Exploring gamification in team sports: A scoping review and research agenda

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Abstract

While team sports play a pivotal role in societies around the world, we recognize a concerningly high dropout rate among young people in organized sports clubs in recent years. Research indicates that a central reason is the declining enjoyment of conducting team sports over time. In parallel, digital games have become one of the most popular leisure activities globally. Thus, gamifying team sports, i.e. the integration of design elements of digital games into team sports, is considered a promising way to re-boost the motivation of individuals in sports. However, while digital games and team sports are closely intertwined phenomena, we lack a structured understanding of how aspects of gaming can be utilized to benefit team sports and what avenues future research in this area should pursue. Therefore, in this paper, we present the results of a scoping review examining the emerging field of hybrid forms that combine digital games and team sports into gamified team sports. This paper highlights the significant potential of merging digital games into team sports to promote athlete engagement and motivation. Further, the findings reveal a need for further research and innovative approaches to unlock the full spectrum of benefits this fusion of gaming and team sports offers. Therefore, we provide a research agenda that can serve as an anchoring point for future research.

Keywords

games, gamification, exergames, sports, team sports

1. Introduction

Team sports are an essential part of human culture and play a crucial role in many societies worldwide. From ancient times to modern times, team sports have been a source of entertainment, a driver for people to engage in physical exercise, and a way to bring people together regularly. However, while TV viewer numbers all over the world show a globally great interest in team sports, such as during the recent soccer World Cup or the American football Super Bowl [1], there is a noticeable decline in active participation in these sports [2,3]. Especially the dropout rate in organized sports in adolescence is very high. Research indicates that various discrete factors cause the decision to quit, which can be summarized into five primary sources: lack of enjoyment, perception of competence, social pressure, competing priorities and physical factors [2]. As enjoyment is the number one reason for people to participate in sports activities [2,4,5], it is not surprising that individuals stop engaging in team sports because the activity becomes unenjoyable over time [5]. In Europe, the recruitment and especially the retention of members is reported to be a significant challenge by more than a fifth of the

sports clubs [6]. With the COVID-19 pandemic, the quitting rate even further increased [7].

In parallel, digital games are increasingly gaining attention in society and have not only become one of the most popular leisure activities in recent years but have also penetrated areas such as education, culture, health, work, and especially sports [8]. Further, gamification, which refers to *'the use of game design elements in non-game contexts'* [9] in order to enhance motivation in an activity and even change behavior [10], is increasingly applied in individual sports [8]. Previous studies indicate that gamification can increase athletes' enjoyment and continued participation in various forms of exercise [8,11–13] and that users already expect digital applications for sports to be gamified [14]. As a consequence, we see an increasing number of gameful solutions in the app stores that aim to engage people in specific physical activities [15], such as taking more steps per day, going running or cycling, by using game design features such as captivating stories, competitions or rewards. Previous research at the intersection of digital games and sports has yielded a plethora of studies and reviews focusing on the gamification of sports, which extensively explore and document this fusion [13,16,17]. Surprisingly, the intersection of games and team sports has hardly been considered so far,

although combining the two phenomena has the potential to boost the motivation and enjoyment of participating in team sports and offers a chance to ensure the survival and prosperity of youth sports by addressing the number one reason for quitting [18]. Additionally, a lack of structured guidance for future research on the interwoven phenomena of digital games and team sports prevents us from gaining a more detailed understanding of the existing relationships, interactions and yet untapped potential. Therefore, we are conducting a scoping study to structure the field, identify initial approaches and overlaps, and provide anchor points for future research in this emerging research area.
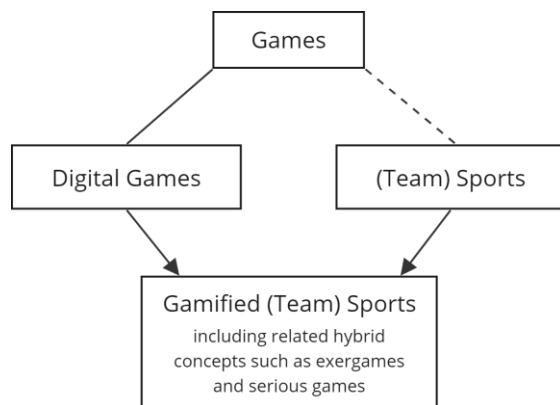

Figure 1: Conceptual mapping of the roots of the phenomenon of gamification of team sports.

2. Conceptual framework

Guided by the goal of our research, it is of great relevance to first investigate to what extent the parallel but closely related concepts of team sports and (digital) games differ in their origins and what similarities exist. In recent decades, various philosophers and scientists have addressed this question in order to contribute to a better understanding of these interwoven phenomena. While reviewing the literature on this topic, we mapped the relationships between the two disciplines into a conceptual framework, depicted in Figure 1.

2.1. Games

One of the first famous approaches to defining the term *game* is the attempt by Wittgenstein [19]. He denied that there is any common feature in the multifaceted approaches we call *game*, pointing out that the meaning of the term is not as simple as it sounds. He rather suggested clustering games into families dependent on the presence and absence of the characteristics of *strategy* and *luck*. Roger Caillois later separated between *paidia* as playfulness and *ludus* as formal, rule-based game behavior [20].

To this day in literature, there are numerous definitions of the term *game*, and between them, a lot of discussions and critics [21]. One more precise and widely used definition originated from Suits [22]:

'to play a game is to engage in activity directed toward bringing about **a specific state of affairs**, using only **means** permitted by specific **rules**, where the means permitted by the rules are more limited in scope than they would be in the absence of the rules, and where the sole reason for **accepting such limitation is to make possible such activity**'

In other words, he reduces the construct of *game* to four defining factors: a goal, means, rules and lusory attitude [23]. This concept is very broad but has been considered as a common basis for the two related phenomena of team sports and digital games, which is why it is placed at the top of the conceptual framework in Figure 1.

2.2. Digital games

Games are a formative part of human culture [24]. People have always played games and continue to do so in modern times, not just in analog forms but also in digital games. The invention of the TV in 1909 laid the foundations to bring games into a digital world. The 1970s and 1980s was the great period of arcade games and home gaming, after the first PC games came out. Since 2007 casual gaming even on smartphones became common and latest since then digital games became part of our everyday lives. *Digital games*, as games mediated through digital media, are therefore a subcategory of the broad concept of games and are presented as such on the left side of the framework in Figure 1.

Beyond the defining factors found by Suits [22], digital games are a multifaceted, continuously evolving phenomenon that can include a large variety of mechanics and features that induce these unique gameful experiences that excite people about games. A specific subset of digital games worth highlighting in our case are multiplayer games. Multiplayer games and modes (i.e. multiplayer expansions of primarily single-player games) utilize specific mechanics and features to asynchronously or synchronously connect people in play. These features can be split into *cooperative* approaches like team challenges, for which multiple players have to work together to reach a shared goal; *competitive* approaches when players have the individual goal to obstruct the goals of other players; and *cooperative-competitive* approaches like team competitions, in which groups of players have the shared goal to obstruct the goals of others [25]. Although digital games and team sports are usually considered as separate phenomena, they have many similarities. Commonalities can be found in their specific goal structures, rules and design features, in particular in the case of multiplayer games. However, team sports are also often used as a source of inspiration for digital games, such as FIFA or Madden NFL [26,27].

2.3. Sports and team sports

Analogous to the umbrella term *games*, the term *sports* is also used in a sprawling way to cover a wide range of concepts. It is a colloquial term used worldwide since the beginning of the 20th century, making it

difficult to find a comprehensive and precise definition of sports [28]. Nevertheless, there are attempts such as in the Oxford dictionary of sport science and medicine [29], which defines sport as 'structured, goal directed, physical activity governed by rules, which has a high level of commitment, takes the form of a struggle with oneself or involves competition with others'. The dictionary also describes characteristics of play and external rewards combined with intrinsic satisfaction from the activity itself as sources of motivation. This definition describes some aspects that are reminiscent of the definition of a game, such as goals and rules, which shows that the two concepts are somehow related. Furthermore, human activity, which serves physical and mental exertion, is a crucial part of the concept [30,31].

Team sports are an integral part of human culture in various societies around the world, which is why this subset of sports is worthy of special attention. In team sports, individuals are organized into opposing teams consisting of at least two players, and the teams play against each other [31]. The most popular team sports worldwide, based on TV viewer numbers, include e.g. soccer, cricket and hockey [32].

According to Suits, 'sports are essentially games' [23], fitting into his definition of games cited earlier in this paper. To differentiate sports, he added further distinctive elements of sports compared to other types of games: (1) sport is a game of *skill*, (2) the skill is *physical*, (3) the game has a *wide following* and (4) achieved *stability* [23]. He later proposed a distinction between sports that are *refereed games* and sports that are not games but *judged performances*, revising his first definition to classify all sports as games [33]. Refereed games in his definition, are sports such as soccer or basketball, which have constitutive rules, as opposed to diving or figure skating (judged performances), which have no constitutive rules but focus on performance. However, Suit's revised definition sparked a philosophical debate with scholars, such as Meier, Kretchmar, and Hurka all rejecting Suit's revision and arguing for his first definition that all sports are games [34–36]. This indicates that the dominant view among scholars is that all sports are games. For this reason, the term *(team) sport*, like digital games, forms a subcategory of games in the framework in Figure 1. However, since scholars diverge on this point, the connecting line remains dashed.

2.4. Gamified sports

While a main difference between digital games and team sports is that sports commonly require physical skills and digital games are used via digital media, there has recently been a rise in hybrid forms, which combine aspects of digital games with physical sports. Such approaches are often called exertion games or exergames, meaning digital games or gameful systems for exercise [13], which can be grouped under the umbrella term of gamification [37].
Gamification refers to the use of game design elements to transfer any activity into one that affords additional gameful experience [37]. In individual sports, there are numerous examples of applications in which

gamification has been applied to extend physical activity with gameful experiences, such as Ring Fit Adventure for Nintendo Switch, where fitness exercises are embedded into a video game [38] or the smartphone app Zombies, Run! motivating runners with captivating narratives [39]. These applications are mainly used by individual athletes. However, there are also applications with integrated multiplayer modes, such as Zwift, that cyclists can use to interact and ride with other cyclists virtually or compete in virtual races [40]. Considerable research has already been carried out in this area, even focusing on various technologies, including wearables and Virtual Reality (VR) [13,16,17]. Such gamification can make sports more enjoyable and even improve performance [8,12].

Based on the positive findings on the use of gamification in individual sports, potential benefits on motivation and performance in team sports can be assumed [8,11,12]. Further, we recently see an increasing interest of people in innovative forms of gamified team sports, such as various fantasy sports apps like NFL Fantasy or Fantasy Premier League [41,42], in which the users can build virtual teams and compete against other players based on the performance of professional real-world matches, or an American football league, where fans control the plays online to make watching the game more enjoyable [43]. Finally, there are many potential use cases for using gamification in team sports, such as applications to improve physical skill in team sports training with exergames or to improve cognitive skills with serious games, which can be games focusing on sports-related education or raising awareness of specific topics in team sports [44]. Although evidence from individual sports and practice suggests that gamification can also bring many benefits in team sports, we lack a structured understanding of the current body of knowledge in this field and guidance for future research to advance our understanding of these new hybrid forms of gamified team sports and to better support practitioners in leveraging existing opportunities. Therefore, this paper presents a scoping review guided by the following research questions:

- **RQ1: How has existing research applied gamification in team sports?**
- **RQ2: What benefits and challenges of using gamification in team sports contexts have been identified in existing research?**

3. Research method

The purpose of this scoping review is based on two common reasons according to Arksey and O'Malley [45]: First, this study aims to investigate the above-defined research questions by synthesizing the existing body of knowledge related to the intersection of team sports and digital games in order to clarify how game design features are employed in hybrid forms combining digital games and team sports as well as whether and what game design features are beneficial in different contexts of such hybrid forms. Second, this study strives to identify key anchor points and directions for future research in this area. We adopted the framework of Arksey and O'Malley [45] to conduct

a scoping review and followed the five mandatory stages enhanced by recommendations of Levac et al. [46]: (1) defining a clear research question, (2) identifying relevant studies with a balance of breadth and depth, (3) iteratively selecting studies, (4) charting the data and (5) analyzing, reporting and considering the meaning of the findings.

The search string development was guided by our research questions and focused on gamified team sports, i.e. hybrid formats of the two disciplines, digital games and team sports. To identify relevant keywords, we conducted initial pilot searches and developed our search string iteratively. The final search was:

TITLE-ABS-KEY ((gamif* OR exergam* OR "extertion game" OR "extertion games" OR "serious game" OR "serious games") AND ("team sports" OR *ball OR soccer OR rugby OR hockey OR "water polo" OR cricket OR curling OR bobsleigh))

The search string covered the term 'team sports' and any permutation of the term gamification, exergame or serious game, covering the discipline of digital games in a way that is usually used in conjunction with other disciplines.

Further, in order to find relevant literature in the field that focuses on a specific form of team sports but may miss using the keyword *team sports*, we included the names of popular team sports listed in the summer and winter Olympic games [47] and additionally included cricket, which is not listed as Olympic discipline, but very popular in some countries, such as India or Pakistan [32]. We needed to balance the breadth and depth of the resulting literature to provide a comprehensive and meaningful overview of the field. Therefore, we decided not to include search terms for esports, which can also be seen as a mix of sports and games. This specific phenomenon has recently received great attention in the scientific literature, and many reviews already exist which provide an overview of the scholarly work in this field (cf. [48–50]). Therefore, and because the primary focus of this review is on physical sports, we decided not to include any esports-related search terms in our search string.

We limited the literature search to the metadata (title, abstract or keywords), as searching for the terms in the whole text would result in a large amount of false positives mentioning one of the searched terms without being a central aspect of the paper. We used the Scopus database as our source of data since it contains the most potentially relevant databases in the area around games and sports. The literature search in the Scopus database was conducted in July 2023.

The Scopus search query resulted in 246 hits. These contained 29 conference reviews and two literature reviews, which do not provide self-contained research contributions, so we excluded them from the literature review. We screened the resulting 215 papers for inclusion and relevance by the iteratively developed inclusion criteria: (1) screening of the title and abstract indicates that gamification in any connection with a team sport is a relevant topic in the paper; (2) the paper is in English; (3) the full text can be acquired; (4) a full paper screening shows that gamification in any connection with a team sport is a relevant topic in the paper.

Therefore, we excluded 126 papers based on their title and abstract not containing team sports and a form of gamification. For instance, we found that the term *ball is used in various other contexts such as Schuller [51] gazing into a crystal ball or Mizuyama et al. [52] speaking of a snowball effect. Furthermore, we excluded eight more papers not available in English and five where the full paper was unavailable. After reading the full text of the remaining papers, we excluded additionally 15 papers not containing team sports, such as Kaisar et al. [53] inventing a new collaborative sports like game but not fitting our understanding of team sports, or a paper missing a concrete proposal for the use of a developed motion recognition technique of tennis players in games, such as Bačić [54]. At the same time, we excluded 33 papers describing gamification features associated with team sports, complementing other contexts such as education or health, such as Cerqueira et al. [55] designing an Augmented Reality soccer game that supports the learning of basic mathematical functions or Amprimo et al. [56] evaluating the effectiveness of a soccer themed game for Parkinson rehabilitation. Finally, we included the remaining 28 papers in the scoping review: [57–84].

We created a charting table to investigate the pool of papers in a deductive and iterative manner. We extracted the papers' information regarding bibliometric information, descriptive information about the context and design of gamified systems described in the papers, empirical work conducted, and their findings. The charting table serves as the basis for the results section. The most relevant findings are presented in tables in the following section.

4. Results

4.1. Bibliometric information

As a first step, we examined the bibliometric data of the 28 included papers. In 2011 initially the first paper combining digital games and team sports was published. Notably, the investigated research field has developed in parallel with other research on gamified information systems, which also started in 2011 [8]. The number of papers increased in the following years, from one paper each in 2011 and 2012, to two papers each in 2014 and 2015, to three papers in 2016. This trend was interrupted in 2017, when no paper was published, but continued in the following years with one to three papers per year again until 2021. Afterwards, there is a noticeable upward trend as shown in Figure 2. In 2022, six papers were published, followed by an additional five by July 2023.

Most papers were published at conferences and in journals related to games, HCI and computer science (18 papers). Further three papers were published at conferences and in journals related to medicine and sport sciences. The remaining articles were published in venues related to social sciences (3), psychology (2), and engineering (1), or were multidisciplinary (1).

More than half of the papers were published as journal articles, starting with the first one in 2011. The number of journal articles kept low with maximum one

paper per year until 2021, as illustrated in Figure 2. Four journal articles were published in 2022, and five journal articles were published in 2023 by the time the review was conducted in July, indicating an increasing trend. The remaining 13 papers were published at conferences in varying numbers between zero and two per year. However, a slightly decreasing trend of conference papers is visible since 2019, and in 2023 no conference paper was published by July.

The bibliometric descriptors of the reviewed literature show an increasing amount of research that has been published on the topic of gamification, such as exergames, serious games and gamification solutions connected to team sports. Since the number of literature on gamification in general shows a steadily increasing trend [8], we also expect to observe a growing number of research papers for the future combining digital games and team sports, as indicated by Figure 2. The rising number of journal papers over the last year indicates greater interest and in-depth research on that topic in the future.
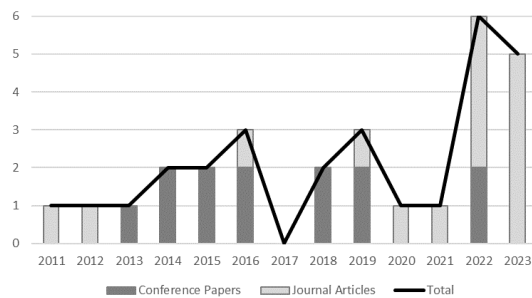

Figure 2: The number of publications per year split into journal and conference papers.

4.2. Identified topics

Members of universities conducted the projects addressed in all reviewed papers. Some projects additionally consulted sports experts outside universities [57,80] related to the topics addressed. Surprisingly, compared to the large amount of academic attention devoted to the gamification of individual sports, only 28 of the reviewed papers address systems intending to gamify team sports. They address mainly soccer (12), but also basketball (4), handball (3), tennis (3), volleyball (2), baseball (2), rugby (1) or various team sports at once (4). The applications described in the papers mainly focus on a specific aspect of the athletes' training, like practicing basketball free throws in a VR simulator with enhanced visual guidance [58], thus only covering certain facets of sports. The single facets of the respective team sport addressed were various, as shown in Table 1, such as practicing concrete ball throws or tennis swings with simulators, teaching sports values with ratings transferable in a virtual game or avoiding injuries by engaging habit tracking. Most of these gamified applications build a separate training block not fully included in the regular training routines and is merely seen as an addition to standard training, like VR basketball training [58,59] or computer games such as eFootball PES [85] used to

improve tactical skills [70], what is caused by technology constraints. While the majority of studies focused on gamifying athletes' training, three papers focused on the training of referees [80], sports journalism [81] and the involvement of the audience during public matches using fan tokens [82].

Table 1

Topics addressed in the described applications.

Topics	Count	%	Papers
Training of physical skills and sports-related core activity			
Throws/swings/kicks	7	26%	[57–63]
Duels	1	4%	[64]
Ball handling	1	4%	[65]
Training of sports-related cognitive skills			
Cognitive skills	4	11%	[66–69]
Tactical skills	2	7%	[70,71]
Reaction time	1	4%	[72]
Activities related to increased athlete's health and well-being in sports			
Sport values education	4	15%	[73–76]
Avoid injuries	1	4%	[77]
Rehabilitation	1	4%	[78]
Sports-related knowledge acquisition			
Basic knowledge	1	4%	[79]
Referee training	1	4%	[80]
Involvement of fans and spectators			
Sport journalism	1	4%	[81]
Audience engagement	1	4%	[82]
Not specified	2	7%	[83,84]

4.3. Gamification in team sports

The systems and technologies used to gamify team sports are various, led by standard computer games, as seen in Table 2. Some applications use technologies, such as marker-based tracking, to track users' motion data to be able to involve full body movements in the gamified approach [54,60]. Other applications track inputs on hit or light-sensitive surfaces, triggered mainly by ball hits. Two papers also mention using VR systems to present fully immersive games. Other technologies, like game consoles, Smartphone apps and Fitlights, which is a commercial multifunctional light-based system for sports training [86], were rarely used. One paper uses a very specific medical device, a TecnoBody ProKin, for balance training with an attached touch display to gamify rehabilitation training for athletes with back pain [78].

While the technologies used to gamify team sports are diverse, the gamification features used follow the patterns identified in related reviews of the use of gamification in other contexts [8]. Overall, game design features were not discussed in detail. However, it is worth noting that many of the features described were used to create immersion in team sports, for example, by using specific themes or environments known from team sports, such as a soccer field as the design of a virtual game board [80]. Additionally, it is noticeable that points, scores and leaderboards are widely used

in the systems described, as in other areas [8]. Most studies implemented game designs related to the sport itself, like virtual soccer matches [76] or practicing basketball or handball throws [59,67] or penalty shots in soccer [68]. Most approaches award players with points. Surprisingly only six of the reviewed papers included multiplayer approaches in their applications. Four of them mentioned pure competitive modes. Two papers describe a system where competitive and collaborative interactions are possible. In a basketball application, several people can interact virtually on a virtual basketball court, free in their decision how to play together, collaboratively or competitively [59]. Another paper adds gamification features to standard handball training, where cooperation and competition usually are part of the game [71]. Other 18 papers describe systems that can only be used individually. The remaining four did not describe a concrete game. They focus on a technical invention, a sports activity recognition system for exergames in VR, or they describe first ideas but without details on the game design.

Table 2
Systems and technologies used to gamify team sports.

System and technology type	Count	%
Computer or web-based games	6	22%
Virtual Reality systems	5	19%
Marker or suit-based motion tracking	4	15%
Hit or light sensitive surfaces	4	15%
Game consoles (Nintendo Wii, Xbox)	2	7%
Smartphone app	2	7%
Fitlights	1	4%
TecnoBody ProKin	1	4%
Not described	2	7%

Table 3
Types of data collected in the identified 18 papers with empirical data, excluding preliminary studies and functionality tests of technological innovations. In some cases, multiple types of data were collected.

Data type	Count	%
Performance measurements	7	26%
Questionnaire data	6	22%
Interview data	4	15%
Reaction time	3	11%
Qualitative data form observations	3	11%
Qualitative data of expert reviews	2	11%
Qualitative feedback	1	4%

4.4. Effects of gamification in team sports

Twenty-two of the total 28 reviewed papers included studies, out of which two papers showed preliminary tests and results, such as Lyons et al. [77] who conducted a pilot study for avoiding injuries using a self-monitoring app without gamification features to solve usability issues before adding additional features. In addition, two papers examined the functionality of a specific technical innovation, an

activity recognition system for VR sports games including soccer, presented in an empirical study without information on the effects of gamification [83,84].

Except of pilot studies and evaluated technical innovations, the remaining 18 papers evaluated the effects of different forms of gamified team sports in empirical studies. Nine of them collected mainly quantitative data, four qualitative data and five used mixed measures. The most commonly used method to analyze the effects of the used gamified approach was an experimental setup, which was used in 14 papers. Only two papers focused on interviews and observations, for example, to get insights into the opinion of players on the game's proficiency and derive challenges [70] or to gain experts' knowledge towards better understanding sports media coverage of big sports events [81]. Two papers used a case study, such as one paper with a sample size of two, to receive feedback on the applicability of a new VR system for novice and expert basketball players [58] or another paper that examines the dangers of fan tokens by investigating a specific case [82]. Table 3 reports the type of data collected in the empirical studies. Most commonly, performance measures were collected, such as Jensen et al. [65] investigating performance improvement through scores by using an interactive training game to practice ball handling skills while simultaneously surveying the field. Reaction time measurements are used similarly, often to examine reaction time improvements, such as Amprasi et al. [66] conducting reaction time measurements to investigate whether children can improve their selective attention with VR gaming for playing volleyball [66]. To gain further insight into the user, questionnaires, interviews, observations, expert reviews and feedback were also conducted.

The participants attending the mentioned studies were either children between seven and 17 years old, which was the case in eight papers, or adults in ten papers. In most of the analyzed papers, the gender of the subjects was not reported. The reviewed papers reporting gender either had mixed gender samples, which was the case in seven studies, had only male subjects in three studies or had only female subjects in one study. In one mixed-gender study, the results were even analyzed separately by gender. This demonstrated that descriptive reaction times improved more effectively in female participants than in male participants after three months of reaction training with Fitlights [72]. Although they studied the differences between the genders descriptively, no statistical tests were used to test the significance of the gender difference. Overall, the reviewed papers paid little attention to demographic differences such as age and gender, although these differences could impact on the effects studied, as implied by Badau et al. [72].

Further, the number of subjects varied between the papers but was rather small in most cases. The minimum number of participants was two in a case study mentioned above [59], a high number of subjects was 38 in a within-subjects experiment investigating the improvement of basic knowledge on rugby knowledge through standard instructions and video gaming [79]. However, a lot of papers reported between-subjects experiments with small sample sizes

per intervention group, such as Šlosar et al. [68] examining the effect of additional tennis exergaming in addition to standard tennis training with 63 participants split into four different groups. However, there was one outlier having a sound sample size of even 360 subjects, which were children of different sports disciplines in the aforementioned within-subjects designed study on reaction training with Fitlights by Badau et al. [72].

Table 4
Benefits and challenges of gamifying team sports, which are reported in the analyzed papers with empirical results and selected preliminary studies with valuable findings. Preliminary studies are indicated with an *.

Finding	Count	Paper
Increasing motivation		
Gamification, using team sports as a guiding design concept, can motivate behavior change	1	[76]*
Increasing performance		
Player performance in team sports can be improved with additional gamified training units	4	[65,66, 68,72]
Playing video games can improve specific team sports skills, such as tactical thinking	2	[70,79]
Visualizations like visual guidance, perspective changes or celebrity avatars can increase users' performance	3	[58,59, 63]
Multiplayer games/modes		
Competitive multiplayer modes can increase physical intensity of training units	1	[64]
Gain knowledge		
Gamification can help to gain team sports related knowledge	3	[71,80, 81]
Recovery		
Gamification can help prevent or recover from sports-related injuries	3	[69,78], [77]*
Challenges of gamifying team sports		
Children prefer real world activity compared to virtual exergames	1	[62]
Gamification must maintain sports relevance during an exergame	1	[67]
Fan tokens, a cryptocurrency for fans of elite sports teams, may be harmful	1	[82]

Five papers did focus on a rather single usage of a gamified solution [58,59,63,64,67]. All other papers concentrated on multiple-use scenarios of an application to give the users time to experience the application and improve in doing their respective sports. Therefore, the authors gave the subjects a variety of time spans between two weeks to over one

year, which was the case in a field experiment examining exergaming improving reaction times in tennis after the intervention of 6 months and an additional follow-up test after one year [68]. In the investigation of gamification in sports media coverage, the authors even looked at the past four years [81].

There was a variety of different studies conducted in the reviewed literature. Still, the authors of the reviewed papers focused on developing gamified applications or prototypes to enhance team sports-related aspects. They conducted user testing over a specific period to allow participants to experience the training and gather performance data before and after usage, in order to assess the effectiveness of the application.

The findings of the empirical studies were various and very specific as their research questions. The findings of the empirical studies and relevant pre-studies are summed up in Table 4. The reviewed papers indicate that gamification can be used in the form of separate training units to improve the players' performance in team sports, such as a specific gamified soccer field installation with goal-like rebound surfaces on each of the four sides of the playing field [65]. Further, the empirical findings reported in the analyzed papers indicate that commercial video games can be used to improve specific cognitive skills, such as using the eFootball PES computer game to improve tactical thinking [70,85] or playing Rugby League Live to learn the basics of rugby [79,87]. Gamified technologies, such as Fitlights, are also used in separate training units in other sports such as Volleyball, Handball and Basketball [72]. Furthermore, the analyzed studies indicate that specific visualizations within implementations, such as visual guidance for a perfect basketball throw [58], the change to a third person perspective to better observe and correct own behavior [59] or a celebrity avatar [63], can support performance improvement. Gamification also appear to be a viable approach to assist athletes in preventing or recovering from injuries; for example, one study indicates that back pain can be cured more effectively with VR racing game therapy than standard therapy [78]. However, deploying gamification in sports also brings challenges, such as the need to carefully design scoring systems while maintaining the sports relevance so that players are not only engaged to score but also perform actions correctly [67]. Additionally, one study mentioned that children prefer real-world activities compared to the usage of exergames as a replacement for common training, which was examined in context of a commercial Wii Sports exergame solution [62,88].

5. Discussion

This paper investigates how game design features are employed in gamified team sports, i.e. hybrid forms combining digital games and team sports (RQ1) and what is known about the benefits and challenges of such hybrid forms (RQ2). For this purpose, we conducted a scoping review with 28 paper and generated a comprehensive overview of the current state of research. This overview indicates that there is

a lot of potential for combining team sports and digital games:

The screened literature demonstrates that team sports can profit of including game design features in the sports training to improve athletes' performances. The reviewed papers used various innovative technologies and concepts to gamify special training units, commonly used in addition to standard training. Purpose of such applications are mainly to improve scoring techniques and other performance-related aspects in sports, such as training of cognitive and tactical skills or reaction time. Skills not directly related to performance but still crucial in sports, such as knowledge of sports values, can also be supported by gamification.

In summary, this review demonstrates that incorporating game design elements and principles in team sports can positively influence behavioral outcomes, such as sports performance. However, in contrast to research on the effects of gamification in other contexts [8,11], the existing body of literature on gamified team sports barely reports details on the psychological outcomes of using gamification in team sports. The potential effects of gamification on the motivation and enjoyment of athletes or social dynamics in team sports still need to be investigated in future research. However, since lack of enjoyment is the primary reason for people quitting [2,4], research should aim to advance our understanding of how gamification can help restore and maintain enjoyment in team sports and increase re-attendance and retention of athletes.

Exploring the common potential of the two disciplines of digital games and team sports to increase user's motivation is a young field of research, which noteworthy increased in the past years. This scoping review presents the first comprehensive overview on hybrid forms of digital games and team sports, which is beneficial for comprehending how team sports can profit from digital games in hybrid forms, and what knowledge on its effectiveness has been gained so far. In addition, this overview of the literature can offer valuable information to guide future research endeavors [89].

The literature contributing to this review overall includes few empirical papers partly lacking high quality studies. This reveals a high demand for further research in the area of gamified team sports. Therefore, we present an agenda for future research on hybrid forms combining digital games and team sports in the following sections. The agenda is divided into thematic and methodological agendas, presenting eight agenda points suggesting future directions for research on hybrid forms of digital games and team sports.

5.1. Thematic research agenda

Agenda point 1: More holistic gamification approaches

The body of literature provided insights into gamified team sports, highlighting their focus on isolated aspects of athlete training. For instance, studies focused on enhancing the scoring accuracy in basketball throws [58] or improving cognitive skills, such as selective attention through exergame play [66]. However, this research has largely been limited to the improvement of individual components and does not take into account the multi-faceted nature of team sports. Moreover, these gamified approaches have typically been deployed as separate gamified training units, supplementing conventional training sessions, such as additional reaction time units with Fitlights [72] or additional ball handling units in a specific gamified setup [65]. However, this approach tends to overlook the complex dynamics inherent in team sports, including factors such as team cohesion, identity formation, intergroup relations, team interaction and effective communication.

Furthermore, it is important to recognize that team sports span various phases, including training, matches, seasons, breaks, and preparation periods, each with its own unique requirements. To truly enhance the team sports experience, it is needed to adopt a more holistic approach that seamlessly integrates gamification into the overall training program and, ideally, throughout the season. This holistic approach aligns more organically with existing team processes and will provide teams with practical benefits in terms of performance and player engagement.

Future research should investigate how gamification can be integrated into team sports accompanying the entire training and season instead of adding extra gameful training sessions covering just single aspects of the team sport.

Agenda point 2: Seamless integration of gamification

In addition, the development of new technologies needed to support the integration of gamification into training should be addressed in future research. The current landscape of gamified training systems often relies on technologies that are not conducive to on-field or on-site club ground usage, such as VR Systems enabling athletes to embody celebrity avatars for training purposes [63] or computer and console games aimed at enhancing tactical skills [70,79]. These approaches require the deployment of computer pools or special arrangements to allow all team members to participate at the same time, which is a significant barrier to seamlessly integrating gamification into standard training sessions.

To address this challenge, researchers should investigate and innovate in the realm of technological solutions. This could involve the development and utilization of wearable devices, smart clothing, or sideline displays specifically designed to facilitate the integration of gamified elements into training sessions and other team activities. By exploring these technological frontiers, future research can help unlock innovative ways to tap into the potential of gamification in team sports, ultimately improving both individual skills and the overall team sports experience.

Future research should explore innovative technologies to seamlessly integrate gamification into team sports training sessions, addressing the limitations of existing systems.

Agenda point 3: Diversifying gamification

The implementations of gamification described in the reviewed papers focus on diverse use cases and stakeholders, such as improving throws or swings,

avoiding or recovering from injuries of players, and referee training. However, the game design features used are, on the whole, rather uninventive, using themes and environments familiar from the sports themselves, and earning points by scores visualized on leaderboards, which can be also seen in various other contexts [8,90]. Surprisingly only six papers mentioned multiplayer approaches in their implementations imitating the team sports character, although the interplay of multiple players is the most prominent feature of team sports. Almost all of these multiplayer approaches use competitive game design features, neglecting the cooperative team nature of the sport. Only two systems were included in which collaborative interactions would be possible caused by the free play character of the interventions [59,71]. Based on the characteristics of the sport, team-based features using cooperative or cooperative-competitive features can also be beneficial to adapt the nature of team sports, which should be investigated in future studies. Additionally, other social-related features supporting the social connections of the team should be examined [91], as especially social relations is an essential factor for performing leisure sports [4]. Furthermore, it is important to investigate the effects of immersive game design features, such as avatars and creative narratives, in order to tap the full potential of game design elements in the context of gamified sports to further enhance the positive effects found [91].

Future research on gamified team sports should seek to diversify the use of game design features and concurrently develop an understanding of what constitutes and creates gameful and engaging experiences.

Agenda point 4: Exploring emerging forms of gamified team sports

Beyond the reviewed literature, we see recent trends that demonstrate an intriguing integration of game design elements into traditional sports. For example the King's League - a Spanish soccer league, innovatively extends the conventional rules of soccer by incorporating additional design elements of digital games [92]. These modifications not only increase the dynamics of the team sports but also increase the entertainment value for the spectators. On the other hand, new hybrid forms emerge that utilize recent technological developments in the gaming industry to merge the physical world of sports with the digital world of gaming. For instance, HADO is a physical esport where teams compete in person on a real playing field by playing an augmented reality strategy game that requires significant endurance from the players [93]. Notably, HADO has established an active league in Japan, demonstrating the public's interest in such emerging hybrid sports experiences.

While our review indicates that these novel applications that bridge the fields of digital games and team sports are hardly covered in the existing body of literature, scholars should put their attention on this development to deepen our understanding of this phenomenon and its potential social and economic implications. In particular, research should aim to shed light on the effects of these novel approaches on player and spectator experience and their resulting potential to increase people's engagement in team sports. Further, by carefully investigating the specific design patterns and socio-psychological dynamics of innovative forms of gamified team sports, research can gain valuable insights to inform practitioners about how these approaches might influence the future of sports and sports culture.

Future research should examine emerging hybrid forms of digital games and team sports to gain valuable insights into their social and economic implications and their potential disruptive dynamics for the sports culture.

Agenda point 5: Revealing adverse effects

The literature review revealed predominantly positive effects of gamified team sports on behavioral outcomes. While many studies highlight such benefits, certain studies also report challenges, including children's preference for real-world sports over digital activities [62] and the potential risks associated with certain technologies, such as the addictive potential of fan tokens [82]. In addition, incorporating game design elements into team sports applications can pose a risk by shifting the users' focus to rewards rather than to a proper execution of sports-related activities. Thus, maintaining the sports relevance of an application while integrating gamification features and mechanics was found to be critical to effectiveness. [67]. While in other contexts, such as education, previous research that systematically analyzed the potential negative effects of using gamification found that gamification can reduce the effectiveness and user performance in specific activities [94,95], there is also clear relevance to investigating potential negative consequences of gamifying team sports. This is particularly important given the risk of severe consequences, such as injury, in sports.

Future research should examine potential adverse effects of using gamification in team sports to support the development of successful, safe, and effective approaches.

5.2. Methodological research agenda

Agenda point 6: Conduct solid empirical studies

The majority of all studies reported positive effects of hybrid forms of digital games and team sports, indicating a great potential for team sports. However, many papers conducted experiments with a small sample size for the empirical research designs used. This might be attributed to the novelty of the research field. For this reason, the results of such studies should be taken with the necessary caution. At the same time, the number of male participants exceeds that of the number of female subjects clearly, without knowing the exact number due to the lack of description in some studies. Most studies did not include data from female participants at all, which we know from three papers mentioning only male participants out of 11 papers mentioning the gender of their participants. In contrast, only one study included only female participants. However, previous research suggests that the perceptions towards and effectiveness of a gamification approach strongly depends on users,

their characteristics, and their individual goals [90,96]. In the literature, small studies with a specific user group have provided quick insights into a phenomenon, but have limitations. Subsequent large studies with a more diverse user group are necessary to ensure the reliability and generalizability of the results. Even deeper insight and understanding can be gained by comparing results across different user demographics.

Further studies should conduct appropriate empirical evaluations to gain knowledge about the actual effects of gamified team sports. In particular, studies should draw on sufficient samples and reflect on potential demographic and cultural differences.

Agenda point 7: Understanding differences in gamification design

Thirty-eight of the reviewed studies contained empirical results on the effects of gamification in the context of team sports or alternative contexts using elements related to team sports. Our overview indicates that gamification tends to motivate users and can even lead to improved performance, which is consistent with findings on gamification in different contexts [8,97,98]. Multiplayer modes created through cooperative, competitive, or cooperative-competitive features have been examined as gamification features in a number of studies, indicating that multiplayer modes are an engaging factor [25,99]. However, these results of the reviewed papers are still too vague to derive specific design recommendations for gamifying team sports. Most of the studies reviewed examined only the overall results of using gamification, rather than isolating and studying individual game mechanics or measuring the corresponding effects separately. Throughout gamification research, this is a common challenge [8]. However, to capture the full range of effects, it is also necessary to study the interaction between different game design elements, as isolating individual game elements may not reflect the real-world effects of complex gamification approaches. As a result, current research provides limited insights into the complex interplay of different factors that influence motivation and performance in the context of digital games and team sport. We therefore believe that a careful and systematic empirical evaluation of the effects of game design features, psychological and behavioral outcomes, and the differences between different designs would be beneficial, to identify which element actually causes the observed effects.

In future research, game design elements should be investigated in isolation and in conjunction with each other to derive concrete design recommendations.

Agenda point 8: Understand the psychological dynamics and outcomes of gamifying team sports

Research on gamification in various contexts, such as education, health and crowdsourcing shows that gamification is a multifaceted approach. Gamification can be beneficial in cognitive, social and emotional aspects which can positively influence the user's motivation and thus the behavior related to an activity [8]. Our scoping review revealed that existing research on gamified team sports primarily focuses on improving individual athletic performance, which is undoubtedly a crucial aspect for the team to progress and succeed in their discipline. However, focusing solely on performance, and thus behavioral outcomes, neglects other potentially relevant factors that engage people to participate in team sports, such as the enjoyment of the activity itself and the interaction with peers. Such a performance-oriented perspective may hinder the generation of innovations to counteract the increasing disinterest of people in team sports, especially in leisure sports [5]. Therefore, future research should consider investigating the cognitive, social and emotional effects of gamification in team sports in more detail [4].

Further studies on gamified team sports should focus not only on performance measures but also investigate cognitive, social and emotional outcomes of using gamification in team sports to tap the full potential of gamification and digital games.

5.3. Limitations

Limitations of this study include a focus on English-language articles only, which omits non-English literature that could be considered in future reviews of hybrid forms of digital games and team sports. Additionally, despite the use of different search terms, it is possible that studies using different terminology or examining different types of team sports were not included in our search. Nevertheless, the diverse findings from this scoping review can still significantly enhance our understanding of the application of game design features in team sports.

6. Conclusion

In conclusion, this scoping review has made a significant contribution in understanding and structuring the field of gamified team sports. We have identified key application areas for gamification in the context of team sports, and provided a systematic analysis of gameful design and its impact on the field. In addition, the study has uncovered important thematic and methodological agenda points for researchers in this field, laying the groundwork for realizing the full potential of gamification in team sports in the future. By addressing these agenda points and building on the insights gained, researchers and practitioners can continue to advance the integration of gamification in team sports and ultimately improve the overall sports experience.

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