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Gamification Design Framework to Support Autism Children Interaction Skills: A Systematic Review

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ABSTRACT

This systematic review article focuses on the gamification design framework in supporting interaction skills among autism children. Generally, the fact that gamification is not a new phenomenon has attracted researchers to conduct several relevant studies. Unfortunately, previous studies were not targeting the interaction skills from the viewpoints of autism children. Thus, the present study reviewed a considerable amount of past literature on the mentioned viewpoints. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) was adopted for the review of the current research, which utilized four journal databases, namely IEEE, Springer, ScienceDirect and Google Scholar. Accordingly, the research effort resulted in a total of six articles that can be analyzed systematically. Significantly, the review managed to formulate three main themes, namely therapeutic, immersive and personalization. Finally, several recommendations were presented at the end of this research for future scholars' reference.

Key Words: ASD, Autism, Design, Framework, Gamification, Interaction

INTRODUCTION

Autism Spectrum Disorder (ASD) children who are having difficulties in social skills can find understanding nonverbal cues and social interaction with other people challenging¹. Various interventions have been designed and evaluated. However, the effectiveness of the intervention treatment depends on the continuity and weekly hours intensity². To support conventional treatment methods, mental health professionals put an effort into exploring the use of digital games and gamified therapeutic interventions³. Hence, the learning process acceleration has been influenced by game-based interventions by increasing the willingness to finish the required tasks. These findings have led to a widespread digital games production for autism children as well as gamification application.

Terms of gamification have been used to represent games application in another non-gaming field. In other words, it can be defined as the use of game elements in non-gaming contexts⁴. Various organizations have begun exploring gamification as a way to motivate, engage and increase user expe-

rience. Education, training, self-management, marketing and health are several fields of applications that adopt gamification to its function. Due to these reasons, gamification has risen significantly in the past seven years and shows no sign of declining growth. Nowadays, early signs of gamification research institutionalizing as a cross-disciplinary field can be seen in the form of educational programs⁵. Thus, many gamification and autism literature can be found, which aimed to tackle the benefits of gamification application towards children behaviour.

THE NEED FOR A SYSTEMATIC REVIEW

A systematic review can be defined as quantitatively and qualitatively recognizing, combining and evaluating all accessible data to generate an observationally determined response to an engaged research question⁶. Meanwhile, an extensive amount of existing systematic review associated with gamification framework has been conducted across the world. However, only several numbers of studies were performed within the context of autism children⁷ because the

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available literature heavily focuses on the general gamification users as to improve the engagement period and user experiences, regardless of specific skills. The current paper attempts to systematically review all the appropriate literature to fulfil the gap by examining a growing body of evidence on the gamification towards autism children with regards to their interaction skills. Also, the present study is important because it provides information on the extent of the focus of peer review literature, which can assist the scholars in delivering the prospect to understand future attention related to gamification concerns.

The current systematic review development and writing are based on the main research question: How can gamification be incorporated for autism children specifically about their interaction skills? The principal focus of the investigation was on the design frameworks. On top of that, gamification and serious games are used in the current review as both terms share a common goal⁸.

This section discusses the need to conduct a systematic review of autism children, while the following section presents the approach that was employed to obtain the answer to the research question formulated by the current research. Then, the third section conducts a systematic review and synthesizes the scientific literature to distinguish, select and evaluate the significant research on the gamification framework towards interaction skills of autism children. Finally, the last section examines the measure that needs to be taken when focusing on future researchers concerning the concerns being raised.

MATERIAL AND METHODS

This section enlightens the four main sub-sections, namely PRISMA, resources, the systematic review process, and data abstraction and analysis, which are employed in the current research.

PRISMA

Publication standards are required to guide authors with the related and necessary material that will enable them to evaluate and examine the quality of a review. One of the published standards in conducting systematic literature reviews is called PRISMA or Preferred Reporting Items for Systematic Reviews and Meta-Analyses. Furthermore, PRISMA highlights on the reviews report that evaluates randomized trials, which can also be applied as the fundamental in reporting systematic reviews for other types of research⁹. On top of that, Johnson *et al.*⁸ claimed that PRISMA checklist is a rigorous and widely used reporting guideline for systematic reviews as well as gamification. Other than that, PRISMA can also be used as a basis for reporting systematic reviews particularly evaluation of interventions, which is suitable to be adopted in this study.

Resources

Methods of the review were conducted using four databases, namely IEEE, Science Direct, Springer and Google Scholar considering that all databases cover gamification and serious games studies. Specifically, those databases indexes computing and information system related studies including gamification. However, it should be noted that no database is perfect or comprehensive. Accordingly, Younger and coworkers¹⁰ suggested that scholars should conduct their searching process using various databases to increase the possibility of obtaining significant and related articles. Hence, the present study has conducted manual searching as well considering that the articles are journals related to gamification.

Systematic Review Process for Articles Selection

This section consists of another three sub-sections, namely identification, screening and eligibility, which are the main and fundamental process for systematic review articles selection.

Identification

The systematic review process in selecting several relevant and significant articles for the present study consists of three main steps. The first step is the keywords identification, followed by the process of searching for related and similar terms based on the dictionaries, thesaurus and past researches. Thus, the search strings database were developed in April 2020 (Refer to Table 1) after all relevant keywords were determined. Most importantly, the current research work successfully retrieved a total of 1115 articles from all databases. As formerly stated, manual searching was conducted and additional numbers of four articles were found based on similar keywords. Altogether, 1119 articles were retrieved in the first step of the systematic review process.

Table 1: The Search String

Database Search String	
IEEE	TITLE-ABS-KEY(("Gamification* design*" OR "Gamification* framework*" OR "Gamification* model*") AND ("Autism" OR "ASD" OR "Autism Spectrum Disorder") AND ("Interaction*" OR "Interaction* skill*" OR "Interaction* support*"))
Science Direct, Springer and Google Scholar	("Gamification* design*" OR "Gamification* framework*" OR "Gamification* model*") AND ("Autism" OR "ASD" OR "Autism Spectrum Disorder") AND ("Interaction*" OR "Interaction* skill*" OR "Interaction* support*")

Screening

The purpose of the first step of screening was to remove duplicate articles. In this case, three articles were excluded during the first step, while a total of 1116 articles were screened based on inclusion and exclusion criteria determined by the researchers in the second step. The first criterion is the literature type where the researchers decided to focus only on the journal research article due to its primary sources that offer empirical data. Thus, this further signifies that publication in the form of the systematic review, book chapter, journals review, and conference proceeding were excluded in the current research. Furthermore, the review only focused on English articles. Additionally, it should be noted that 10 years (2009-2019) was selected for the timeline. On top of that, to increase the possibility of retrieving related articles, articles published in psychology and medical health, as well as articles associated with serious games, were selected. Overall, a total of 1074 articles were excluded based on these criteria (Refer to Table 2).

Table 2: The Inclusion and Exclusion Criteria

Criterion	Eligibility	Exclusion
Literature type	Journal (research articles)	Journals (review), chapter in the book, conference proceedings
Language	English	Non-English
Timeline	Between 2009 and 2019	< 2009
Subject area	Computer Science, Information Systems, Serious Games, Medical Health and Psychology	Other than Computer Science, Information Systems, Serious Games, Medical Health and Psychology

Eligibility

A total of 42 articles were prepared for the third step known as the eligibility. In this significant step, the titles, abstracts and the main content of all the articles were assessed thoroughly to ensure that they fulfilled the inclusion criteria and suitable to be used in the present study to achieve the objectives of the current research. Therefore, a total of 36 articles were excluded due to non-focusing on gamification and serious games issues related to autism children. Conclusively, only 6 remaining articles are ready to be analyzed (see. Fig. 1).

Data Abstraction and Analysis

The integrated review is one of the review techniques that analyzes and synthesizes diverse research designs together (qualitative, quantitative and mixed methods). It can be done by qualifying quantitative data or quantifying qualitative data¹¹. Thus, this study chooses to quality all selected data.

Thematic analysis is carried out to develop the appropriate themes in this study. Data compilation is done where the authors thoroughly analyzed a group of 6 selected articles to extract statements or data that answers the research question. Hence, the process has resulted in three main themes namely therapeutic, immersive and personalization.

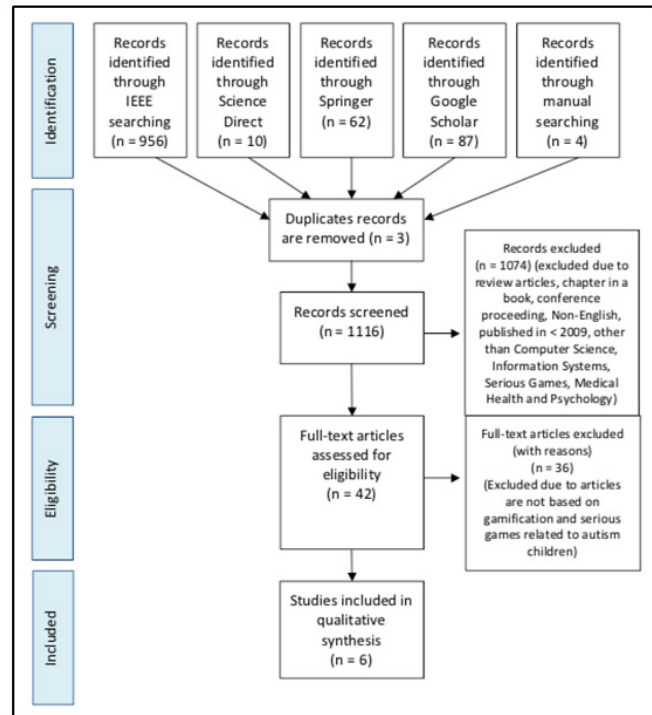


Figure 1: Flow Diagram of the Study⁹.

RESULTS

The analysis produced a total of three themes related to gamification application and autism. The three themes are therapeutic, immersive and personalization. More specifically, it should be noted that six previous studies¹²⁻¹⁷ focused on social, communications, vocabulary and emotions where those aspects are measured to be important in the development of interaction skills.

Therapeutic

Therapeutic is one of the elements that should be included in a gamification framework design. In particular, therapeutic practices is helping autistic children to better adhere to the invention process. Prior studies have argued that various therapeutic training tasks could be enhanced through the use of game elements and thus making them more engaging for patient¹²⁻¹⁴. In other words, the gamification application should achieve therapeutic objectives such as motivation to achieve long-term behaviour change, motivation to engage with the application, and motivation to use gamification within the therapeutic procedures.

Immersive

Gamification design towards interactions skills among autism children seems to be related to immersive experience^{12, 16}. The studies have shown that a virtual 3D environment can stimulate users' interactivity and motivation. Specifically, virtual reality offers opportunities for social interaction, a sense of co-presence and realism. Also, it can increase a sense of control and allow users to have more engaging in-world experience. This kind of immersive experience can potentially benefit from the fact that learning in a virtual environment that reproduces the realism can minimize the problems related to learning transfer. Developing Extended Reality (XR) can be exposed to real-world scenarios to support the generalization of autism children learning.

Personalization

Gamification framework requires personalization of user to be adopted in the development process. The range of children, which may be catered, is highly dependent on the behaviours targeted in its design. The gamification needs to be able to correspond to a broad range of patient characteristics and context^{12, 14-17}. Providing a real-world experience that users can relate to would enable them to be more aware of the potential benefits of therapeutic technique, thus helping to better manage user expectations.

DISCUSSIONS

In this study, three themes were formulated from the systematic literature review process namely therapeutic, immersive and personalization. All these elements reflected as significant aspects or elements that should be incorporated and adopted in gamification design framework to ensure the effectiveness of the application. Also, to have meaningful gamification, the application should be able to improve user experience and user engagement¹⁸. User in this context of the study is referring to autism children and it is challenging to maintain their engagement with the applied game. On top of that, this study is referring to interaction skills in terms of how the gamification can assist autism children to improve their interaction skills as a support and an intervention approach from the conventional therapy done by the therapist. Various skills are associated with interaction such as social abilities, behavioural, communication proficiencies, emotion and vocabulary. Thus, the discussion will focus on how those three themes can improve autism interaction skills through gamification application.

Early treatments or known as early intervention play an important role as well as to help the autism children to optimize their daily behaviours. On top of that, the efficiency of therapeutic treatments is associated with the intensity of the treatment in terms of duration or hours of the treatment¹⁹. To-

gether with the definition of the treatment plan, the therapist defined a set of behavioral skills that are usually addressed within conventional treatments for fostering social initiation. Behavioural skills such as vocalization, cooperation, turn-taking, recognition of basic emotions and imitation are converted to game mechanics structure to define ways to apply it playfully within a gamification application. The process of merging perspective was carried out by using the structure defined with the therapists that were instantiated as specific elements through the inclusion of children contributions.

Besides therapeutic, immersive storyline is required as well for contextualizing the learning goals and maximizing learning. The term Extended Reality (XR) refers to the new paradigm of human-computer interaction that is currently predominantly realized with Augmented Reality (AR), Virtual Reality (VR) and Mixed Reality (MR). XR maximizes human engagement with the digital content, and in terms of learning applications, the user is fully immersed in the experience and learning content²⁰. In gamification, engagement is one of the significant elements that should be produced and maintained while using it. Also, the application of XR to the education sector has been well studied and widely accepted as an engaging and effective method of delivering immersive experiences to the users²¹. On top of that, studies have also shown that a 3D virtual environment can stimulate users' interactivity and motivation²². To relate the immersive technology with a particular context of the study, the 3D virtual environment provides opportunities for social interaction and can offer users a sense of co-presence and realism. Thus, allowing autism children to have more engaging in-world experiences. Moreover, XR can improve autism children's enjoyment and interest in the learning process if they are designed appropriately during the gamification development process.

Furthermore, targeting multiple behaviours in the gamification design would allow an individual child with autism to learn, practice and improve their difficulties in one or more behaviours targeted in the gamification application. Personalization is better to be integrated into gamification to correspond to a broad range of autism characteristics and context. In designing the gamification, there has to be a room for personalization of therapy goals. Providing a real-world experience that users can relate to would make them more aware of the gamification potential, and thus help to better manage user expectations¹⁶. This could be done either explicitly by manually personalizing the game content or more implicitly, through automatic adaptation based on player preferences or modelling technique. In this study context, the gamification frameworks could be improved as it is designed based on the children's autism characteristics and therapeutic goals whether short term or long term goals with assistance from their therapists. Thus, the range of autism children, which may be catered, is highly dependent on the behaviours or

personalization targeted in the gamification design framework.

Recommendations

The findings and systematic review process of the present study have led to several recommendations that may be helpful for future scholars. First, future studies should be conducted using Scopus and Web of Science database to obtain more relevant articles. In this study, due to limitation of database access, articles were obtained using other several established sources as mentioned at the beginning of this study. Meanwhile, it should be noted that various keywords could be added to increase the relevant articles to be analyzed. For example, the “interaction” keyword for the search strings could be further improved by adding keywords such as “social”, “communication”, and “verbal”. Other than “interaction” keyword, the “gamification” keyword can also be added as “serious games” as both terms share a common goal; to form human behaviour or attitude through the intrinsically encouraging qualities used in well-designed digital games⁸. Regardless, both gamification and serious games capitalize on the popularity nature of recreational digital games and within the current review, the term “applied games” can also be used to refer to both terms collectively. On another note, it should be realized that all of the articles analyzed in this study are only concentrating on journal articles while excluding any other systematic review journal articles. Thus, results analysis could be improved if conference proceeding articles were also included for review as it was discovered that the number of full conference proceeding articles also contain relevant data to be analyzed in this study.

CONCLUSIONS

In this paper, a systematic literature review process has been discussed and associated with gamification design framework for autism children aimed at supporting therapy of social and interaction skills. Furthermore, three main themes that represent the gamification design framework were identified based on the systematic review performed through the current research. The first theme refers to therapeutic, which is described as treatment plan whereby the therapist defined a set of behavioural skills that are usually addressed within conventional treatments for fostering social initiation as to help the autism children to optimize their daily behaviours in using the gamification application. The second theme refers to an immersive experience, which could be incorporated into the design framework to improve the user’s engagement as well as user experiences. In other words, the virtual 3D environment provides opportunities for social interaction and the ability to offer users a sense of co-presence and realism. Next, the third theme is known as personalization, which allows the individual child with autism to learn, prac-

tice and improve their difficulties in one or more behaviours targeted in the gamification by tailoring the gamification objectives to accommodate their specific autism characteristics and context.

The key contribution in this paper is to provide more knowledge about designing gamification towards autism children specifically to support their interaction skills. Detailed descriptions of the systematic review process as well as the recommendations of gamification design framework in this context are provided. In the future, the structural design framework recommended in this study can be used as the basis for the development of a gamification framework for autism children specifically related to their interaction skill.

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Conflict of Interest

The authors involved in the current study does not declare any competing conflict of interest.

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