



# Psychological interventions of virtual gamification within academic intrinsic motivation: A systematic review

Joy Xu<sup>a,\*</sup>, Aaron Lio<sup>b</sup>, Harshdeep Dhaliwal<sup>a</sup>, Sorina Andrei<sup>a</sup>, Shakthika Balakrishnan<sup>c</sup>, Uzhma Nagani<sup>a</sup>, Sudipta Samadder<sup>a</sup>

<sup>a</sup> McMaster University, Hamilton, ON, Canada

<sup>b</sup> St Robert CHS, Thornhill, ON, Canada

<sup>c</sup> University of Waterloo, Waterloo, ON, Canada

## ARTICLE INFO

### Keywords:

Motivation  
Gamification  
Psychology  
Virtual  
Intervention  
Mobile app  
Intrinsic motivation  
Extrinsic motivation  
Autonomy  
Productivity  
Student  
College  
Young adults  
Psychiatry  
Systematic review  
Felicity App

## ABSTRACT

**BACKGROUND:** Students constantly seek ways to improve productivity within academia. With the advancement of technology in the recent decade, virtual implementations may provide additional support for student productivity, particularly during the COVID-19 pandemic with online learning. One of the virtual realms for motivation include gamification, which has potential as an effective tool to further bolster an individual's source of intrinsic motivation.

**METHODS:** Qualitative and quantitative studies were extracted from APA PsycInfo, ProQuest, and IEEE for relevance to virtual gamification and intrinsic motivation. Studies were reviewed based on a pre-determined and piloted screening tool. Included studies were published between 1990 and 2020 in English within Asia, North America, or Europe. Only systematic reviews, randomized control trials (RCTs), meta-analysis, and grey literature were included. Study screening, extraction, and quality appraisals using the Mixed Methods Appraisal Tool (MMAT) were performed independently among two authors. Disagreements following reconciliation between two authors were settled by a third author. Heterogeneity in study designs, outcomes, and measurements precluded meta and statistical analyses; thus, a qualitative analysis of studies was provided.

**RESULTS:** Based on the appraised articles, gamification improves intrinsic motivation through badges, social interactions, points, and leaderboards. Experimental studies also displayed a correlation between learning behaviour.

**CONCLUSION:** The data exhibited an increase in intrinsic motivation due to gamification features, which can be integrated within a virtual context to enhance motivation with potential for application towards online learning settings.

## 1. Introduction

Academic motivation is a major field in psychology, as it explores the correlation between student motivation and academic success. Research has discovered that the presence and integration of various forms of motivation, such as intrinsic motivation, were required to maintain and improve academic performance (Amrai et al., 2011), as only 48.9% of students remained interested in initiated tasks and 36.9% of students did not postpone solving difficult problems, such as math problems (Organisation for Economic Co-operation and Development 2013). The Organisation for Economic Co-operation and Development (OECD) also measured that 27% of students in the member countries have skipped at

least one class within two weeks, partly attributing to a lack of engagement at school (Organisation for Economic Co-operation and Development 2019). Furthermore, 40% of students reported feeling disengaged in class and put in minimal effort (Steinberg et al., 1997). Student cohort studies also displayed a 14% decline in intrinsic motivation when comparing students between the ages 11 to 16, thereby, exhibiting a decrease in motivation as adolescent populations age (Gnambs and Hanfstingl, 2016).

Within motivation, two categories have been observed in the workplace and academia: extrinsic and intrinsic motivation. The self-determination theory introduces extrinsic and intrinsic motivation, in which the relationship between personality, motivation, and optimal

\* Corresponding author.

E-mail address: [joyxu@gmail.com](mailto:joyxu@gmail.com) (J. Xu).

<https://doi.org/10.1016/j.jad.2021.06.070>

Received 22 April 2021; Received in revised form 24 May 2021; Accepted 25 June 2021

Available online 2 July 2021

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functioning is analysed (Deci and Ryan, 2008). Deci and Ryan's theory of motivation further elaborates on extrinsic motivation as a behaviour reinforced by external sources ranging from materialistic objects to standardized achievements (such as certificates, financial compensation, or academic grades) (Deci and Ryan, 2008). Extrinsic motivation applies operant conditioning from behavioural psychology by using external stimuli to increase or decrease the frequency of behaviours (Ryan and Deci, 2000). Thus, extrinsic motivation encourages individuals to complete a task by focusing on the outcome rather than the process. However, it is unlikely to motivate students in the long-term (Lee et al., 2010). In contrast, intrinsic motivation develops an internal drive to engage in activities based on an individual's motives, goals, values, and personal interests (Deci and Ryan, 2008). A significant purpose of intrinsic motivation is to practice and meet individualistic needs for autonomy, competence, and relatedness, with students experiencing a 15.2 % increase in academic achievement when autonomous motivation improves by 1% (Feri et al., 2016). Nevertheless, intrinsic motivation is limited in its application settings, as there are many circumstances in which individuals will not enjoy the task they are required to complete (Eisenberger et al., 1999). One potential solution to this limitation is to incorporate gamification into such educational settings.

Gamification theory is defined as the implementation of video game elements in a non-gaming setting to improve individual engagement (Deterding et al., 2011). Gamification theory uses the entertainment-focused design of video games to alter the attitude and behaviour. The components of gamification include the goal, challenge, and reward, which can be in the form of badges, points, or trophies (Seaborn and Fels, 2015). While it is not a new concept, attention towards gamification has increased significantly in the last 15 years as a result of several factors, like easier access to gaming mediums and affordable technology (Seaborn and Fels, 2015). Gamification has been used in vocational settings to increase customer interaction. Nike demonstrates the use of gamification through their Nike+ app, where individuals are encouraged to participate in fitness challenges to earn badges and trophies. The gamified approach of the app has made Nike+ one of the top fitness apps (Wu et al., 2015). Furthermore, implementing gamification in the workplace has been effective in improving productivity, with 83% workers feeling motivated to accomplish tasks after undergoing gamified employee training, 88% feeling happier at work, and 89% believing they would be more productive if work included more gaming elements (TalentLMS 2019). Gamified training softwares are used to teach courses, such as project management essentials, by building employee skills in an engaging manner (TalentLMS 2021). In the education sector, gamification may increase positive attitudes towards learning by increasing the willingness of students to take advantage of educational material (Landers et al., 2015). After gamification, 11% of learners displayed higher factual knowledge levels and 9% showed increased retention rates (Sitzmann, 2011). Gamification has become increasingly popular in marketing, healthcare, human resources, training, environmental protection, well-being, and education (Dichev and Dicheva, 2017). The value of the global gamification market grew to almost 11.94 billion USD in 2021 from 4.91 billion USD in 2016 (Clement, 2021). Many corporations invested in gamification software for employee training to optimize customer satisfaction (Robson et al., 2016). In particular, educational programs are incorporating gamification techniques to improve student motivation, with the educational field as the greatest contributor generating 26% of research conducted on the topic (Seaborn and Fels, 2015). There is great interest in the virtual applications of gamification (Linehan et al., 2011), evident with the recent surge of research concerned with the theory's implications, seen in 105 new publications on virtual gamification in education in 2020 compared to 3 publications in 2013 on PubMed. In the survey conducted by Seaborn and Fels, the authors found that 61% of findings from 31 papers reported positive results regarding the effectiveness of gamification while 39% had mixed results (Seaborn and Fels, 2015).

Moreover, gamification is a useful educational tool for its long-term contributions to behavioural patterns for learning. Through the use of gamification, students view progress as an achievement and are encouraged to focus on completing achievable goals rather than focusing on an extrinsic metric of performance (Seaborn and Fels, 2015). Thereby, learning becomes a durable and engaging activity, and students build resilience to failure. Gamification serves as a potential solution to break procrastination habits and reinforces consistency in working towards achievable goals (Karimi and Nickpayam, 2017).

Furthermore, online-based gamification introduces gamification to a population already immersed in technology (Rosas et al., 2003). 90% of teenagers in the United States play video games with various devices (Anderson and Jiang, 2018). Resources for technology-based programs are largely accessible in developed countries. 87% of households in urban areas and 81% of households in rural areas within developed countries have access to computers and/or the internet (International Telecommunication Union 2020). As such, developing countries will be omitted from this systematic review because of technological constraints and high levels of variance, when compared to developed countries.

This systematic review focuses on gamification's impact on intrinsic motivation in improving student behaviour and attitude towards learning (Elias et al., 2011). The drive to achieve internal goals (i.e. to obtain new skills) pushes students to perform well in examinations. Competition, immediate feedback, and storytelling are examples of gaming elements that are being used by researchers in developing gamification systems (Witt et al., 2011). For example, gamification users can compete with one another to earn points by engaging in certain actions, such as commenting on the ideas of other users (Witt et al., 2011). Points (units collected that reflect individual progress) and badges (icons earned through achievements) reward players for completing tasks and reaching goals, and achievements can be publicly displayed by ranking individuals on a leaderboard (Seaborn and Fels, 2015). Acquiring experience points increases a student's level and displays recognition for diligence (Seaborn and Fels, 2015). Group tasks and chats allow players to interact with and support each other. By building an online community, students can engage in discussions and build relationships with peers.

This systematic review seeks to address the concerns surrounding student motivation and engagement in education by reinforcing productive behaviours. The research targets declines in student motivation by studying the virtual gamification methods that can be implemented to enhance student motivation and engagement during the completion of cognitive tasks. Resulting research may lead to advancements in the field and provide information to the Felicity App. Felicity is an application targeting productivity in students. The application will incorporate gamification elements to improve intrinsic motivation, with a focus on students, to promote these habits. Therefore, this systematic review is also intended to analyze the relevant practical findings of research to incorporate elements that are most effective on a virtual platform, like Felicity. Since gamification is an unfamiliar topic, more empirical research and experimental replications must be conducted to further support the effectiveness of gamification. The literature has indicated a lack of statistical analyses and a lack of isolation of the gamification effect, noted through the absence of control groups (Seaborn and Fels, 2015).

Findings of this systematic review will address the potential challenges associated with student motivation through interventional methods.

## 2. Method

A systematic review was performed to determine the influence of virtual gamification integration on student motivation within academia. The objective of this systematic review was to search available literature to identify effective gamification techniques. Chosen interventions from this systematic review will yield potential features on the Felicity app

after screening, extraction, and quality appraisal of data in present literature. The selection procedure followed the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) guidelines. The protocol of this systematic review was registered with PROSPERO (record ID: CRD42021234241). PROSPERO is an international database of prospectively registered systematic reviews in health and social care.

### 2.1. Study design & setting

The purpose of this systematic review was to assess the effectiveness of virtual gamification methods in enhancing student intrinsic motivation and engagement in independent cognitive tasks. Rather than assessing all gamification techniques, this systematic review focused on the efficacy of virtual techniques, which can be integrated into a virtual application for greater global accessibility. The mixed methods design was used as it evaluates both qualitative and quantitative studies to establish breadth and depth within the systematic review (Schoonenboom and Johnson, 2017). The convergent integrated synthesis approach in a mixed methods design provides comprehensive assessment to the credibility, context, and utility of the studies while exploring diverse findings (Wisdom and Creswell, 2013). The mixed methods research design permits the examination of multidisciplinary data regarding gamification elements prevalent in motivational systems. The design also reveals a variety of findings, such as quantitative changes in grades and self-reported perceptions of satisfaction and motivation (Seaborn and Fels, 2015).

The demographic of interest encompasses students between the ages of 15–40 years residing in developed countries located in North America, Asia, and Europe, and included findings from all ethnicities. Research was collected from members of these regions as the majority of technological users reside in these countries with compatible devices necessary for the Felicity App (such as the internet and smartphones). Of the global youth population aged 15–24, internet users are proportioned as 90% in the Americas, 96% in Europe, 84% in the Commonwealth of Independent States (CIS), 70% in Asian and Pacific Islands, and 67% in the Arab States (International Telecommunication Union 2020). In comparison, only 40% of youths from Africa use the internet. There is also a greater number of mobile phone subscriptions in the Americas, Europe, and Asia compared to Africa (International Telecommunication Union 2020). To manage this discrepancy in resources, research on virtual gamification techniques in regions outside of North America, Europe, and Asia were omitted from this systematic review. The geographical exclusion reduces variability to ensure that the participants in the reviewed studies share similar technological backgrounds and experiences. Australia was also excluded from the search due to the limited number of relevant research in its region.

### 2.2. Search strategy & criteria

A diverse selection of literature, which included grey literature, was reviewed based on a predetermined inclusion/exclusion criteria. The criteria was established prior to the search and validated the contextual and scientific relevance of the data by developing a standardized expectation for the literature's content and experimental purpose.

Online databases that were searched in this systematic review include IEEE-Xplore, APA PsychInfo, and ProQuest from January 4, 2021, to January 16, 2021, by utilizing search strategies composed of key words related to the following: motivation, gamification, education, and psychology (refer to Appendix 1 for the search strategy). Regarding grey literature, the snowballing method was employed to identify and review the International Society for Technology in Education (ISTE) and Edutopia.org. Keywords including “gamification” and “motivation” were included to enhance search result relevance (refer to Appendix 2). Searches were further filtered to ensure relevance based on its date of production, as studies were set within the publication date range of January 1, 1990 to December 31, 2020.

The search strategy was developed by using keywords with booleans and truncations according to the population, intervention, comparison, outcomes, and context (PICOC) criteria. Specifically, “gamif\*”, “educat\*”, “psych\*”, “student”, “motivat\*”, “self-determination theory”, “autonom\*”, and “intrinsic motivat\*” aided in the extraction of published literature, while “econ\*” and “extrinsic motivat\*” were used to exclude material through the “not” function. All of the keywords were used for a majority of our searches, although deviations in keyword usage are present in ProQuest, ISTE, and Edutopia.org searches. These searches excluded keywords, such as; “extrinsic motivat\*” and “student” to broaden results, due to the limited number of relevant articles within the specified databases. A comprehensive set of sources were further processed using advanced search features to optimize relevance. Database-specific filters such as full-text, peer-reviewed, and journals were also applied, when applicable. The last search was conducted in January, 2021.

### 2.3. Inclusion & exclusion

Eligible studies included systematic reviews, randomized control trials (RCTs), and grey literature that were published in English between January 1, 1990 to December 31, 2020 within the field of psychology to provide a consistent baseline for searches by ensuring the relevance, accessibility, and quality of the preliminary literature. The populations of interest included students between the ages of 15 and 40 years old residing in developed countries within North America, Europe, and Asia. Since students in South America and Africa have significantly less access to the Internet and smart devices than those in the regions of interest, excluding these regions inhibited the wide discrepancy of resources from influencing the research conducted. The geographical exclusion created a control amongst acquired material. The focus of these studies was to explore the effect of gamification on personal, intrinsic motivation, and engagement using qualitative and quantitative data. Articles which reviewed one specific aspect of gamification in-depth, sampled individuals with mental or physical health diagnoses, and were unavailable online were excluded. The exclusion of these factors reduces bias as physical/mental conditions will uniquely affect a student's capacity to learn through gamification; thus data derived from students with such diagnoses can not be meaningfully compared amongst each other without significant confounding factors. The inclusion and exclusion criteria were predetermined. Refer to Fig. 1 for PICO analysis.

### 2.4. Data collection and abstraction

An abstract screening tool, consisting of 10 questions, was created and developed using the inclusion and exclusion criteria. These questions prompted the authors to analyze the literature's purpose, experimental design, methods, results, usage of gamification, and possible applications. The tool was tested by conducting a pilot screening trial in which five reviewers independently screened 24 abstracts and reconciled the individual scoring. The tool received an average accuracy score of 79%, as approximately four out of five authors agreed on the relevance of each abstract to the research question. The pilot screening validated accuracy and prompted two authors (AL and HD) to revise and refine the screening tool to improve precision. Modifications to the tool were prompted by discussions during reconciliation. More objective questions were created to improve the accuracy of the scoring. The database search results were combined, and duplicate articles were removed manually using Endnote (version 8.0.2) prior to the screening phase.

### 2.5. Identification of relevant studies and data extraction

Using the abstract screening tool, two review authors (SB and SS) independently reviewed 381 articles, which included study abstracts and grey literature to determine suitability of studies for inclusion. After

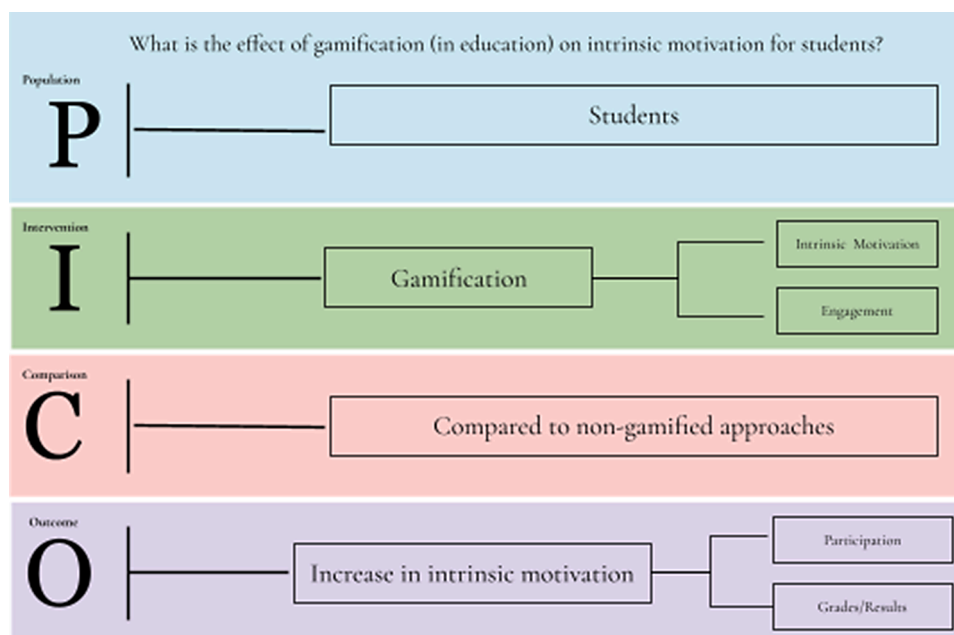


Fig. 1. Structural outline of PICO components that will be analyzed by this systematic review

the removal of duplicates, the literature was screened based on its title, abstract, and summary, when applicable. Disagreements between the two independent screeners were reconciled by a third author (AL), followed by the full-text screening of eligible literature from the abstract screening phase. Hand searches were conducted from January 4, 2021–January 17, 2021. The abstract screening took place between January 18, 2021–January 23, 2021 and the grey literature screening took place between January 21, 2021–January 24, 2021. A list of excluded studies is shown in [Appendix 3](#).

## 2.6. Quality appraisal

All included studies were assessed for quality using the Mixed Methods Assessment Tool (MMAT). The MMAT is a quality appraisal tool designed for literature that includes qualitative, quantitative, and mixed methods studies ([Hong et al., 2018](#)). The MMAT provides an effective measure to appraise a wide variety of empirical studies. The tool has been tested for reliability and content validity, however, the literature on the quality of the MMAT lacks consensus ([Hong et al., 2019](#)). Several studies reported a large range of inter-rater agreement scores, which raises concerns regarding the reliability of the tool. To address this issue, the review authors (AL and SA) clarified some criteria used in the MMAT to obtain more objective ratings of the studies. Disagreements between the authors were discussed during reconciliation.

## 2.7. Data extraction

Two authors (AL and SA) independently extracted data from the finalized list of studies that met the inclusion criteria. Data on study design, duration of intervention, participant information, type of data collected, and outcome of the intervention were recorded (for study characteristics, refer to [Appendix 4](#)). The two authors resolved any disagreements during reconciliation and disagreements were resolved by a third author when necessary.

## 3. Results

### 3.1. Study selection

The study selection and screening process is outlined in [Fig. 2](#). 381

papers were identified from the database search, out of which 49 were grey literature, 331 were published studies, and 1 was a duplicate. Out of the 331 published studies 89 were retrieved from IEEE-Xplore, 8 from APA PsychInfo, and 231 from ProQuest. Out of the 49 grey literature, 14 were retrieved from the ISTE, and 36 were retrieved from Edutopia.org. Both the published and grey literature articles went through abstract screening and full-text screening. After abstract screening 82 articles remained in total, out of which 6 were grey literature and 76 were published studies. After full-text screening, 66 articles were left, out of which 18 were grey literature and 48 were published studies. Through hand searching, 380 articles were identified with 47 grey literature, 333 published studies, and 16 duplicates. After abstract screening 74 articles remained, out of which 10 were grey literature and 64 were published studies. Through full-text screening 39 articles remained with 9 grey literature and 30 published studies. In total, combining database and hand searches, 105 articles remained, out of which 27 were grey literature and 78 were published studies.

### 3.2. Study characteristics

Of the 78 published studies included in this review, 36 studies are qualitative, 12 are quantitative descriptive, 15 are mixed methods, 8 are Randomized Control Trials (RCT), and 7 are non-randomized control trials. Furthermore, 15 studies are from the USA; 9 from Spain; 5 from Hong Kong; 4 from Portugal, Malaysia, France, Belgium, Bulgaria, Germany, and Iran contributed 3 studies, per country; Cyprus, Netherlands, Indonesia, Canada, Norway, and Taiwan provided 2 studies, per country. Also, 1 study from each of the following countries: Finland, Jamaica, Northern Ireland, Mexico, Croatia, South Korea, Hungary, Sweden, England, Italy, Scotland, Serbia, Switzerland, and Romania, were analyzed. Some studies are from more than one country. The collected data were grouped into four categories based on methods of collection: observational, questionnaire based, literature reviews, and data analysis. Out of the 78 papers, 33 are observation-based studies, 32 are questionnaire-based studies, 28 are literature reviews, and 2 are data analysis-based studies. Many studies are a combination of these data types and are incorporated in the values above. Studies were rated using the MMAT tool which has a 5 point scale, with 5 being the highest rank and 0 being the lowest rank. Out of the 78 articles appraised, 10 were rated 5, 22 articles were rated 4, 27 articles were rated 3, 10 articles

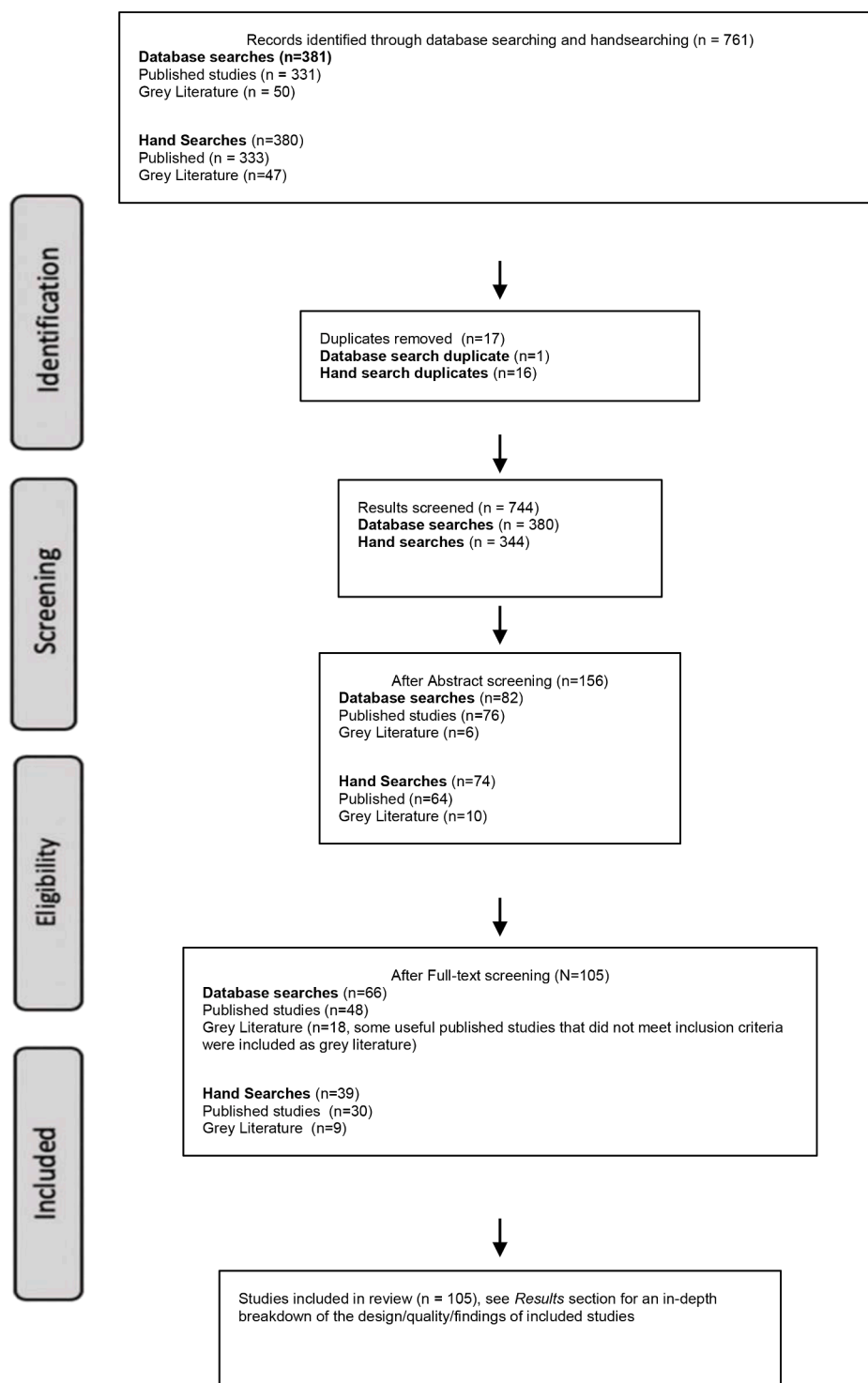


Fig. 2. Structural diagram of the screening and study selection processes completed

were rated 2, and 9 articles were rated 1.

### 3.3. Findings

Findings from studies that were rated 2 below 3 out of 5 using the MMAT tool were not considered. 59 articles were rated above 3, out of which 35 (59.32%) found that gamification improves motivation, 3 (5.08%) found that gamification did not improve motivation and 20 (33.9%) have either inconclusive results or results that were not relevant to the research question of this study.

### 3.4. Outcomes

Major outcomes were only considered for articles that were rated 5 out of 5 (n=10) using the MMAT. 3 out of these 10 studies had outcomes that were not relevant to the research questions. The remaining 7 found that gamification improves intrinsic motivation. The outcomes from these articles are listed in [Table 1](#). A detailed table of characteristics for included studies may be found under [Appendix 4](#).



**Table 1**

Findings and outcomes of articles that were rated 5/5 (n=10)

Article	Finding	Outcome
Facey-Shaw L et al., 2018, Educational Functions and Design of Badge Systems: A Conceptual Literature Review (Facey-Shaw et al., 2018)	Gamification improves intrinsic motivation	There are positive effects of using badges on learning
Chan G et al., 2019, Motivational strategies and approaches for single and multi-player exergames: a social perspective (Chan et al., 2019)	Gamification improves intrinsic motivation	Gamification motivated people through social interaction as it was more enjoyable
Herbert B et al., 2014, An Investigation of Gamification Typologies for Enhancing Learner Motivation (Herbert et al., 2014)	Gamification improves intrinsic motivation	Good relationship between gamification type and learner behaviour
Dichev C & Dicheva D, 2017, Gamifying education: what is known, what is believed and what remains uncertain: a critical review (Dichev and Dicheva, 2017)	Not relevant to the research question	Research on gamification is diverse; majority demographic for studies is college students; focus is on badges, points and leaderboards; not enough longitudinal research and education context
Dicheva D et al., 2015, Gamification in Education: A Systematic Mapping Study (Dicheva et al., 2015)	Gamification improves intrinsic motivation	Most reviewed papers showed that gamification improves learning
Mosalanejad L et al., 2018, Educational Game: A Fun and team based learning in psychiatric course and its effects on Learning Indicators (Mosalanejad et al., 2018)	Gamification improves intrinsic motivation	Gamification improved learning through increasing engagement.
Piras L et al., 2019, Design Thinking and Acceptance Requirements for Designing Gamified Software (Piras et al., 2019)	Gamification improves intrinsic motivation	Design thinking improves effects of gamification
Saputro RE et al., 2019, A gamification framework to enhance students' intrinsic motivation on MOOC (Saputro et al., 2019)	Gamification improves intrinsic motivation	New gamification platform increases student intrinsic motivation in online course format
Zhang R, 2020, Game-based self-regulated language learning: Theoretical analysis and bibliometrics (Zhang et al., 2020)	Not relevant to research question	Game Based Self-Regulated Language Learning (GBSRL) has been receiving more attention, specifically in the fields of learning strategies and the effect of GBSRL on learner states and its features.
Connolly TM et al., 2012, A systematic literature review of empirical evidence on computer games and serious games (Connolly et al., 2012)	Not relevant to research question	Serious game studies used quasi-experiments more, studies of entertainment games used quasi-experiments and surveys. RCTs and qualitative designs were uncommon.

#### 4. Discussion

This review provides a comprehensive examination of current literature regarding the effect of gamification on student intrinsic motivation in an academic setting. Generally, gamification is associated with increases in intrinsic motivation, which was recorded by observational, self-report, data analysis, or systematic review measures. The literature demonstrated this relationship, although there was variation in the

presence and level of motivational improvement. Gamification methods reinforced extrinsic motivation through the implementation of points, badges, and leaderboards, to strengthen individual intrinsic motivation. Continuous usage of gamification methods developed intrinsic motivation by creating an internal desire to complete tasks and diverting the source of motivation from external to internal.

According to the reported findings, a significant understanding has been gained in regards to the effect of numerous gamification elements on intrinsic motivation. The vast majority of studies (n = 53) incorporated some combination of three popular gamification elements: points, badges, and leaderboards. Thus, the implementation, effectiveness, and feasibility of integration into the Felicity App will be assessed.

##### 4.1. Points

A number of the included studies (n = 38) used a points system to record user progress and growth. Much like in video games, many of these studies found that Experience Points (XP) assisted the completion of various tasks by providing participants with insight into their level of progress. Subsequent increases in engagement and level of interest in tasks often resulted in improved outcomes, such as higher, more consistent test scores and class participation. Qualitative data from semi-structured interviews found that these points systems provided encouragement to participate in learning activities. Moreover, point systems were found to be helpful in providing external validation regarding the value of one's work.

35 studies coupled the points system with a leaderboard, badges, or an external reward system. Two of the three studies that only included a point system found that the intervention on its own had no significant effect on the outcome, even though the point system encouraged motivation. Similarly, Felicity should implement a point system, rewarding users for completed tasks. These points will be assigned a weighted value, based on the kind of task completed and will be used to compete in leaderboards and acquire badges. The effects of these additional components will be assessed in the following paragraphs.

##### 4.2. Leaderboards

The integration of leaderboards, as a gamified intervention, demonstrated an increase in student motivation (n = 32). Leaderboards allow students to compare their own achievements amongst peers to foster competition and social recognition. The participants in the studies attributed this gaming element to increase positive competition, subsequently increasing their motivation to take on tasks and to perform well. Qualitative data from interviews and focus groups, however, revealed that some students reported feeling less motivated to participate as a result of this added competition. This appears to be the case with students who were unable to reach a high rank on leaderboards. To address this concern many of these studies limited leaderboards to social groups and/or academic cohorts.

Acknowledgement of progress and achievements has been reported to have increased motivation in students. Whether through rankings and badges or socially by teachers and peers, participants in the studies reported that recognition increased the students' desire to complete more activities.

Felicity will reinforce positive competition and achievement recognition on an individual and user-based level by implementing leaderboards into its design. To prevent demotivation amongst users, because of the possible intensity of competition, Felicity will create an option to group users and thereby create an intimate and inclusive environment. As such, the incorporation of leaderboards for friend groups and academic classes seems to be the most effective to enhance the intrinsic motivation of students, as noted in Chan's study (Chan et al., 2019).

### 4.3. Badges

Along with point systems and leaderboards, several studies utilized digital badge systems. According to Alsawaier (Alsawaier, 2018), players who earned badges felt inner satisfaction as their status was shared and displayed publicly in the gamified environment. The study added that badges not only signal progress, but also serve as indications of past achievements. Additionally, by creating extrinsically motivating conditions through points, badges, and leaderboards, to encourage intrinsic motivation, the individual's focus gradually shifts from seeking rewards to completing tasks to fulfill internal desires.

In order to implement a badge system as effectively as possible in the Felicity app, upon acquiring specific achievements, badges will be displayed on the user's profile, which can be viewed publicly. Furthermore, it would be useful to include a feature that allows these badges to be shared on social media. Despite serving as a form of extrinsic motivation, the goal of this system is to assign value to otherwise menial tasks which may be difficult to complete. Thus, it will be useful to acknowledge and reward dedication and the completion of tasks through badges such as, "completed seven scheduled tasks" or "worked for six hours". Daily attendance badges will also be utilized to reinforce application use and promote productivity-associated behaviour, such as the completion of tasks.

### 4.4. Strengths and Limitations

Qualitative, quantitative, and mixed methods studies were examined for this systematic review. The mixed methods design provides a holistic view of the findings by incorporating both qualitative and quantitative data. Data were collected from a diverse pool of literature that focused on key concepts related to gamification and student intrinsic motivation. Beyond the quantitative findings, excerpts were analyzed from interviews and focus groups, which yielded a more in-depth understanding of the participants' experiences and opinions regarding gamification in education.

The systematic review includes studies from many regions within North America, Europe, and Asia. 17 studies were conducted in all countries in North America; 42 studies were conducted in Europe, encompassing the Eastern, Northern, Southern, and Western regions; 17 studies were conducted in Asia, encompassing the East, South East, and Middle East regions. Data were extracted from a variety of countries and education systems to inspect the impact of gamification on students within these areas. Studies that were not written in the English language were excluded from the systematic review which may limit the scope of the literature collection. As the Felicity app will be mostly accessible to members of these regions, measures were taken to ensure that the literature collected is representative of the target population.

There were some challenges regarding the objectivity of the MMAT ratings during the quality appraisal process. When rating qualitative and mixed methods studies, subjective judgement was required to assess the methodological quality criterion "Is there coherence between qualitative data sources, collection, analysis and interpretation?". While the

two authors responsible for quality appraisal came to an agreement as to what is considered relevant and significant, the MMAT ratings may not serve as a fully objective tool of measurement.

Another limitation of the systematic review is a lack of longitudinal studies that focused on the long-term effects of gamification on student learning. Majority of the gamified interventions introduced in the primary scientific literature were implemented for time spans ranging from a few hours to one academic semester. Data on the impact of gamification was collected immediately following the termination of the intervention. Additionally, the researchers did not follow up with the participants after time had passed since the intervention ended. As a result, there is a lack of substantial data that indicate which elements are most beneficial long-term and how certain gaming elements may influence intrinsic motivation over a long period of time.

## 5. Conclusion

Points, badges, and leaderboards were found to be the most effective media for using gamification to grow intrinsic motivation. 35 studies used points, leaderboards, and badges in cumulation to reinforce motivation and enhance self-efficacy. These interventions also foster positive competition and acknowledge individual achievements, which collectively inspires students to participate in and complete more activities. The level of student engagement with respect to task completion rate was also higher when utilizing gamified platforms, compared to the non-gamified condition. Therefore, gamified elements can be applied to enhance student productivity by instilling support for intrinsic motivation. The collected data provide insight for the curation of motivation-enhancing features within the Felicity App.

## Declarations

**Funding:** This systematic review was funded in part by a grant from The Duke of Edinburgh's International Award through the P2P program and in partnership with the federal government of Canada.

**Availability of data and material:**

**Code availability:**

N/A

**Authors' contributions:**

JX devised and supervised the project and secured funding acquisition. AL and HD conceptualized the review, AL, HD, and SB designed the protocol and search articles, AL and HD revised the protocol, SB and SS completed preliminary and full-text screenings, AL, HD, SA, and UN completed hand searches, AL and SA completed quality assessment and data extraction. AL created figures and computed numerical data, UN completed the data analysis, AL, HD, SA, SB, UN, and SS equally wrote the manuscript. All authors reviewed the final manuscript.

## Declaration of Competing Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

## Appendix 1

### Database Searches

January 4, 2021 to January 16, 2021

Database	Search	Results
Institute of Electrical and Electronics Engineers	(((((Full Text Only:Gamif*) AND "Full Text Only:Educat*) AND "Full Text Only:Psych*) AND "Full Text Only:Student) NOT "Full Text Only:Econ*) AND "Full Text Only:Motivat*) AND "Full Text Only:intrinsic motivat*) NOT "Full Text Only:extrinsic motivat*)	89
APA PsychInfo	(Gamif*) AND (Educ*) AND (Psych*) AND (Student) NOT (Econ*) OR (Motivat*) OR Self-determination theory) AND (autonom*) AND (intrinsic motiv*) NOT (extrinsic motivat*)	8
ProQuest	Gamif* AND Motiv* AND Educ* AND Psych* AND (Intrinsic Motiv*) NOT (Econ*) AND (Self determination theory)	231

## Appendix 2

### Grey Literature Searches

January 17, 2021

Database	Search	Results
International Society for Technology in Education	Gamification AND intrinsic motivation AND student	14
Edutopia.org	Gamification AND motivation in learning	36

## Appendix 3

### List of Excluded Studies from Quality Appraisal

Author	Article Title
Brull S & Finlayson S Danka I	Importance of Gamification in Increasing Learning Motivation by gamification: Adapting motivational tools of massively multiplayer online role-playing games (MMORPGs) for peer-to-peer assessment in connectivist massive open online courses (cMOOCs)
Oldenhave D et al.	Using Game Psychology in Information System Design for Sustainable Behavior Changes
Randall DL et al.	Giving credit where credit is due: Designing open badges for a technology Integration course
Hickey DT et al.	Badges design principles documentation project: Interim report January 2014 update
Engedal JØ	Gamification: A study of motivational affordances
Jackson M	Gamification in education: A literature review
Grabowski J et al.	Gamification in online education: how and why?
Perez BG	Applying gamification to education: A case study in an e-learning environment
Davidson S & Candy L	Gameful learning as a teaching/learning strategy: Best practices and lessons learned
Nicholson S	A user-centered theoretical framework for meaningful gamification
Lee J & Hammer J	Gamification in education: What, how, why bother?
Molina-Carmona R & Llorens-Largo F	Gamification and Advanced Technology to Enhance Motivation in Education

### Excluded Files from Hand Searches

Author	Title
Anderson, A et al.	Steering User Behaviour with Badges
Bruder, P	Game on: Gamification in the classroom
Clements, J	Gamification: Freshman English can be a game
Farber, M	Beyond badges: Why gamify?
Hamari, J et al.	Does gamification work? A literature review of empirical studies on gamification
Foster, J	The promise of digital badges
Hamari, J	Does gamification work? A literature review of empirical studies on gamification
Keeler, A	Beyond the worksheet: Playsheets, GBL, and gamification
Kim, Y et al	Connecting agents: Engagement and motivation in online collaboration
Kumar, B et al	Gamification in education: Learn computer programming with fun.
Hakulinen, L et al	Empirical study on the ef-fect of achievement badges in TRAKLA2 online learning environment
Lieberman, D	What can we learn from playing interactive games
Monterrat, B et al	A framework to adapt gamification in learning environments
O'Byrne et al	Digital badges recognizing, assessing, and motivating learners in and out of school contexts
Papastergiou, M	Digital game-based learning in high school computes science education: Impact on educational effectiveness and student motivation
S. O'Donovan, et al	A case study in the gamification of a university-level games development course
Jafari, S et al	Investigating the relationship between learning style and game type in the game-based learning environment
Andrias, R et al	User/Player Type in Gamification
Haaranen, L et al	Software Architectures for Implementing Achievement Badges - Practical Experiences

### Excluded files from full text motivation



Author	Title
Ehsan, A et.al	Performance appraisal of knowledge workers in R&D centers using gamification
Lourdes, A	Learning Prosody in a Video Game-Based Learning Approach
Ines, A	Gamification: methodology to engage and motivate students in the learning process
Paz, D.P et.al	Use of Information and communications technology in language teaching: Connecting knowledges
Demkah, M & Bhargava, D	Gamification in Education: A Cognitive Psychology Approach to Cooperative and Fun Learning
Bovermann, K et.al	Online learning readiness and attitudes towards gaming in gamified online learning – a mixed methods case study: Revista de Universidad y Sociedad del Conocimiento
Patrick, B et.al	Game On! Students' Perceptions of Gamified Learning
Thili, A et.al	Personality Effects on Students' Intrinsic Motivation in a Gamified Learning Environment
Sun, Y.A & Chiou, M.J	Online Platform to Evolve and Develop Motivational Theories on Manufacturing Management Learning to Achieve Pandemic Curriculum Outcomes
Su, C.H	Exploring Sustainability Environment Educational Design and Learning Effect Evaluation through Migration Theory: An Example of Environment Educational Serious Games
Cinganotto, L	Gamification and virtual worlds for language learning
Cohard, P	Evaluation of Serious Game User Experience: the Role of Emotions
Qiu, C.S	The impact of a gamified world on medical education
Labrador, E. & Portero, E.V	Gamification and User eXperience for make the learning experience better
Waweru, B.W et.al	Gamesy: How Videogames Serve as a Better Replacement for School?
Fernandez, M.M	MÉTODOS PEDAGÓGICOS EMERGENTES PARA UN NUEVO SIGLO ¿QUÉ HAY REALMENTE DE INNOVACIÓN?
Valero, A.F et.al	Gamification in Physical Education: Evaluation of Impact on Motivation and Academic Performance within Higher Education
Malicki, A et.al	Gamification in nursing: a literature review
Fleischmann, K & Ariel, E	Gamification in Science Education: Gamifying Learning of Microscopic Processes in the Laboratory
Fuhrmann, T	Motivation Centered Learning
Gadanez, P	The nature of positive emotions via online language learning
Taylyn, H et.al	From here to there! Elementary: A game-based approach to developing number sense and early algebraic understanding
Hung, H.T	Clickers in the flipped classroom: Bring your own device (BYOD) to promote student learning
Dichev, C et.al	Towards Activity-Centered Gamification Design
Denden, M et.al	Students' learning performance in a gamified and self-determined learning environment
Chang, J.W & Wei, H.Y	Exploring Engaging Gamification Mechanics in Massive Online Open Courses
Kapsalis, G.D	Kahoot! As a Formative Assessment Tool in Foreign Language Learning: A Case Study in Greek as an L2
Kim, S	Team Organization Method Using Salary Auction Game for Sustainable Motivation
Marczak, R et.al	Influence of Dissociated Mechanisms of Gamification on the Learning of Reading
Matute, J & Melero, I	Game-based learning: using business simulators in the university classroom/ Aprender jugando: la utilización de simuladores empresariales en el aula universitaria+F190
Rodenburg, D	Dynamically adaptive simulation based on expertise and cognitive load
Ndlovu, T.N & Mhlongo, S	An investigation into the effects of gamification on students' situational interest in a learning environment
Yousefi, B.H. & Mirkhezri, H	Toward A Game-based Learning Platform : A Comparative Conceptual Framework for Serious Games
Moody, S et.al	Vocabulary Instruction: A Critical Analysis of Theories, Research, and Practice
Tal, I et.al	Multimedia in Telecommunication and Networking Education: A Novel Teaching Approach that Improves the Learning Process
Zamorano L.R et.al	Gamified crowdsourcing in higher education: A theoretical framework and a case study
Oberdorfer, S & Latoschik, M.E	Knowledge Encoding in Game Mechanics: Transfer-Oriented Knowledge Learning in Desktop-3D and VR
Kamunya S et.al	A Gamification Model For E-Learning Platforms
Ohn, M.H et.al	Gamified Online Active Learning Theory
Santos, T.C & Parizi, R.B	Gamification and Project-Based Learning as Software Quality Teaching Methodologies
Dziedz, M.P	Gamifying Online Tests to Promote Retrieval-Based Learning
Mayer, R.E	Theory: Applying Cognitive Science to Games for Learning
Rist, T & Masoodian, M	Promoting Sustainable Energy Consumption Behavior through Interactive Data Visualizations
Sanchez, S.P et.al	Gamification as a Methodological Complement to Flipped Learning—An Incident Factor in Learning Improvement
Smiderle, R et.al	The impact of gamification on students' learning, engagement and behavior based on their personality traits
Smith, T	Gamified modules for an introductory statistics course and their impact on attitudes and learning
Jarvis, K	Using Gamification to Increase Engagement During Hybrid Learning
Willis, J	Matching Edtech Products With Neurological Learning Goals
Moler, A	Does Our Natural Affinity for Games Have a Place in the Classroom?
Jain, R	Can stress help students?
Willis, J	Strategies to Prevent the Neurotoxic Impact of School Stress
Fodor, Z	'Gamified' Technology Supported Project Based Learning + Student Habits of Mind Leveraging Aspects of Games Like MinecraftEdu in Order To Achieve Something Beyond Traditional Project Based Learning.

## Appendix 4

### Study Characteristics

Author, date, title of study	Country	Study design, duration, and participants	Type of data	Gamification elements	Outcome	Quality: design/score 1/****
Hernandez-Fernandez, 2020, Is Classroom Gamification Opposed to Performance?	Spain	Qualitative; 175 h classroom hours and 133 h on virtual platform; 151 masters students across 3 academic years	Longitudinal case-study; Final mark in the course (obtained from various assessments/activities), attendance, surveys (on subject and teachers), gamified points	Points	Negative correlation between the scores of the evaluations and the marks obtained in the activities of gamification. The group less involved in the gamification obtained	

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Abdollahzade, 2018, Investigating the Relationship between Player Types and Learning Styles in Gamification Design	Iran	Quantitative Descriptive; 121 university students	Questionnaire on learner styles (n=44); questionnaire to measure type of player (n=24)	N/A	better academic results. Gamification improved motivation. Confirmed relationships between specific player types and learning styles (e.g. socializer player and active learning style) suggesting that certain players respond best to certain forms of learning (like e-learning).	4/****
Alsawaier, 2018, The effect of gamification on motivation and engagement	USA	Qualitative; first part of research trilogy	Critical analysis of literature on gamification	Avatars, quests and challenges, badges, points and levels.	Gamification uses various theories. There are different player types. gamification features include avatars, quests and challenges, badges, points and level. Gamification is connected to motivation, engagement, and fun. More research must be conducted on the topic.	1/*
Alvaro-Tordesillas, 2020, Gamification experience in the subject of descriptive geometry for architecture	Spain	Quantitative non-randomized; students aged 18-19 years of age (n=321) throughout 6 semesters	Academic results; surveys on student perception of the subject	Points, badges, and leaderboards.	The implementation of gamification improved the perception and experience of the university students of the subject of Descriptive Geometry, as well as the development of the professor.	3/***
Mora, 2018, Effect of personalized gameful design on student engagement	Spain	Quantitative Descriptive; 81 university students for 20 school weeks (14 gameful weeks)	Trello user logs, practices, and a survey to measure student motivation to solve non-evaluative activities	Points and rewards.	Personalized gamified learning works better regarding the behavioral and emotional engagement of the students with the course, but there weren't significant results on some characteristics.	4/****
Aşıksoy, 2018, The effects of the gamified flipped classroom environment (GFCE) on students' motivation, learning achievements and perception in a physics course	Cyprus	Quantitative randomized controlled trials; 61 undergraduate students for 8 school weeks in a physics course	Physics motivation questionnaire, electromagnetism achievement test and semi structured interviews	Points, badges, and leaderboards.	Gamified flipped classroom students had a significantly increased motivation and students' opinions on the gamified classroom environment were positive.	2/***
Hakulinin, 2014, The Effect of Gamification on Students with Different Achievement Goal Orientations	Finland	Quantitative Non-Randomized; university students in a Data Structures and Algorithms course (N=278) for 1 semester (half of which was gamified)	A pre-test and post-test was used to measure differences in the prior knowledge; goal orientation survey; course feedback questionnaire on badges; first half vs second half performance	Points and badges.	No significant differences in the behavior of the different goal orientation groups regarding badges. Students who reported high motivation towards badges had higher mastery-intrinsic, mastery-extrinsic and performance-approach orientation, and lower avoidance-orientation.	3/****
Facey-Shaw, 2018, Educational Functions and Design of Badge Systems: A Conceptual Literature Review	Jamaica and Netherlands	Qualitative; literature (n=63) from electronic databases (n=7) between 2010–2016	Literature review regarding specific gamification tools	Badges	The three core design dimensions found were the specific function of badges, the structure of badge systems and the different types of interactions with badges. Results are mixed, but many report positive results concerning aesthetics. Overall the potential of badges for learning in various disciplines and across all educational levels, from elementary to post-secondary seems to be confirmed.	1/*****
	USA			N/A		1/****

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Breatman, 2019, Games in Learning: Shedding Light on a Problematic Taxonomy		Qualitative; 50 definitions were sourced through examining original source literature	The literature was surveyed for the definitions terms relating to this paradigm through both a survey of the literature and a novel variant of sorting activity		Individual item definitions do not semantically cluster together by corresponding term (suggests lack of clarity and consensus). Through both the survey of the literature and the card sort analysis, the disjointed state of the current disciplines of study becomes rapidly apparent.	
Chan, 2019, Motivational strategies and approaches for single and multi-player exergames: a social perspective	Canada	Qualitative; identified 30 articles from 5 electronic databases	Literature review (snowball method)	Social interaction.	Exergames are effective at motivating people to participate in exercise, but not long-term. Gamification uses self-determination theory. Players are motivated by social interaction, competition, and cooperation.	1/*****
Mi, 2018, A Gamification Technique for Motivating Students to Learn Code Readability in Software Engineering	Hong Kong	Quantitative randomized controlled trials; 14 days involving undergraduate students (n=161); control (n=81)	Post-experiment questionnaire collecting student feedback on perceived ease of use, perceived usefulness, attitude toward game design elements, and user satisfaction	Points, badges, and leaderboards.	Points and leaderboards are more effective than badges in motivating students to participate. Gaming techniques weren't as attractive to students. Gaming technique was easy to use.	2/***
Herbert, 2014, An Investigation of Gamification Typologies for Enhancing Learner Motivation	Northern Ireland	Mixed Methods; two twelve week long computing modules with university students (n=93)	Questionnaire to establish their gamification learning profile and developed a decision tree to track relationship with intrinsic and extrinsic motivation; tracked learner movement and number of resources used; measured learner performance average	Points, badges, visible status, unlockable content, customization, levels, and leaderboards.	Good relationship between clusters of learner gamification type and learner interactive behavior within the gamified technique. behavior of each gamification type was consistent between two separate learning modules.	5/*****
Chasanidou, 2018, Design for Motivation: Evaluation of a Design Tool	Norway	Qualitative; one pilot study and six workshops with participants with multidisciplinary backgrounds (n=32)	A pre-questionnaire (open questions measured with likert scale), observations with field notes and video-recordings during the workshop, and a post-questionnaire (about experience and satisfaction) and audio-recorded semi-structured interviews after the workshop	Cards	The results indicate that the design process of creating motivational innovation platforms is supported by the features of the DEMO tool.	1/****
Clément, 2020, Prospective study on a fast-track training in psychiatry for medical students: the psychiatric hat game	France	Quantitative Descriptive; third-year medical school students (n=166) used the "Psychiatric Hat Game" for four months	Pre- and post-evaluation of knowledge (n=20) and a satisfaction survey (n=8)	N/A	The Psychiatric Hat Game improved knowledge of psychiatric semiology in medical students and was enjoyable.	4/****
Cruz, 2014, Too cool for school?: The effects of gamification in an advanced interdisciplinary course	USA	Qualitative; one semester long; undergraduate students (n=43)	A survey regarding their perceptions of learning through gamification (n=2); end-of-semester review activity	Badges, points, and prizes.	Mixed results from survey regarding effect of gamification on motivation to participate. many students participated with the games and achieved many points. Few students didn't engage with the gamified elements but still performed well. Under-performing students enjoyed gamification.	1/***
De Troyer, 2020, Playful Learning with a Location-Based Digital Card Environment: A Promising Tool for Informal, Non-Formal, and Formal Learning	Belgium	Qualitative; "youngsters" (n=undefined) from 11 organizations for individual interview sessions; animators aged 16-25 (n=20) in first evaluation of phase 2; animators aged 18 and older (n=18) in the second evaluation of phase	Literature review; evaluation of proposed design; Interviews for initial evaluation of application; questionnaire on experience and application for phases 2 and 3	Points and rewards.	Feedback for initial phase was positive. the application can be used for team building activities, for information providing, and for non-formal learning activities, as well as in the context of regular	1/****

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		2; participants aged 14-15 (n=6) in first evaluation of phase 3 participated in a city game (2h); students in the second evaluation of phase 3 (n=7) were in a five day long camp			education in an engaging manner.	
Dichev, 2017, Gamifying education: what is known, what is believed and what remains uncertain: a critical review	USA	Qualitative; empirical research studies (n=51) and theoretical papers (n=11)	Literature review using online databases	Points, badges, levels, leaderboards and progress bars.	Research on gamification is diverse with most papers focusing on empirical studies rather than theory. Majority of the target demographic is college students. Large focus on badges, points, and leaderboards. Not enough research on long-term effects and on educational context.	1/*****
Dicheva, 2015, Gamification in Education: A Systematic Mapping Study	USA and Bulgaria	Qualitative; empirical studies (n=34) between 2010-2014 from scientific databases (n=7)	Systematic mapping study; frameworks, patterns, educational contexts, and configurations of used game elements collected	Points, badges, levels, progress bars, leaderboards, virtual currency, and avatars.	Most reviewed papers show promising results. majority describe only some game mechanisms and dynamics and re-iterate their possible use in educational context, while true empirical research on the effectiveness of incorporating game elements in learning environments is still scarce.	1/*****
Doney, 2019, Research into effective gamification features to inform e-learning design: Association for Learning Technology Journal	United Kingdom	Qualitative; case studies (n=41) by searching various journals	Data from case studies categorized from 7 headings	, challenge, control, feedback, interaction, representation, rules and goals, and reflection.	There are a number of gamification approaches that may be effective when designing e-learning activities for adult learners. Effective learning relies on what happens beyond the gamification medium.	1/***
Chong, 2019, Benefits and challenges with gamified multi-media physiotherapy case studies: a mixed method study	Hong Kong	Mixed methods; year-3 students (n=100) in a Neurological Physiotherapy course for 1 month; 6 gamified tutorial sessions; focus group for feedback (n=12)	Interviews with focus group; survey (n=12) on perception and satisfaction on the virtual patient cases	Narration storytelling, points, leaderboards, rewards, and feedback.	Most students found the gamification in class to be useful, enjoyable, and improved motivation. Leaderboards motivated the students through visualisation of progress. Feedback on performance and progress enhanced self-efficacy. Team dynamics need to be fostered in order to achieve the optimal benefits of social interactions.	5/**
Moreira, 2020, Teaching and learning Modelling and Specification based on gamification	Portugal and Spain	Qualitative; method proposal	Literature review	Levels, leaderboards (Ranking Block), rewards (experience points (XP reward), Badges and Coins), Progress bar and content locking.	A proposal to use gamification as a teaching-learning methodology which aims to increase student involvement and motivation. Uses leaderboards, badges, coins, progress bars and a blocking system.	1/*
Ting, 2019, Active Learning via Problem-Based Collaborative Games in a Large Mathematics University Course in Hong Kong	Hong Kong	Quantitative Descriptive; 13-week Applied Mathematics course with undergraduate students (n=1017)	Pre and Post Concept and Midterm Tests (n=20); survey on perception of active learning in class	Points, leaderboards.	Students who perceived they were more actively engaged or spent more time in active learning performed better in the post test. Students' perceptions of time spent in active learning is a significant predictor of their level of conceptual understanding of differential calculus. Students' perceptions of	4/****

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Isanova, 2019, Towards a justified choice of gamification framework when building an educational application	Bulgaria	Qualitative; analysis of recent frameworks	Literature review; framework developed to record how studies meet various criteria	N/A	their level of active engagement is a significant predictor of their academic performance. Provided a theoretical framework for gamification. levels, rewards, points, hints, badges, challenges, goal setting, progress/story, time frame, and immediate feedback are useful gaming elements.	1/****
Romero-Rodriguez, 2019, Gamification in MOOCs: Engagement Application Test in Energy Sustainability Courses	Mexico	Mixed methods; quantified findings of various studies; research methods not defined	Literature review and analysis; studies extracted for features like simplicity, progress, feedback, etc.	Rewards in the position charts, medals, badges, and points	The degree of student engagement with respect to the completion rate of activities was higher in the gamified platform than in the traditional design. Applying gamification strategies in MOOCs achieves a higher level of engagement and student motivation.	5/**
Brayshaw, 2016, Using motivation derived from computer gaming in the context of computer based instruction	United Kingdom	Qualitative; methods not well developed	Literature review; makes no mention of extracted data	N/A	In order to motivate, desirable properties include understanding and using competence, autonomy and relatedness alongside rich, immersive interactions, levels of achievement through appropriate feedback and the movement to higher levels reflecting and rewarding this, user ownership of their learning, and the importance of learning as a social endeavour.	1/**
Hammerschall, 2019, A Gamification Framework for Long-Term Engagement in Education Based on Self Determination Theory and the Transtheoretical Model of Change	Germany	Qualitative; discussion of theory and proof of concept	Literature review	N/A	A proposed framework is based on outcomes from motivational (SDT, CET) and behavior change (TTM) theories.	1/****
Mystakidis, 2019, Enter the Serious E-scape Room: A Cost-Effective Serious Game Model for Deep and Meaningful E-learning	USA	Mixed methods; high school students (n=148) played a serious E-scape room game for two months	Pre-test assessment (n=12) on game content and outcomes; post-test (n=21) on same assessment as well as evaluations on the game	Points, badges, challenges.	Performance increase and high overall satisfaction following E-scape room. The game has been received enthusiastically by students, it increased their motivation and helped them build a deeper understanding of the learned concepts.	5/*
Johnson-Glenberg, 2017, Embodied science and mixed reality: How gesture and motion capture affect physics education: Principles and Implications	USA	Quantitative randomized controlled trial; physics lesson (1 h) with undergraduate students (n=166)	Content knowledge pre-test and post-test (n=34 multiple choice for computer version, n=8 for gesture-based version), and an engagement survey (n=5) on the activity and participants ranked the games based on preference (n=7)	Narrative storytelling and points.	The predicted differences in engagement and learning for the condition with the graphically rich story narrative were not supported. Hypothesized that a narrative effect for motivation and learning may be difficult to uncover in a lab experiment where participants are primarily motivated by course credit.	2/***
Kermek, 2016, Preparation of a hybrid e-learning course for gamification	Croatia	Mixed methods; students in a learning management systems course for one semester	Literature review for creation of course; self-assessment test scores and homework score	Points, levels, leaderboards, badges, challenges/quests, onboarding, and social engagement loops.	The experimental group exposed to gamification achieved higher scores for the self-assessment tests and the homework assignments. Experimental group was more interested in the activities.	5/*
			Literature Review	N/A		1/***

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Kim, 2013, Dynamical model for gamification of learning (DMGL)	South Korea	Qualitative; Qualitative analysis of precedent theories and research, dozens of explored elements including GDF, KCLG, MDA, etc.				Created a sigmoidal equation for the educational effectiveness of Gamification. Game elements play substantial roles not only in education but also in numerous non-gaming applications on pc's, smart phones, and tablets. More students were able to solve the exercises after playing the game.	
Kiraly, 2020, The Effectiveness of a Fully Gamified Programming Course after Combining with Serious Games.	Hungary	Quantitative non-randomized; university students (n=400; n=200 in experimental group) in a Learning Management Systems course for 1 semester	Number of students able to complete both exercises	Points, badges, incentives, immediate feedback and leaderboards.			3/***
Handani, 2018, Comparing Learning Media Applications Using Gamification Theory	Indonesia	Mixed method; high school students (n=128); Literature review discusses aspects of intrinsic motivation, researchers build two productivity apps, one which used these features and one which didn't	Questionnaires were used to assess the effects of the apps.	Feedback		There is no difference in motivation, self-determination, achievement goals, social learning and student learning and feedback on both applications.	5/*
Leftheriotis, 2017, Gamifying informal learning activities using interactive displays: an empirical investigation of students' learning and engagement	Norway	Mixed methods; high school students (n=16) engaged with the application (45 min)	Pre-post attitudinal surveys (n=20) and cognitive tests along with photos and observations were recorded	Points.		Most of the studies found in the literature are focused on the positive effects of an interactive display (such as a multi-touch screen) on users' experience. Gamification of a learning activity improved students' knowledge acquisition, satisfaction, enjoyment and intention to participate on similar events in the future.	5/****
Li, 2018, Can a Game-based Productivity Tool Improve Procrastination?	Taiwan	Quantitative descriptive; users (n=81) used the productivity tool app	Questionnaire on perceived usefulness	Goals, feedback, rules, and social awareness.		The perceived usefulness is significantly related to attitude. Most users agree that the proposed game-based framework does provide useful features to avoid procrastination. Perceived usefulness is not significantly related to the intention of using the proposed framework	4/**
Laine, 2020, Designing Engaging Games for Education: A Systematic Literature Review on Game Motivators and Design Principles	Sweden and Belgium	Qualitative; studies on game motivators and game design principles (n=52) from online databases; Iterative workflow for data analysis, comprising study selection and quality assessment as well as data extraction and synthesis	Systematic literature review	N/A		Motivated engagement is essential in educational interventions. Many of the motivators and design principles have strong support in previous research. Several taxonomies were identified. The results offer educational game designers a practical toolkit that can help promote motivated engagement in their games.	1/****
Lumsden, 2016, The effects of gamelike features and test location on cognitive test performance and participant enjoyment	England	Quantitative randomized controlled trial; university staff and students (n=304) took part in either gamified or non-gamified variants of a task	Reaction time, reaction accuracy, a questionnaire on enjoyment and engagement	Points		Points are a highly suitable game mechanic for gamified cognitive testing and they increase enjoyment. No evidence that game-like features could increase engagement to the point where participant performance improved.	2/***
Batooli, 2018, Information Literacy Gamified Online Tutorial	Iran	Qualitative; articles related to the online tutorial information literacy elements (n=18) and articles that addressed motivational and game strategies (n=23); online tutorials were reviewed from the PRIMO database (n=81)	Literature review; classification of 43 essential features for the creation of an online tutorial	Many		11 elements of structural and content gamification and 28 motivational strategies were identified to meet the three requirements of internal competence, autonomy and relatedness.	1/***
				Avatars, challenges.			5/***

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Jong, 2018, Gamifying and Mobilising Social Enquiry-based Learning in Authentic Outdoor Environments	Hong Kong	Mixed methods; grade 10 students (n=559) tested the gamified application (3 days)	Knowledge test scores and semi-structured interviews (45 min)		The application had different degrees of positive effects on the high, moderate, and low academic-achieving participants. Students in the gamified condition achieved higher scores on the test. gamified application promoted learners' motivation and significantly enhanced knowledge construction performance. Promoted cooperation and competition.	
Mosalanejad, 2018, Educational Game: A Fun and team based learning in psychiatric course and its effects on Learning Indicators	Iran	Quantitative descriptive; nursing students (n=39) participated in a psychiatric course	Quasi-experimental studies; pre-post test (Questionnaires on learning readiness, self-regulation, teamwork, and self-reflection)	N/A	Gamification can affect the individual and participation learning by creating an entertaining and interactive environment. No significant change in team-based learning.	4/*****
Piras, 2019, Design Thinking and Acceptance Requirements for Designing Gamified Software	UK and Italy	Qualitative; four members of the research team conducted post-review questionnaire to assess the effectiveness of the gamification solution	Case study and literature review; post-study questionnaire to assess perceived the usefulness of DTA (n=8)	Points, badges, leaderboards.	The analysis of these works provides further evidences about the practical relevance of the Design thinking in gamification.	1/*****
Mystakidis, 2020, Distance Education Gamification in Social Virtual Reality: A Case Study on Student Engagement	UK	Qualitative; post-graduates students (n=14) participated in an e-learning course (2 years)	Observations (qualitative comparisons between gamified and non-gamified conditions)	Story, points, levels, quests, classes, badges, and achievements.	Gamified elements elicited students' interest, motivation and autonomy towards critical engagement.	1/****
Berkling, 2019, Presenting an Open-Source Platform for Supporting Gamified Class Teaching with Peer Reviews	Germany	Qualitative	Literature review (analysis of current literature and future framework proposal); Useful quality data were extracted and incorporated in a proposal for a gamification platform	Points, progress, leaderboards, tasks, and immediate feedback.	A first prototype is implemented that includes the most important functionalities in order to be exchanged for the status-quo platform.	1/***
Oluwajana, 2018, The Adoption of Students' Hedonic Motivation System Model to Gamified Learning Environment	Cyprus	Mixed methods; literature review; first-year undergraduate students (n=150) participated in a gamified learning environment (5 weeks)	Questionnaire (n=27) of perceived ease of use, usefulness, behavioural intention to use, enjoyment, curiosity, control, and immersion	Storytelling, badges, levels, points, and rewards.	Perceived usefulness, perceived ease of use, enjoyment and control all have a significant positive relationship with behavioural intention of use and focused immersion. increased students' motivation and engagement in learning. Negative relationship exists between enjoyment and focused immersion.	5/***
Ouariachi, 2020, Gamification Approaches for Education and Engagement on Pro-Environmental Behaviors: Searching for Best Practices	Netherlands	Qualitative; analyzed cases (n=6)	Literature review and Triangulation (using two types of secondary data analysis and qualitative content analysis)	N/A	This study concludes that gamification approaches have potential to educate and encourage pro-environmental behavioural change, as long as they combine in their design extrinsic and intrinsic motivational elements, short-term and long-term drivers, and game attributes that encourage taking action in real life.	1/***
Saputro, 2019, A gamification framework to enhance students' intrinsic motivation on MOOC	Indonesia and Malaysia	Qualitative; experts (n=6) evaluated the framework	Literature review; relevant gamification elements extracted to create a proposed framework; evaluation questionnaire on proposed framework	Challenge, positive feedback, transaction, resource acquisition, and feedback.	It is proposed a new gamification framework to be applied to the MOOC platform that focuses on efforts to increase students' intrinsic motivation when taking online courses.	1/*****
Mahmud, 2020, Teaching Presence in Online Gamified Education for Sustainability Learning	Malaysia	Mixed methods; quasi-experimental design; university students (n=48) used a gamified application (8 weeks)	Pre-test and post-test scores, reflections, and focus group interviews	Points, badges, leaderboards.	The findings from the quantitative data showed that the students in the treatment group obtained higher points for their activities in JouleBug compared to the control group. Increment in sustainability	5/***

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Stachowski, 2019, Comparison of three “gamified” exam review activities	USA	Quantitative non-randomized; undergraduate students (n=60) in a gamified psychological methods course (15 weeks)	Exam scores; students completed a survey regarding their motivation and team process and completed another survey to indicate whether their study habits had changed	Points, leaderboards.	knowledge does not necessarily lead to increment in pro-environmental behaviour. Recognition by the teacher was stated to be one of the factors that motivated students to engage in the JouleBug activity. Students rated their motivation for the activities highly and perceived minimal relationship conflict during the exercises. All three review activities are enjoyable and do appear to have value for students.	3/***
Zhang, 2020, Game-based self-regulated language learning: Theoretical analysis and bibliometrics	Hong Kong	Qualitative; 54 papers in the database on GBLL and 314 papers in the database on SRL	Theoretical analysis, thematic evolution analysis, and social network analysis	N/A	The results show that GBSRL is a new interdisciplinary field that has been attracting increasing academic attention since the period from 2018 to 2019. The prominent research topics in this field include self-regulated learning strategies that can be performed in GBLL, the effects of GBSRL on learners' affective states, and the features of GBSRL.	1/****
Hsieh, 2014, Motivation matters? The relationship among different types of learning motivation, engagement behaviors and learning outcomes of undergraduate students in Taiwan	Taiwan	Quantitative descriptive; junior university students (n=231) for one semester	Survey results	N/A	The outcomes from this hierarchical multiple regression analysis show that three different student engagement behaviors do not significantly predict learning outcomes when including the variables of student's demographic backgrounds and learning motivation.	4/***
Gibson, 2013, Digital badges in education	USA	Qualitative	Literature Review; information regarding origin, history, and evidence of use with digital badges	Badges.	Because digital badges seem to have important impacts on motivation for learning, status within a community, and can transparently display achievement level, validation processes and directly link to rich media evidence, the research implications are quite broad and varied. The potential seems high for a transformative moment in the history of technology in teaching and learning.	1/****
Dominguez, 2013, Gamifying learning experiences: Practical implications and outcomes	Spain	Randomized Control Trial; 1st and 2nd year university students, control group (n=80), experimental (n = 131)	Attitudinal survey, tests, presentations, final exam, surveys	Badges, challenges and leaderboards.	Some common beliefs about the benefits obtained when using games in education can be challenged. Students who completed the gamified experience got better scores in practical assignments and in overall score, but the findings also suggest that these students performed poorly on written assignments and participated less on class activities, although their initial motivation was higher.	2/**
Morrison, 2014, Khan Academy Gamifies Computer Science	USA	Qualitative: keywords: "Khan Academy, motivation, gamification",	Literature Review; information content, learning environment, gamification techniques (badges, knowledge map, progress indicators, etc)	Map, badges, goals, and progress indicators.	There are qualities that make it ideal for novice informal learners that are self-motivated, addressing issues of short-term engagement and seeks to use gamification to keep learners engaged and moving forward to more difficult tasks. Khan has missed critical motivational elements in the application of	1/***

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Barata, 2014, Engaging Engineering Students with Gamification	Portugal	Quantitative non-randomized; 2 semesters of MSc course, 42 students in the 1st year (control) and 35 in the 2nd (experimental)	Number of lecture Downloads, Number of Posts, Attendance and Grades, Student Feedback	Scoring, levels, leaderboards, challenges, and badges.	gamification that might dramatically improve the quality of the gaming elements and increase motivation. Results were very encouraging, showing significant increases ranging from lecture attendance to online participation, proactive behaviors and perusing the course reference materials. Moreover, students considered the gamified instance to be more motivating, interesting and easier to learn as compared to other courses. Students did not seem to be ready for autonomy, mastery was not perceived to be relevant and the purpose of starting project work as well as good preparation for the exam seemed unattainable to the students. Gamification was viewed as unnecessary hindrance towards studying for the exams and self-regulation and the ability to schedule the material across the semester was lacking despite a number of proposed schedules that were suggested by the lecturer but not enforced. Even attending lecture was not enforced. This was not welcomed by all students, who were looking for that kind of structure.	3/ ****
Berkling, 2013, Gamification of a software engineering course	Germany	Quantitative descriptive; 2nd year University students taking Software Engineering (n = 90)	Feedback was collected through a built-in form within the application.	Points, Levels, Paths and Progress, Challenges, Immediate Feedback, and leaderboards.	It seems that, despite the overwhelming publicity given to the negative impact of games, like most technologies before them, computer games can have both positive and negative impacts. The results show that studies of games for learning and serious games tended to use quasi-experimental designs with surveys less common, while studies of entertainment games used quasi-experiments and surveys. RCTs and qualitative designs were relatively uncommon.	4/***
Connolly, 2012, A systematic literature review of empirical evidence on computer games and serious games	Scotland	Qualitative: 129 papers were identified on positive impacts of games on users over 14 years.	Literature Review: The outcomes and impacts of playing games were analysed in terms of several variables.	N/A	Different perspectives on badge systems enable a clearer and more complete understanding than if one focuses only on a single perspective. Different stakeholders have different interests and concerns in badges. Without a deep insight into a number of these interests and concerns, it is difficult to acquire a good understanding of this thriving field.	1/ *****
Devedzic, 2015, Developing Open Badges: a comprehensive approach	Serbia	Qualitative Framework of different perspectives on badges	Literature Review	Badges	Results show that students participate more in activities with gamification and also report the course as being both more motivating and interesting than non-gamified courses.	1/**
Barata, 2015, Gamification for smarter learning: Tales from the trenches	Portugal	Mixed methods; First year (n = 35), second year (n = 52), across 2 years	Student grades and feedback questionnaires	Points, badges, leaderboards, challenges, and quests.	Our results found that students in the gamified course showed	5/***
Hanus, 2015, Assessing the effects of gamification in	USA		Video game habits surveys, intrinsic motivation	Leaderboards, badges.		3/ ****

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the classroom: A longitudinal study on intrinsic motivation, social comparison, satisfaction, effort, and academic performance		Non-randomized control trial; 2 university courses (n = 80)	inventory, class satisfaction survey, class effort survey, learner empowerment survey, social comparison scale, and final exam scores		less motivation, satisfaction, and empowerment over time than those in the non-gamified class.	
Herrera-Alonso, 2016, An open-source platform for using gamification and social learning methodologies in engineering education: Design and experience	Spain	Mixed-methods, ambiguous number of students (n = ?),	Exam scores, satisfaction poll, Dependence between continuous assessment and games and pass/fail the subject, Behavior of non-fresh students	Rewards, badges, reputation, and social ranking system.	We argue that this approach, together with gamification elements, is helpful in increasing the students' motivation, besides improving the learning experience and performance.	1/*
Ahn, 2014, Open badges for education: What are the implications at the intersection of open systems and badging?	USA	Qualitative; we considered three characteristics of badges (motivation, pedagogy and credential) and three components of open (production, access and appropriation)	Literature review, information regarding badges and open systems	Badges	The idea of badges as a pedagogical tool and badges as credential may in fact be specialized instantiations of badges as a motivator of some type of behaviour. Badges may promote intrinsically motivated behaviours such as seeking out feedback and guidance through a learning pathway if interpreted as an artefact to encourage particular teaching and learning activities.	1/***
Santos, 2013, Evaluating the Use of Open Badges in an Open Learning Environment	Belgium	Quantitative Descriptive; masters students (n=26), development and evaluation of an OLE	Survey to assess the effectiveness of the platform, google site analytics	Badges, social visualization, and activity stream.	We conclude that the mere fact of tracking student activity and making it public through student activity such as activity streams, tabular and badge overviews may motivate activity such as reading. Social visualisations such as StepUp! and Navi may trigger more explicit activity such as commenting and tweeting. Moreover, badges motivated students.	4/****
Kingsley, 2015, Gamification	USA	Mixed-methods; data collection over 4 weeks, students in an elementary class (n = 47)	Classroom observations, analysis of the gamified learning environment, semistructured interviews with the teacher, and a survey of students	Points, badges, levels, and awards.	There is a potential for gamification to become a constructive force in education by supporting new literacies involving creativity, critical thinking, collaboration, and communication. To ensure meaningful approaches for technological practices, there is a need to align instruction to the ethos of new literacies.	5/*
Kiryakova, 2014, Gamification in education	Bulgaria	Qualitative	Literature review	Avatar, progress, levels, feedback, badges, and leaderboards.	Gamification is an effective approach to make positive change in students' behavior and attitude towards learning, to improve their motivation and engagement. The results of the change have bilateral nature – they can affect students' results and understanding of the educational content and create conditions for an effective learning process.	2/*
De-Marcos, 2014, An empirical study comparing gamification and social networking on e-learning	Spain	Quantitative non-randomized; first year undergraduates (n=114), not randomly assigned to 3 groups, 3rd was control	Interactive tests = pre-test performance. Post-test = assignment scores, final examination and a participation score for each participant, attitudinal survey	Levels, challenge, rewards, badges, leaderboards, and discussion forums.	Results suggest that the proposed instruments improve students' performance on practical assignments related to skill acquisition. Average performance improved in each experimental group even with low participation rates	3/***

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De-Marcos, 2016, On the effectiveness of game-like and social approaches in learning: Comparing educational gaming, gamification & social networking	Spain	Quantitative non-randomized; first-year undergraduate students (n=379), 4 treatment groups, one control group, over 10 weeks in a blended-learning course	The course had five evaluation items: four practical assignments and one final examination.	Challenges, levels, points, narrative, Trophies, badges, leaderboards, and rewards.	affecting the whole group significantly. Results suggest that all experimental conditions significantly impact on learning performance. Moderate differences were also found when experimental conditions were compared suggesting that social networking and social gamification produced better results even at early stages of the course (week 3). The effects on the different kinds of evaluation items were also studied and we found that in a final examination designed to assess conceptual knowledge, the new approaches did not yield any benefit when compared with a control group. Students that used the educational game, the gamification plugin and social network performed poorly when compared with the social gamification and control (blended-learning) groups. Social gamification returned better results in terms of immediacy across different evaluation items	3/ ****
Haaranen, 2014, Software Architectures for Implementing Achievement Badges – Practical Experiences	Finland	Qualitative; examination of 2 past quasi-experimental papers	Literature review; data extracted from past papers	Badges .	Six design principles were constructed to guide in the creation of the new badge system. 1) Functional requirements. The badge system should be able to divide the badges into three main components – signifiers as the visual artefacts seen by the users, completion logic which determines when a badge is awarded, and reward that is the value of badges to their wearers. 2) Interoperability. The system needs to be compatible with the existing Learning Management Systems. 3) Security. The core functionality of the LMS should never be compromised even in cases of failure in badge system in use. 4) Flexibility. Using the system in multiple courses should be taken into account. This would also mean that students could share and compare badges amongst peers, if they so wished. 5) Privacy. The system should not distribute private information about the students to third parties. 6) Usability. The system should be simple and effortless to use and it should integrate well into the general look and feel of the LMS.	1/ ***
Haaranen, 2015, How (not) to Introduce Badges to Online Exercises	Finland	Quantitative Descriptive; follow-up to a previous study. Student respondents (n = 306)	Survey results	Badges, points, and levels.	We found that some students have strongly negative emotions towards badges. Therefore, one should make it technically easy to opt out from badges or make them opt	4/ ****

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Pedro, 2015, Peer-supported badge attribution in a collaborative learning platform: The SAPO Campus case	Portugal	Quantitative Descriptive; SAPO campus, 1 academic year, all students and teachers involved	Number of badges awarded	Badges.	in. Additionally, our badges did not affect grading, but feedback from points and badges can confuse students. Therefore, one should give students clear instructions what else, if anything, is affected by badges. Earning badges has contributed for users to feel more engaged with specific tasks or activities in the platform. The results of the aforementioned pilot test may be understood as a starting point to a deeper analysis about the meaning and role of badges in promoting motivation and providing new ways of assessment	4/*
Leaning 2015, A study of the use of games and gamification to enhance student engagement, experience and achievement on a theory-based course of an undergraduate media degree	UK	Mixed; media theory course at Winchester University, ambiguous number of students, two academic years	Mean marks, attitudinal surveys, student feedback forms	leaderboards .	While the qualitative data from the focus groups and the module feedback forms indicate that students were enjoying the course more, were reporting putting in more effort in terms of their preparation and even felt that there were learning to a deeper level the comparison of mean grades indicated only a small and not statistically significant difference.	5/***
Sanmugam, 2016, The Impacts of infusing Game elements and Gamification in learning	Malaysia	Mixed-methods; eight-week intervention, points, badges, and leaderboards, unnamed number of students (n = ?)	Overall tally of points/leaderboard and badges; 3-stage interviews	Points, badges, levels, and leaderboards.	The findings based on the interviews with the participants found all the elements played a part in engaging the interest of students in learning, more so badges and leaderboard. It was also identified that certain elements are preferred to acquire either online or offline	5/***
Monterrat, 2015, A Player Model for Adaptive Gamification in Learning Environments	France	Quantitative Descriptive; 420 users	Survey results and number of hours spent on task	Points, badges, and leaderboards.	An experiment has proven the effectiveness of the experts-based matrix, as the members of the group with adapted features spent 39% more time on the learning environment than the members of the group with counter-adapted features.	4/**
Nah, 2013, Gamification of Education Using Computer Games	USA	Qualitative; identify 5 main gamification principles: (i) Goal orientation; (ii) Achievement, (ii) Reinforcement, (iv) Competition, and (v) Fun orientation	Literature Review; extracts relevant features to achieve each of the gamification principles	leaderboards, levels, points, onboarding, challenges, quests, badges, immediate feedback, social engagement loops, teams, rules, marketplaces, economies, visuals, sounds, avatars, customization, narrative, and roleplay.	Gamification Framework, see paper	1/****
Nicholson, 2015, A recipe for meaningful gamification	Switzerland	Qualitative; Develops 6 concept framework using existing literature	Literature review, classifies info using framework	N/A	This article introduces six concepts - Reflection, Exposition, Choice, Information, Play, and Engagement - to guide designers of gamification systems that rely on non-reward-based game elements to help people find personal connections and meaning in a real world context.	1/****
McDaniel, 2015, How to Design Experimental	USA	Qualitative; literature review guides framework	Literature Review; assimilates extracted	Badges.	Although recent years have generated exciting insights and ideas about digital	1/***

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Research Studies around Digital Badges		development, ambiguous number of databases/studies	research to develop an experimental design		badging, future research will continue to illustrate the precise conditions in which digital badges thrive. Sound research design will help us to design the experiments that collect the empirical data that help us to outline these conditions.	
Stott, 2013, Analysis of gamification in education	Canada	Qualitative; exploration of 3 gamification cases. The first study; university classroom (n = 200), the second; real world game developed for 400 RIT students, university class of 70 students	Analysis of 3 case studies, extracts data regarding the universality of gamification	Freedom to fail, rapid feedback, progression, and storytelling.	These three case studies are useful in seeing how theoretical 'best practices' in the gamification of education are extremely context sensitive. There is no one-size-fits all model for the successful gamification of a classroom.	1/ ****
Todor, 2013, The Gamification of the Study of Electronics in Dedicated e-Learning Platforms	Romania	Qualitative; observations regarding the use of an e-learning platform	Observations and feedback are collected	Points, leaderboards, feedback, and badges.	There was a major increase of the interest for the course. Furthermore, they wanted to make a contribution in improving the gamified structures, suggesting more interactive tests, new ways of rewarding or proposing new projects and practical applications. Another aspect noticed from the students was the way they showed their positive competitiveness.	1/*
Garcia-Iruela, 2019, Analysis of Gamification Elements. A Case Study in a Computer Science Course	Spain	Randomized Control Trial; faculty of sciences at Lisbon University (n = 200), 4 week intervention, two groups (students randomly assigned) group one was control for the first two weeks, and group two for the last two weeks	Midway and post-test survey	Points, badges, leaderboards, levels, progress bar and classification.	The data collected showed a slightly higher satisfaction of students belonging to a gamified course versus students in a non-gamified course. In group one the satisfaction fell when they stopped being gamified, while satisfaction in group two went up in the second part when they started to be gamified. The data obtained reflects that gamification achieves a slightly higher satisfaction among students. This small difference may be due to the short period of time used.	2/**
Hakulinen, 2015, The Effect of Achievement Badges on Students' Behavior: An Empirical Study in a University-Level Computer Science Course	Finland	Randomized Control Trial; Data Structures and Algorithms course students (n = 281), over one semester, randomly assigned to each group	Scores from computer science exercises, total time in TRAKLA2, and mean number of badges. Open-ended feedback	Badges, leaderboards, and immediate feedback.	Achievement badges had a statistically significant impact on some aspects of students' behavior, and that students had generally positive attitudes towards them. Students who had the badges spent more time per exercise. Students in the treatment group also had a higher number of sessions in the learning environment. The majority of the students reported being motivated by the badges	2/**

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