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Can Badges in Gamified Systems Promote Weight-Related Behavior Change?

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Can Badges in Gamified Systems Promote Weight-Related Behavior Change?

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Can Badges in Gamified Systems Promote Weight-Related Behavior Change?

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Abstract: The current global prevalence of obesity among children and young adults is much higher than in previous decades. Despite efforts to prevent childhood obesity, motivation is a barrier to weight-related behavior change. Pediatric experts have attributed the epidemic to sedentary lifestyles partially driven by the excessive use of media and technology. Recently, researchers have attempted to use gamification to promote healthy diets and physical activity. Gamification is a novel term that refers to the application of game design elements in non-game contexts. Badges are a type of reward system that is used in many health promotion applications. There have been several studies that suggest that badges are effective in promoting behavior change. However, there has not been a review that specifically addresses the relationship between badges and motivation. The purpose of this narrative review is to assess whether badges in gamified settings are effective at promoting changes in diet and physical activity habits among people under 30 years old.

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List of Abbreviations

SDT	Self Determination Theory
CET	Cognitive Evaluation Theory
BMI	Body Mass Index
UTMB	University of Texas Medical Branch

CHAPTER 1: INTRODUCTION

GAMIFICATION

The term gamification gained widespread popularity in the early 2000s when Sebastian Deterding gave an in-depth explanation of its defining concepts [1]. However, this motivational tactic has been used in the education and marketing fields for a while [1]. Gamification is based on the theoretical concepts found in games and play. It is based on two concepts: Paidia (Play) and Ludus (Game) (See Appendix B: Figure 1). Paidia refers to free-form and expressive behaviors that elicit joy or entertainment [1]. Toys, for example, are typically created for play, as they are meant to be forms of amusement. Ludus, on the other hand, specifically refers to play that is structured by rules and competitive drive to reach a goal [1]. Successful gamification design relies on a balance between these two concepts. Experts in the gamification field often refer to educational games as "serious games" to indicate that they are intended for learning instead of play [1,2]. Gamified systems should incite play so that the user sees it as a form of entertainment. However, rules, competition, and goals offer levels of difficulty that keep the user engaged.

BADGES AND MOTIVATION

One common design element featured in gamified applications is the use of a reward system as positive reinforcement when a desired behavior is achieved [3]. Rewards can be given as points, achievements, badges, medals, tangible rewards, or currency [3]. Badges are visual representations of a players' accomplishments in gameplay [4]. They can be digital, as is commonly seen in smartphone applications, or tangible. Examples of tangible badges are those that are given to Boy or Girl Scouts.

Motivation is hypothesized to be an intermediate between badges and behavior change (i.e. badges promote motivation, which in turn promotes changes in behavior). According to the Self Determination Theory (SDT), there are primarily two different types of motivation: intrinsic and extrinsic [5,6]. Intrinsic motivation refers to one's internal

drive to perform a certain activity because of the inherent enjoyment they feel when doing it [5]. Extrinsic motivation refers to behaviors or activities that are completed to gain desired external rewards or avoid punishment, not because of the internal will to behave a certain way [6]. Extrinsic motivation, however, still lies on a spectrum of self-determination [5]. Individuals may continue to perform a certain action because someone has obliged them to do so or they may do it because they perceive some sort of personal gain [5]. Consider a person who doesn't enjoy their entry-level job. They may continue to work because they do not want to be fired (controlled). Or, they may continue to work because they want to gain experience before their career advances (autonomous). Intrinsic motivation is associated with greater improvements over time whereas the effects of extrinsic motivations appear to decrease with time [5,7].

Some critics have alluded that badges may only appeal to externally motivate [8,9]. Badges in their most literal sense, are extrinsic motivators. But, they seem to fall on the more autonomous end of extrinsic motivation. Also, there is suggestion that badges may induce long-term changes or stimulate internal drive when viewed in terms of the Cognitive Evaluation Theory (CET). CET is a subset of the SDT that lists 3 fundamental needs to induce intrinsic motivation: autonomy, competence, and relatedness [5,10]. Most gamified systems use badges as a way to show players the realm of activities they can perform within a game [4]. When the player is able to choose which of these goals they'd like to meet, their need to be autonomous is fulfilled. Competence is satisfied through badges because they represent the challenges that the user has overcome and fuels self-efficacy and internal volition. However, this is only accomplished when the goals are challenging but still attainable [4]. Relatedness, or social connectedness, is empowered by badges when players can view each other's collections, like a trophy case. Users with similar badges feel included in a group of equally qualified peers but are also driven to compete for more coveted badges [11].

CHAPTER 2: BACKGROUND

GLOBAL PREVALENCE OF CHILDHOOD OBESITY

The global prevalence of obesity is staggering compared to rates 10-20 years ago. In fact, the prevalence among children and adolescents has increased 47.1% from 1980 to 2013 [12]. In 1990, 4.2% of preschoolers (children younger than 5) were overweight and obese. Ten years later, this rate had increased to 6.7% [13]. If the rate of growth continues as is, an estimated 60 million preschoolers (9.1% of all preschoolers worldwide) will be overweight and obese by 2020 [13]. Despite prior beliefs that obesity is a disease of the wealthy, developing countries have also seen rapid climbs in the prevalence of overweight and obese children, adolescents, and young adults [12,14]. In 1980, the rate among children ages 2-19 in developing countries was 8.1% for boys and 8.4% for girls [12]. These rates have risen to 12.9% among boys and 13.4% in girls in 2013 [12].

The rapid growth of obesity rates parallels the expansion of "western diets" and technological advances that promote sedentary behavior and cheap nutrition [15]. Food industries are no longer based primarily on natural food sources. Increased consumption of refined carbohydrates, sugars, fats, and animal products may have contributed to such drastic leaps in obesity [15]. Combined with easier transportation options, entertainment venues available at home, and internet access at our fingertips, the rates of obesity are likely to continue to rise without appropriate interventions [15,16].

MEDIA USAGE

Access to electronics has also skyrocketed in the last decade [17,18.] Higher usage rates of electronics make digital interventions a prime target for engaging children and adolescents to participate in better health practices. More children and teens have access to cell phones, computers, and television than ever before. In 2004, 18% of U.S. youth ages 8-18 owned an iPod, 39% owned a cell phone, and 12% owned laptops [17.] By 2009 these rates had almost doubled (76% owned iPods, 66% owned cell phones, and 29% owned laptops) [17]. Over 84% of kids older than 8 had internet access at home that year [17].

The average amount of recreational time that U.S. youth spent using various forms of media increased from 6 hours and 30 minutes a day in 1999 to nearly 8 hours a day in 2009 [17]. Daily electronic use is typical among children younger than 8, too. A study by the Kaiser Family Foundation found that kids under 6 spend an average of 1 hour and 43 minutes a day recreationally watching television, videos or DVDs, video games, or computers [19]. The average daily time spent using mobile media has tripled from 5 minutes in 2011 to 15 minutes in 2013 [20].

CHAPTER 3: METHODS

SEARCH STRATEGY

A librarian at UTMB conducted an extensive literature search in Web of Science, PsychINFO, OVID, ERIC, CINAHL, and PubMED databases. Search terms included Gamification, Badge, Motivation, and Behavior Change. Truncated versions of each term were also used to collect all possible forms of the keywords. Other relevant terms for badges were Reward, Award, Achievement, and Prize. Health Behavior, Incentive, and Engagement were other terms for motivation. The librarian used the same search keywords for each database. Article years were restricted from 2000 until 2017 because gaming technology has changed drastically since the 1990s. Also, the term gamification was not well known until the early 2000s. Few articles were suspected to be found using gamification as a keyword before that time. The resulting articles from each database were uploaded into individual reviews in the Rayyan online systematic review application. Duplicate articles were removed from each database result. An additional search was completed in Google Scholar to increase the number of articles to be included in the review. Keywords included Gamification, Badges, Motivation, Behavior Change, Physical Activity, Nutrition, Diet, and Obesity. Full-text versions of this search were examined.

TITLE & ABSTRACT REVIEW

Next, two reviewers completed a title and abstract review. Included articles had to evaluate a gamified program that used badges as a motivational tool. Inclusion criteria were intentionally broad so as to incorporate as many articles as possible. Gamified systems and badges could be digital (smartphone applications, video games, computer programs, etc.) or non-digital (intervention programs, school initiatives, etc.). Outcome measures could be any form of behavior change or any assessment of participant motivation. Initial literature reviews showed that exclusive use of one gamified reward element is uncommon, so articles could use other forms of reward such as leaderboards, points, or avatars in addition to a badge system. Participants had to be students (up to the

undergraduate level) or no older than 30 years. In order to capture as many articles as possible, a specific study design was not necessary and could range from small case-studies to large randomized controlled trials. Meta-analyses were also eligible for inclusion only if they provided enough details about the intervention in each article that was reviewed. The references were searched if the analysis did not provide enough information about each article. Systematic reviews and literature reviews were excluded. Instead, references from these reviews were explored and cited articles that met this study's inclusion criterion were accepted. Meta-analyses were considered for inclusion and other reviews were not because many meta-analyses provide aggregate qualitative results, while the results in other reviews are usually more descriptive. International articles were also welcomed but had to be written in English. After the initial review was completed, conflicting decisions between reviewers were resolved via email and labeling in Rayyan.

PHYSICAL ACTIVITY AND NUTRITION REVIEW

All included articles were combined into one review and any duplicate articles were deleted in the Rayyan system. A search within these included articles was competed to find articles relating to physical activity and diet. Obesity, Physical Activity, Health, Fitness, Nutrition, Food, and Diet were individually placed into the search bar in Rayyan. Full-text pdf versions of resulting articles were uploaded for review by only one of the initial reviewers. The same inclusion criteria were applied except that studies with disabled or sick participants were not included. Other studies have excluded disabled or ill populations or examined them separately because they require different means of motivation than healthy participants [21]. An additional search was completed in Google Scholar to increase the number of articles to be included in the review. Keywords included Gamification, Badges, Motivation, Behavior Change, Physical Activity, Nutrition, Diet, and Obesity. Full-text versions of this search were examined. References were cross-checked for eligibility from the articles that met inclusion criteria.

CHAPTER 4: RESULTS

SEARCH RESULTS

The initial search by the librarian yielded 1618 articles (See Appendix B: Figure 2). After duplicates were deleted (n=471), 1147 remained. The title and abstract review resulted in 411 included articles. Reasons for exclusion of each article were not documented at this stage so exact percentages cannot be reported. However, most articles were irrelevant to the topic of gamification. Among the articles that did focus on gamification, most were background articles or literature reviews that did not evaluate a gamified system. Others reported a study population that was too old.

The physical activity and nutrition sub-search resulted in 105 articles. Of these, 5 articles were identified by the reviewer for inclusion in the final review and one was found within the references of an article that was eventually excluded because it did not use a badge system [22]. The Google Scholar search resulted in 25 articles. Full-text evaluation yielded 2 additional articles for inclusion. The final review included a total of 8 studies. Study intervention characteristics and results are summarized in Table 1.

STUDY CHARACTERISTICS

The study designs of the included articles ranged from quasi-experimental trials [23], randomized control trials [10,24–27], a case study [28], and a mixed-method experiment [11]. Three articles explained the development of the gamified program or the theoretical basis for it [10,27,28]. The study populations were within the ages of 8-23 and included boy scouts [24,25,29], elementary school students [23,27], and undergraduates [10,28]. Five studies were concentrated on changing participants' physical activity habits [10,11,24,27,28], 2 focused on diet as an outcome [25,29], and one on both [23]. Other secondary outcomes were body mass index [23,27], motivation [10,11,23], and knowledge [23,24,27,29,30]. The most common method of evaluating motivation was via survey response from participants and/or their parents. Parents were included to improve accuracy of students' self-report responses. However, only 3 studies included parents in the intervention activities or outcome data collection

[23,27,29]. Most interventions lasted 8-9 weeks except one that lasted for 5 months [11]. Two studies were primarily focused on gameplay and evaluated participants' motivation after just one game [10,28]. Intervention design elements were broad but the most common were group sessions where participants were taught about healthy habits, played active games with other participants, or performed an activity such as cooking or exercising [23–25,27,29]. Electronic design elements ranged from web or computer-based games for teaching purposes, active games like Wii Fit, or exergames created by the researchers. One early study used comic books instead of a web application because of the socioeconomic status of the participants [29]. Of note, two studies each represented two different arms of the same trial (i.e. one was the control group for the other in each appropriate article) [24,25] (See Appendix A: Table 1).

BADGE CHARACTERISTICS

Badges were awarded based on goal achievement or collection of points for all included studies. Achievement based badges and digital badges were the most popular. Studies with boy scout participants received tangible badges, as is common among scout programs [24,25,29]. Boy scouts were only eligible to receive one badge compared to the possibility of multiple badges in other studies (See Appendix A: Table 1). In one study, badges were used as a symbol of status, like moving on to a new level [23]. The length of time before awarding varied. Participants of some studies could receive badges as soon as the individual collected enough points or met a goal [10,11,27,28]. Some could only receive a new badge after a new week of the intervention [23]. Others could only receive their badge at the end of the intervention [24,25,29]. Only one of the articles mentioned a format for recipients to display their badges to other players [11]. Other gamified elements used within the interventions were points, leaderboards, avatars, narratives/role-play, levels, winning-losing, and tangible prizes. Unfortunately, but not unexpectedly, none of the studies exclusively used badges.

INTERVENTION EFFICACY

All 8 interventions showed positive results for both physical activity and nutrition. Among the studies that sought to improve physical activity habits, two saw increases in light activity and declines in sedentary behavior [24,27] (See Appendix A: Table 1). However, the average time spent doing moderate to heavy intensity activities actually declined or did not change at all [24,27]. One of the authors speculated that this may be because the interventions did not address strategies needed to break barriers associated with moderate or higher intensity exercise in children [27]. Moderate to high intensity exercise (sports participation, swimming, weight lifting, etc.) often requires parental involvement in younger populations. It is difficult to maintain parental participation [27,29]. Environment safety is another factor that limits higher intensity activities in younger populations and is often a larger issue among families with lower socioeconomic status [27]. Russell Jago found that the season during the intervention was also likely to be a reason why increases in moderate intensity exercise did not occur [24]. He hypothesized that participants are more likely to be outside when the weather is nice in summer or spring than they are in winter or fall [24]. His intervention (Fit-for-Life) only taught the participants about activities that can be done outside and did not focus on indoor exercise.

A study that utilized a computer program and group sessions saw gender differences in changes to physical activity [27] (See Appendix A: Table 1). Girls who participated in the intervention spent 81% of their time each day doing some form of light intensity exercise (playing, walking, etc.) compared to 78% in controls. Boys in the intervention group, on the other hand, spent less of their time doing light intensity activity (75%) compared to controls (78%). The authors suspected that boys may need more hands-on experience to teach them about exercise rather than a CD-ROM game [27]. The authors also admitted that sitting at a computer and teaching about exercise is ironic, but found that it seemed to work well in girls [27].

There was also subjective evidence of higher motivation to exercise after intervention completion in programs that compared an intervention arm with gamification features to a control arm without gamified elements [10,28]. The two studies by Gonzalez et al. and Peng et al. had intervention groups that received only 2 reward elements (badges and points [23] or success meter [10]). The use of only 2 reward systems could strengthen the

assumption that badges played a large role in cultivating motivation. The results of both studies showed improvements in diet [23], physical activity [23], and motivation [10] (See Table 1). In the studies that reported increased motivation to engage in healthier habits, the authors alluded that the success of the intervention was due to components that catered to elements of the CET (autonomy, competence, and relatedness) [10,23]. These interventions promoted autonomy with individualized goal setting, competence with badges and realistic tasks, and relatedness with group learning sessions or social media. The results showed increased motivation in intervention groups with CET driven components compared to motivation in control groups.

For the studies hoping to improve diet, all showed some improvement in knowledge and eating habits among participants [23,25,29]. However, one only saw significant differences in the amount of fruit and 100% juice consumed [25]. Low-fat vegetables did not show an improvement. The authors concluded that children are more likely to choose fruits than vegetables because of the sugar content. Their intervention did not stress that the health benefits of produce stems from increased consumption of both groups (fruit and vegetables), not just one [25]. Another study that focused on participants' diets saw an increase in both fruit and vegetable consumption as well as availability of these foods at home [29] (See Appendix A: Table 1). The author noted that providing children with "asking skills", or the knowledge to ask their parents to buy fresh produce, likely contributed to the intervention's success [29].

CHAPTER 5: DISCUSSION

SUMMARY

Overall, the results of all the studies presented evidence that gamification appears to promote changes in physical activity, diet, and motivation. However, because none of the studies used badges exclusively, all claims to the contribution of badges to improved results is only speculative. But, the results of the two studies that had intervention groups that received badges and one other reward feature do suggest that badges play a large role in manipulating motivation and behavior change [10,23]. Future studies should try to evaluate the individual contributions of each reward system to participant behavior changes either through data analysis or study design. In general, we see that gamification likely influences motivation, but there is still a knowledge gap about which features work best. There has been a call to study gamification as a whole, instead of by parts [2]. However, one could argue that each individual component should be tested so that developers will know which features work best for their specific population and study outcomes. Also, the intervention periods were fairly short (typically 2-3 months long). Longer interventions or follow up times may show stronger results in relation to changes in body mass index and maintenance of learned behaviors.

FUTURE RESEARCH

A lot can be learned from the selected studies about effective intervention strategies. Gamified programs should utilize a reward system to promote self-efficacy and provide positive feedback. Also, programs should be developed with a motivation-based theory in mind. The most common theories in the studies in this review were Social Cognitive Theory and Self-Determination Theory. Group sessions and family-based components were also found to be beneficial. Longer follow up times after intervention completion was another factor that authors believed would help maintain behaviors learned during the study period. Tom Baranowski, a co-author of three of the included studies, noted that narratives and role-play in the game increase user enjoyment and

motivation to play [29]. Three other interventions used narrative gameplay and saw positive results [10,24,25].

STRENGTHS AND LIMITATIONS

This review is the first to specifically evaluate the effect of badges on motivation and healthy lifestyle changes across several studies. Other reviews have looked at gamification in general, but did not select one specific element to evaluate. The initial literature search was also very broad and likely included many of the relevant studies available in this age group.

This review also has several limitations. The biggest is that it is a narrative review within a larger systematic review and includes a small number of articles. A better approach would have been to include keywords about obesity, physical activity, and nutrition in the initial literature search. Initial discussions with a librarian found that including more keywords in the search limited the results and increased the likelihood of missing relevant studies. Thus, it may actually be beneficial to have used such broad terms for the initial search and narrowed down the inclusion criteria by physical activity and nutrition later. A more robust systematic review will be completed at a later time. Another limitation is that most studies that focus on gamification interventions have small sample sizes. This is likely due to the large financial burden associated with implementing a gamified intervention. Future studies should attempt to reach larger populations by partnering with schools or other organizations such as the Boys and Girls Club, Boy or Girl Scouts, and religious institutions. Also, it was somewhat difficult to know if the interventions included badges. Many articles were excluded due to vague wording such as “engaging aspects of the game”, “reward”, or “prize”. Future manuscripts should use uniform definitions of each gamified element and clearly state which features were used.

CONCLUSION

Badges used in gamified settings can promote motivation and modest behavior changes in relation to physical activity and nutrition among children, teens, and young adults. Regular use of digital programs and applications means that gamified

interventions can easily be woven into participants' routines without feeling like an added burden. Future research should focus on badging as a primary means of reinforcement and motivation.

APPENDICES

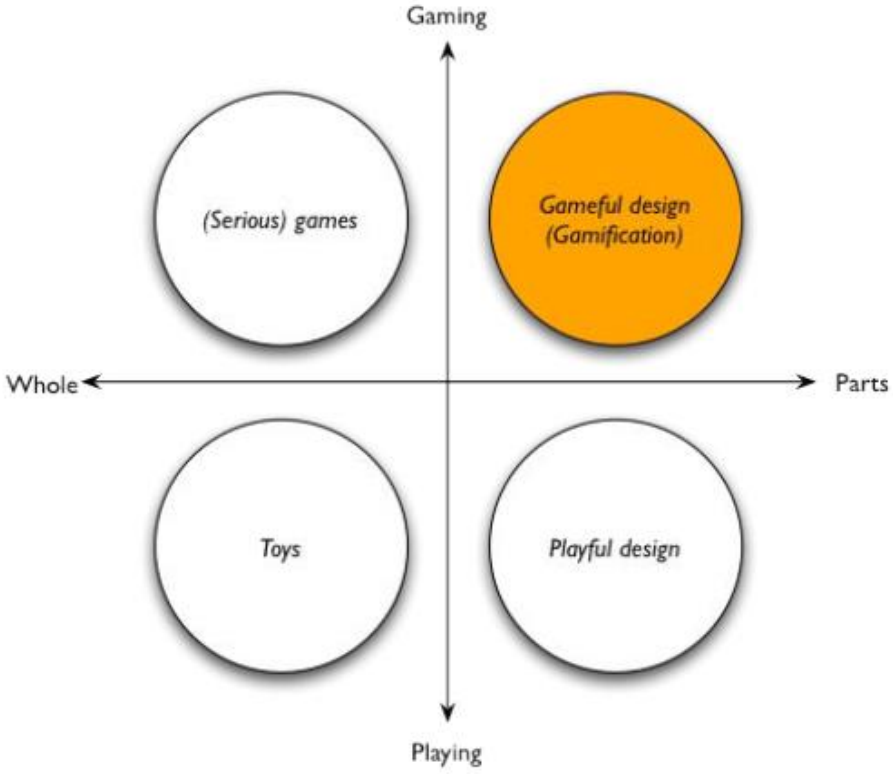
Appendix A: Tables

TABLE 1. STUDY CHARACTERISTICS

Reference	*Study Design*	*Population*	*Duration*	*Intervention*	*Outcome*	*Badge Type/ Number*	*Other Gamification Elements*	*Results*
Gonzalez et al. [23]	Quasi-Experimental	Overweight 8-12 y/o (n=24)	8 weeks	Group session & Active games vs. No intervention	Weight, Diet, Physical Activity, Motivation	Point Based/ Multiple	Points, Leaderboards	Improved diet and physical activity
Peng et al. [10]	RCT, Theory	Undergraduate gamers w/ little physical activity (n=160)	15 minutes (one gameplay session)	Exergame with vs. without gamified features	Physical Activity, Motivation	Achievement Based/ Multiple	Heroism (Success) Meter, Narrative, Avatar	Improved motivation with gamification
Jago et al. [24]	RCT	10-14 y/o boy scouts (n=473)	9 weeks	Group session & Website vs. "Mirror Image" Nutrition Program	Physical Activity	Point Based/ Single	Points, Role-Play	Increase in light activity; No significant increase in moderate-vigorous activity
Thompson et al. [25]	RCT	10-14 y/o boy scouts (n=473)	9 weeks	Group session & Website vs. "Mirror Image" physical activity program	Diet	Point Based/ Single	Points, Role-Play	Increase in fruit and juice consumption; Decrease in low-fat vegetable consumption
Baranowski et al. [29]	RCT	African-American Boy Scouts (n=186)	8 weeks	Group session & Comic book vs. Control group	Diet	Achievement Based/ Single	Tangible Prize, Narrative	Increase in fruit and vegetable consumption
Goran et al. [27]	RCT, Development	8-11 y/o 4th graders (n=209)	8 weeks	Group sessions and computer-based game vs. placebo control group	BMI, Physical Activity	Achievement Based/ Multiple	-	Improved light activity in girls; decreased moderate activity; improved BMI
Pumper et al. [11]	Mixed-Methods w/n a Larger RCT	14-18 y/o (n=71)	5 months	Social Media & Smart Phone App vs. App Only	Physical Activity, Motivation	Achievement Based/ Multiple	Leaderboard/ Competition	Improved motivation to workout
Lopez et al. [28]	Case-Study, Development	18-23 y/o (n=71)	One-time game play	Active game with vs. without gamified elements	Improvement in movement accuracy	Achievement Based/ Multiple	Points, Avatar, Levels, Win/Lose	Better performance with gamification

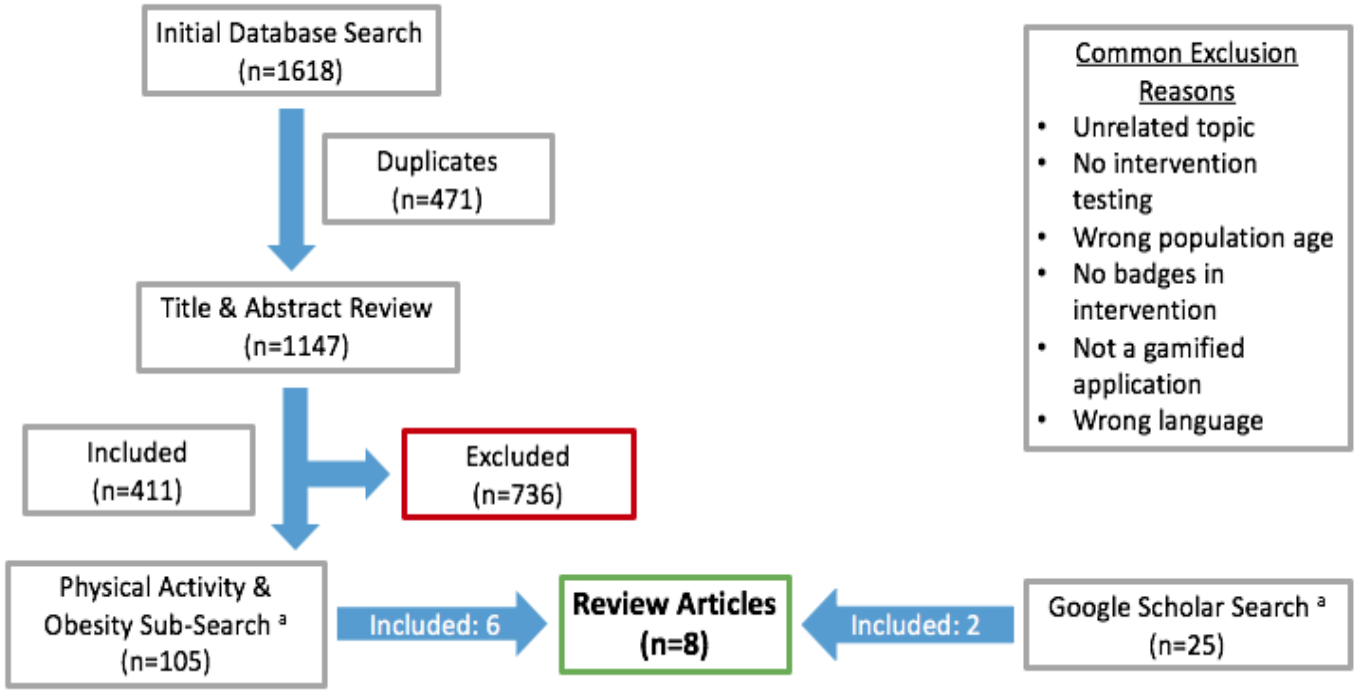
Appendix B: Figures

FIGURE 1 – "GAMIFICATION" BETWEEN GAME AND PLAY, WHOLE AND PARTS.



Source: Deterding et al., 2011[1]

FIGURE 2 – SEARCH STRATEGY AND COMMON REASONS FOR EXCLUSION



[a] Full-text reviews were completed on the results of these searches

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