants enjoyed the competition and were intrinsically motivated to exercise and upheld a positive mood (Song et al. 2010).

These findings of this study suggest that the competition can be a very powerful motivational affordance but it requires the users to be highly competitive for it to positively impact the intrinsic motivation. The competitive setting is not suitable for the lowly competitive individuals and can negatively impact the intrinsic motivation.

5.2 Feedback

Feedback was another highly frequent motivational affordance within the primary studies. After the analysis feedback was found to be included in 6 primary studies. With feedback the user can review their previous activities which can help clarify the progression and what the user should improve on next. This can be a powerful motivator. There were, however, some conflicting conclusions within main studies on whether feedback effects on extrinsic or intrinsic motivation.

A study by Spiller and Asimakopoulos (2014) discusses the usage of gamification in fitness apps and their impact on intrinsic motivation. The authors examined three different fitness apps which track the user's running activity. The data was collected from 15 mobile app users and runners with an online diary study and brief interviews. The study results indicate that the apps that track the runners' activity can impact the intrinsic motivation regardless of the app's social or gamification elements. However, the user experience can also impact the motivation. If the usability of the app is poor, it can severely damage the user's experience of using the app, which in turn can negatively impact the user's motivation to use the app itself (Spiller F., Asimakopoulos S. 2014).

Attig and Franke (2019) provided another study related to the activity trackers' impact on intrinsic motivation. The authors performed a study in which 210 users were given a scenario- and questionnaire-based survey. The survey results indicate that the activity trackers have a dependency effect. According to the survey results, when the activity tracker was not available, the motivation for the activity decreased. This dependency effect was reported to be especially prevalent among the users with high extrinsic motivation for physical activity. By contrast, the users with high intrinsic motivation were less dependent on the activity tracker. These results suggest that the activity trackers that provide feedback to the user impact the extrinsic motivation rather than intrinsic motivation (Attig C., Franke T. 2019).

A study by Helmefalk et al. (2020), however, provides a different angle on feedback's impact on intrinsic motivation. The authors examined the impact of digital coaching systems on the users' intrinsic motivation. They performed interviews with 8 respondents. The interview was made to examine the respondents' digital coach usage from the perspective of the Self-Determination Theory, specifically concerning the three needs of the theory: autonomy, competence and relatedness. The results indicate that the data provided by the digital coaching systems had a bigger impact on the intrinsic motivation than the other gamification elements within the system. According to one of the respondents, the sport became much more interesting when they could see data on their performance. This gives the user a perception of their competence, one of the needs for intrinsic motivation according to the Self-Determination Theory.

The feedback by the digital coaches themselves based on the data they've gathered was found to be insignificant compared to the actual coaches. The respondents felt that the digital coach was not adequate at giving them goals like an actual coach and they had to set the goals by themselves. The feedback, however, supports the respondents by providing the data which the respondents could use to perceive their progress towards the goal. The respondents were also reported to come up with their own rules using the data provided by the system. The chance to set the goals and rules by yourself gives the user autonomy which is another need in the Self-Determination Theory (Helmefalk M. et al. 2020).
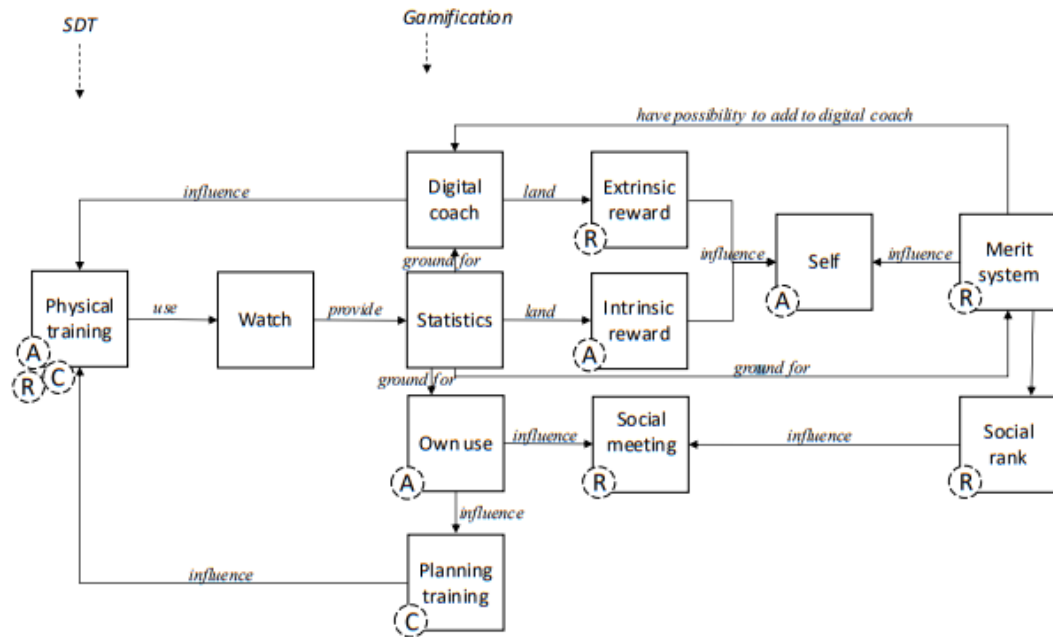
Figure 7. Model for individual's physical training and motivation with digital coaching system (A = Autonomy, C = Competence, R = Relatedness) (Helmefalk M. et al. 2020)

5.3 Social

According to the results, social elements were the most frequent motivational affordance. Social elements were included in 7 different primary studies. In the results chapter I defined social elements as a means for a user to interact with other users. Social elements are usually associated with relatedness, one of the needs in the Self-Determination Theory.

A study by Feng et al. (2020) performed a study where they compared Walkup, a fitness app with commensurate game elements like badges, points and rewards and WeRun, a fitness app with incommensurate game elements like roles, leaderboards and likes. According to the results, the participants using the WeRun had stronger intrinsic motivation compared to Walkup. The authors claim that the social elements in WeRun like 'likes' provide the users the relatedness of the Self-Determination Theory (Feng W. et al. 2020).

In the previously mentioned study by Helmefalk et al. (2020) the authors found that social elements played an important role for some of the respondents of the study. The social elements in the coaching systems use the before mentioned exercise data and turn it into something comparable. With the social elements the users can compare their data with other users' data. According to the results the respondents compared their exercise data with family, friends or acquaintances. This comparison, according to the authors, gives the user a feeling of belonging to a group, supporting the relatedness in Self-Determination Theory. However, the authors also found that some respondents did not care for the social elements which could, according to the authors, mean that social elements could bring a risk of hurting intrinsic motivation for some individuals (Helmefalk et al. 2020).

A badly implemented social element could also bring down intrinsic motivation. According to Spillers and Asimakopoulos (2014) the gamified sports apps cannot simply

rely on social elements alone. The authors also claim that poor social user experience can even discourage the use of the app altogether (Spillers F., Asimakopoulos S., 2014).

Hamari and Koivisto performed a data gathering (2015) from the users of a fitness app Fitocracy. The authors found that social influences, different forms of recognition like likes and reciprocity can positively influence the user's attitude and intrinsic motivation to exercise. The authors say that especially groups can be effective at positively influencing the user's motivation. They also claim that this effect gets stronger the bigger the group is (Hamari J., Koivisto J., 2015). The social influences and groups are related to the relatedness of the Self-Determination Theory previously mentioned in the study by Helmefalk et al. (Helmefalk et al. 2020).

As social elements involve two or more people interacting with each other, the personality and the attitude of the people can impact the effect of the element. According to Gerry Chan, matching players by their personal characteristics like personality and player type can positively impact the user retention but the social features need to be persuasive enough and the interaction requires commitment from both players (Chan G. 2021).

5.4 Rewards

In the primary studies, four studies were identified to discuss the reward as a motivational affordance. Although rewards are considered to be more related to extrinsic motivation, some of the primary studies report that there is some connection with rewards and intrinsic motivation.

Plangger et al. (2019) performed an analysis of a health gamification system used by a major university. The results imply that rewards do increase the physical activity levels but the authors also mention the negative impact the extrinsic rewards could potentially have on intrinsic motivation. However, the study's results indicate that the positive impact of the rewards is larger for the physically advanced users who redeem multiple times for the high-cost rewards. The authors suggest that the redemption delay caused by collecting points for the high-cost rewards mitigates the aforementioned negative effect of the extrinsic rewards (Plangger K. et al. 2019). This study suggests that although the rewards don't boost intrinsic motivation, it does not diminish it either if implemented correctly.

A study by Smeddinck et al. (2019) performed a comparative study to find out if PACE , pervasive accumulated context exergames, with linked rewards had any positive impact on the user's intrinsic motivation. According to the results, the linked rewards had no perceived negative impact on intrinsic motivation but the authors found some dimensions of intrinsic motivation measures. The authors found that measures that could be related to intrinsic motivation like perceived competence, heart rate and willingness to perform exercises were increased when the game rewards were linked to a prior physical exercise session (Smeddinck et al. 2019). This study's results regarding rewards' impact on intrinsic motivation were rather lacking and more research is required.

In the previously mentioned study by Feng et al. the authors found that Walkup, the fitness app that used commensurate game elements like rewards, were impacting the user's extrinsic motivation rather than intrinsic motivation compared to the second fitness app WeRun (Feng et al. 2020).

5.5 Microinteractions

For microinteractions there were only two articles they were included in and they were more related to the user experience's impact on intrinsic motivation.

Sergio García-Vergara et al. performed a study (2015) about the effects of improved microinteractions on intrinsic motivation. The authors worked on improvements on a serious game called Super Pop VR and then conducted user studies in which they examined how the study participants would rank the visuals of the improved version of the game by using the Intrinsic Motivation Inventory (IMI). The authors focused on assessing the participants' interest/enjoyment, perceived competence, effort/importance, pressure/tension and value/usefulness to measure the effects of the improved microinteractions on the participants' intrinsic motivation.

According to the authors, interest is a catalyst to intrinsic motivation and the results indicate that the new version promoted more interest than the original one and this led to the participants putting more effort in playing the game (García-Vergara S. et al. 2015).

5.6 Badges & Achievements

Badges and achievements were combined into one category as they are closely related to each other. In the primary studies there were only two studies that included badges and achievements and neither of them showed any positive results.

The gamified rewards like achievements and badges present in the study by Helmefalk et al. (2020) were not regarded as motivating as feedback and the authors described them as merely 'amusing visual components'. One of the participants reported that the virtual coach would tell them that they're an overachiever and display fireworks and buzz upon reaching goals. These did not evoke any strong feelings on the participant. The authors conclude that the achievements failed to impact intrinsic motivation but remained as an extrinsic reward. It is, however, pointed out that the achievements did not have any disrupting effects on intrinsic motivation (Helmefalk et al. 2020).

In the study by Feng et al. (2020) badges were among the commensurate game elements present in the fitness app Walkup. As it was previously mentioned in chapter 5.3, the fitness app Walkup had a weaker impact on intrinsic motivation compared to WeRun, the fitness app using incommensurate game elements. The authors in the study come to the same conclusion as Helmefalk et al. ; badges and achievements operate as extrinsic rewards and do not impact the user's intrinsic motivation (Feng et al. (2020).

5.7 Player Avatar

Player avatar was another motivational affordance that was rarely present in the primary study. Although there were two studies that included player avatars, only one of these two provided substantial findings on the player avatars' impact on intrinsic motivation.

In the study by Benjamin Li and May Lwin (2016) the authors propose an exergame motivation model that is based on Social Cognitive Theory. According to the theory, the user can learn through an enactive experience. The authors depict the enactive experience as a moment when the user learns by first doing something and then seeing the consequences. According to the authors, a player avatar could provide these enactive experiences. 322 students participated in a six-week program in which they played an

exergame session once a week. The exergames used in the session had player avatars in them. To measure the results the authors decided to use Intrinsic Motivation Inventory.

The study's results suggest that the self-presence the user experiences by seeing and controlling their avatar was positively associated with identification and this effect is stronger the more they identify with the avatar. This identification, according to the authors, was positively associated with user enjoyment which then positively impacts the exergame intention. Finally, the authors suggest that the exergame intention is related to the exercise intention (Li B., Lwin M., 2016).

Affordance	Studies	Impact on Intrinsic Motivation
Competition	[1][2][7][8][16]	There is impact but it depends on the individual. The impact is positive for the competitive individuals and negative for non-competitive individuals.
Co-operation	[14][18]	The social aspect can positively impact the intrinsic motivation.
Feedback	[3][9][10][15][17][19]	Feedback is related to the need of competence in the Self-Determination Theory, positively impacting intrinsic motivation.
Social	[2][3][5][13][18][19]	Social is related to the need of relatedness in the Self-Determination Theory, positively impacting intrinsic motivation.
Rewards	[10][11][12][13]	Rewards impact extrinsic motivation rather than intrinsic but does not negatively impact intrinsic motivation either.
Microinteractions	[3][4]	Interest and enjoyment could act as a catalyst to intrinsic motivation.
Badges & Achievements	[13][15]	Impacts extrinsic motivation rather than intrinsic.
Player Avatar	[6][14]	Self-presence is positively associated with identification which is positively associated with user enjoyment which then positively impacts exergame intention. Exergame

		intention is related to the exercise intention.

Table 8. A summary of the motivational affordances, the primary studies they're included in and their impact on intrinsic motivation

6. Conclusion

This study's main objective is to investigate the potential of using gamification to promote physical activity. Specifically, the study aims to examine the usage of gamification in physical activities and the used gamification's effect on the user's intrinsic motivation to be more physically active. This study's research questions were the following:

- Q1. Does gamification impact the person's intrinsic motivation on physical activity?
- Q2. How does gamification impact the user's internal motivation on physical activity?

On the basis of the systematic literature review and the analysis of the results from the review it can be concluded that gamification can have a positive impact on the user's intrinsic motivation to be physically active.

For the data collection I performed a systematic literature review. One of the primary reasons for this choice were time constraints and previous experience of literature searches from courses and the bachelor's thesis. I used Scopus, Web of Science and ScienceDirect as the data sources as they were suggested for the field gamification is related to. As the scope of the study is quite narrow, there were plenty of articles from the initial results that had to be dropped. The finalized search string managed to refine most of the search results but on further examination there were expectedly a couple of more articles that had to be dropped.

According to the results, the motivational affordances where the users interact with each other like competition, cooperation and social elements are the most powerful influencers on intrinsic motivation. However, the effect competition can cause varies from person to person. The results indicate that the person's competitiveness can determine whether the competition can boost intrinsic motivation or hinder it. The results also indicate that feedback can positively impact the user's intrinsic motivation. This conclusion is based on the Self-Determination Theory. Even though the results indicate that multiplayer activity has a powerful impact on intrinsic motivation, there was insufficient data on cooperation to make adequate conclusions compared to competition. The future studies could perform more research on the cooperative side of the multiplayer activities. Future studies could also provide more data on the usage of a player avatar to provide intrinsic motivation.

This study shows that competition and cooperation within gamified apps can be a really powerful physical activity motivator to the individuals who prefer multiplayer aspects of exergames. However, this study also proves that the more independent motivational affordances like feedback can be really effective as well. These insights can help the application designers to create exergame designs that can benefit both extroverted and introverted individuals.

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