

A Conceptual Game-based Design Model: Game Elements for Enhancing User Motivation

Nur Ain Mohamad Yahaya, Dayang Rohaya Awang Rambli, Suziah Sulaiman
Department of Computer and Information Sciences, Universiti Teknologi PETRONAS

nurainmohamadyahaya96@gmail.com (Corresponding author).

Abstract. Recent studies have developed forest-themed VR-based applications for reducing stress. The lack of interaction between users and the virtual environment made users become demotivated and bored. Therefore, there is a need to integrate game elements into the application. Gamification is widely known to increase user motivation. Therefore, this paper focused on identifying suitable game elements to be implemented in the existing frameworks for enhancement. Several game elements were identified able to enhance user motivation. The game elements were grouped into three; feedback, rewards and goals. Each of the game elements consists of two types(feedback: progress bar and scorecard; rewards: points and new content) with the exception of goals game elements. It should be noted that the preliminary model is a conceptual model and has not been validated yet. Therefore, the game elements will be integrated into a forest-themed VR application to evaluate its effectiveness.

Keywords: game-based model, user motivation, gamification, game elements

1. Introduction

In recent years, with the arrival of Covid-19, citizens experienced a high level of stress during the pandemic (Deloitte, 2020). Furthermore, the uncertainty of when the pandemic will end coupled with the issue of long-term financial and career prospects has contributed to an increased level of stress (Deloitte, 2020). Stress could not only lead to a decrease in work productivity, but it could also lead to other mental health disorders or diseases (Ascoe et al., 2020; Trifunovic et al., 2017; Kulkarni et al., 2020). Stress reduction can be achieved by doing therapeutic activities through exposure to nature such as forest therapy, managing stress by using stress management applications and virtual reality technology (Bostock et al., 2019; Hong et al., 2019; Zaharuddin et al., 2019).

VR technology is often used in studies to experiment its effectiveness in the health domain, particularly in rehabilitation and therapy (Naro & Calabrò, 2021; Syed & Kamal, 2021). Furthermore, VR is known able to support cognitive training and increase users' motivation and enjoyment through an immersive virtual environment (VE) (Naro & Calabrò, 2021). VR-based therapy is widely used in mental health disorders and proved effective in reducing the symptoms of mental illness (Emmelkamp & Meyerbröcker, 2021). In recent studies for VR-based stress therapy, many applications use panoramic view or video-based with limited user interaction, limiting meaningful play (Hong et al., 2019; Zaharuddin et al., 2019). The limitation of meaningful play has caused users to quickly feel bored, leading to a decrease in continuously using the applications. The therapy process becomes repetitive resulting in the user feeling demotivated. An increase in user interaction with the VE through implementing game elements could increase user motivation. Furthermore, many studies have focused on user engagement in game elements, but there are only a few studies focused on motivation (Cheng et al., 2019).

Gamification is widely known for its positive impact on user motivation. Nonetheless, there has been no thorough investigation of the gamification context and identification of suitable game elements for stress relief applications in enhancing user motivation (Sardi et al., 2017). Studies that were conducted in gamification for health applications are only limited to raising awareness through an interactive stress management application for young children (Nicolaidou et al., 2019). Furthermore, the integration of game elements was not included in the existing frameworks (Siriaraya et al., 2021). There has been no specification of game elements to be integrated into the framework when developing an application.

This paper aims to identify the suitable game elements that could enhance user motivation to be implemented in the existing framework. It presents the literature review on stress, virtual reality, gamification, and a list of suitable game elements. The findings will be used to propose a preliminary conceptual game-based design

model for enhancing Feedback components in the Dual-Loop framework at the end of the paper.

2. Literature Review

2.1. Virtual reality(VR) for stress relief

VR is a technology that allows users to interact with 3D objects in an immersive virtual environment(VE) or virtual world by stimulating users' senses(visions, hearing, touch, and smell)(Bardi, 2019). Immersion is the experience users gain in VEs through various interactions similar to real-life experiences by representing realistic stimulations (Servotte et al., 2020). Immersive VEs could produce a higher level of presence. A sense of presence allows users to feel detached from the real world and shift their attention to the virtual world (Kardong-Edgren et al., 2019). It allows users to be fully immersive through interactions with the 3D objects in the virtual world. The findings in a meta-analysis study conducted by Akgün et al. show several effects of immersive VEs – the sense of presence, fun, motivation, etc.(Akgün & Atici, 2022).

Recent studies show the use of VR in mental health treatment has expanded from the treatment of phobias to other mental health (posttraumatic stress disorder, addiction, anxiety, etc.) (Emmelkamp & Meyerbröker, 2021). The interaction between users and objects or situations within the virtual environment could not only help decrease stress levels but could also provide a means for people to enjoy the view of the virtual environment after experiencing stressful events(Eswaran et al., 2018). Furthermore, VR has proved to be an important platform for enabling users to use the application for those who are unable to go outside(Jerdan et al., 2018). It is proving to be true with the outbreak of the COVID-19 pandemic in early 2021 which prevents people to go outside for safety measures.

Several studies have used VR technology for stress relief with their respective outcome as shown in Table 1. The use of a forest-themed virtual environment for virtual therapy has significantly reduced stress (Hong et al., 2019; Yuan et al., 2022; Zaharuddin et al., 2019). Additionally, users feel more relaxed and an increase in positive emotions was shown after the therapy session. The findings of a study conducted by Yuan et al show that forest-themed VR applications can enhance the stress recovery of an individual l(Yuan et al., 2022). However, the limitation of interaction between users and the VEs has made the therapy process becomes repetitive, and users become demotivated to perform the assigned tasks (Hong et al., 2019; Zaharuddin et al., 2019). Limiting interaction leads to low immersion and a sense of presence since users could not feel detached from the real world. The addition of game elements will make the applications more interactive and immersive. Furthermore, gamification has been shown able to increase user motivation and

engagement (Alsawaier, 2018). The increase in user motivation leads to continuity in using the applications.

Table 1: List of virtual stress therapy studies.

Publication	Summary	Immersion	Presence	Outcome
Zaharuddin et al., 2019	The application provides a selection of virtual environments and audio options for people to choose from. Users' move to view the environment and teleport to the pre-defined locations.	Low	Low	Reduction in stress and participants feel more relaxed.
Xu et al., 2021	The iVR exergames that were used is a boxing-inspired iVR fitness game, FitXR, that involves movements similar to real-life boxing.	High	High	Unable to reduce stress.
Hong et al., 2019	Viewing a virtual forest video and panorama view.	Low	Low	Reduction in stress and positive emotions increased.
Cabezas et al., 2022	The authors develop a VR-based mobile application for music therapy. Participants listen and interact with the objects generated based on the rhythmic pattern of a music sheet that the participant has selected.	High	High	Reduction in stress and recovery from depression.

2.2. Stress in gamification context

Stress was defined by Hans Selye in 1936 as “the non-specific response of the body to any demand”(Fink, 2017). The bodies create a response from emotional or physical tension and pressure that come from an uncontrollable situation, leading to depression, anxiety, or any related health problems (Vaidya et al., n.d.). Stress was also defined as a response to stimuli that can be short-term (acute stress), long-term (chronic stress) or recurring in our daily life (Trifunovic et al., 2017). An increased level of stress could result in mental health disorders (depression, anxiety, PTSD, addiction, etc.), poor health and a reduction in an individual’s efficiency (Kushal et al., 2018; Pascoe et al., 2020). Stress has been frequently studied to determine ways that could help in

reducing stress. However, the studies on gamification focus on chronic diseases (stroke, diabetes, Alzheimer’s disease, etc.) (Sardi et al., 2017).

In recent years, the most frequently studied mental health domains are anxiety and depression as shown in Table 2 (Chen & Pöcze, 2021; Pitoyo & Asib, 2019; Dias et al., 2020; Fish & Saul, 2019; Minihan et al., 2022). There has been a study on stress, however, the study focused on increasing young children’s awareness of stress through teaching stress management by using an interactive application (Nicolaidou et al., 2019). A study involving anxiety, depression and stress was recently conducted for implementing iAware model in an application (Dias et al., 2020). However, the result of the study shows the model is suitable for patients with symptoms of anxiety. There are no significant changes for patients with symptoms of depression and stress. Although the study involved stress, the outcome of the study does not has positive effect on stress. Furthermore, the use of advanced technologies becomes a medium to develop applications that could help in reducing stress. In stress therapy, the use of mHealth (mobile health) applications has become a very common way of remotely reducing stress (Bostock et al., 2019; Economides et al., 2018).

Table 2: List of gamification studies in the mental health domain.

Publication	Mental Health Domain	Outcome
Minihan et al., 2022	Anxiety and depression	The application is under development and has yet to be evaluated.
Fish et al., 2019	Depression	A questionnaire was used to identify students’ levels of depression. The depression scores show a significant decrease in their depression symptom.
Pitoyo, 2019	Anxiety	A reduction in test anxiety while using the Quizizz platform.
Chen & Pocze, 2021	Depression	Alternative methods were presented: the use of the mobile application and Dance Movement Therapy.
Nicolaidou et al., 2019	Stress	The application in teaching young children about stress management through relaxation was accepted.
Dias et al., 2020	Stress, anxiety and depression	The iAware model is useful for anxiety treatment.

Several studies have shown using the application-based stress therapy has a positive impact on reducing stress and improving well-being (Bostock et al., 2019; Economides et al., 2018; Eswaran et al., 2018; Raevuori et al., 2021). Nevertheless, users need to use the application in a long term for the effect of the therapy to show significant results in stress reduction and the improvement of health and well-being (Bostock et al., 2019). Eswaran et al. have attempted on applying a VR-based therapy

technique for reducing stress among young adults Eswaran et al., 2018). The significant reduction in stress levels has proved that VR-based therapy is suitable for stress relief. Therefore, this study will identify suitable game elements that can be integrated into VR-based stress relief applications, for enhancing user motivation.

2.3. Enhancing user motivation through gamification

The use of gamification, the integration of game-related elements into non-game applications, have become frequent in business, education, healthcare etc. for enabling interaction between users and applications (Basten, 2017). There are two types of gamification; structural and content (Darejeh & Salim, 2016). In structural gamification, the content of the application is not gamified by implementing the game elements to motivate users. Contrary to structural, content gamification focuses on turning the application into a game which frequently used in education. In this aspect, many healthcare applications are considered structural gamification as the content of the application is not game-like.

Several studies were conducted to explore the effects of gamification (Blok et al., 2019; Cechetti et al., 2019; Feng et al., 2020; Jent & Janneck, 2018; Treiblmaier & Putz, 2020). The studies show gamification is able to enhance user engagement and motivation. The feeling of enjoyment through integrating game elements has contributed to increase in user engagement and motivation. Many studies have focused on engagement and there are only a few studies focused on motivation in gamification context (Cheng et al., 2019). Therefore, the identification of suitable game elements for enhancing user motivation through a series of combinations needs to be researched.

Game elements are the components in a game or gamified applications. The commonly used game elements in mental health applications are feedback, rewards, progression and social features (Sardi et al., 2017). Several game elements have been found able to increase user motivation which is influenced by enjoyment (Jent & Janneck, 2018; Treiblmaier & Putz, 2020). However, the implementation of the “time constraint” game element in stress management apps might defeat the purpose of relaxation since the element are more suitable for leading users to excitement and tension (Hoffmann et al., 2017). The game elements will be integrated into the existing framework, the Dual-Loop framework.

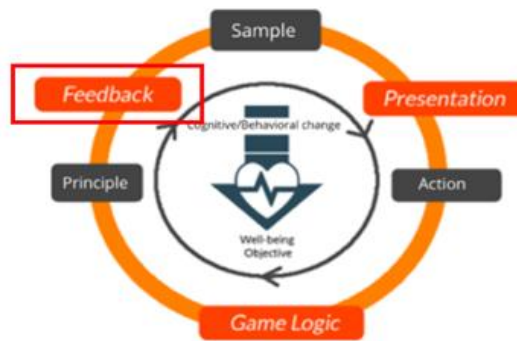


Fig. 1: The Dual-Loop framework proposed by Siriaraya et al.

The Dual-Loop framework was proposed by Siriaraya et al. for designing game-based therapy applications focusing on user engagement (Siriaraya et al., 2021). The framework was designed by combining the therapy world and the game world. It consists of two loops, the therapy loop and the core-game loop. The therapy loop focused on therapeutic activities while the core-game loop focused on gamifying the activities. Several case studies were conducted by referencing the framework in designing the applications (Siriaraya et al., 2021; van Dooren et al., 2019). The results indicate integrating gamification into the therapy world show a positive impact. However, there has been no mention of specific game elements that could be integrated into the framework. Therefore, the framework will be enhanced by implementing suitable game elements into the framework. In this research, the enhancement is solely on the “Feedback” component in the core-game loop as highlighted in Figure 1.

3. Preliminary Game-based Design Model

A preliminary game-based design model was proposed to enhance the “Feedback” component of the Dual-Loop framework. The model consists of three identified suitable game elements for enhancing user motivation. The identified game elements were grouped into three; feedback, rewards and goals. The game elements could produce the feeling of fun, enjoyment and pleasure which leads to meaningful play (Murphy et al., 2012). The meaningful play was defined as a relationship between the user’s interactions with the application and influenced by the elements of fun and play (Tb Tece Bayrak & Bw Wünsche, 2021). The nonexistent of meaningful play in gamified applications leads to a decrease in user motivation (Tb Tece Bayrak & Bw Wünsche, 2021).

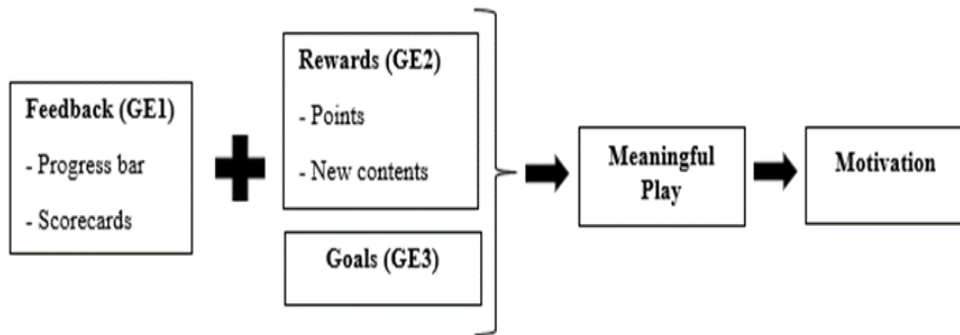


Fig 1: Preliminary proposed game elements for the enhancement of Feedback components in the Dual-Loop framework.

- **GE1: Feedback**

The feedback game element is commonly used in gamified applications for providing information and progress (Comello et al., 2016). There are two types of feedback game elements that can be used to increase user motivation; progress bar and scorecards. Progress bars allow users to know their status or progress within the specific tasks. For example, when users are collecting objects in the virtual environment, users will be able to immediately see the number of objects obtained. It was proven the use of progress bars could lead to an increase in motivation and satisfaction within the gamified environment (Alsawaier, 2018). Scorecards have the same function as progress bars but differ in how it was presented. While progress bars view users' progress during the task, scorecards view users' scores after the task was completed.

- **GE2: Rewards**

The rewards game element can be anything users receive in the gamified applications. In this research, two types of rewards were identified; points and new content. Points allow users to obtain a reward when the number of points reaches the pre-defined milestones. The developer could define a few types of points in the game with separate use of redeeming the rewards. The usage of different types of points could impact user interest and make the user feel more motivated to collect the rewards (Phillips et al., 2018). The new content allows users to obtain locked content that can only be unlocked through a series of tasks. For example, users are able to access new content after completing pre-requisite tasks or goals. The activation of new content can increase user motivation since users will constantly seek new content inside the gamified applications (Tb Tece Bayrak & Bw Wünsche, 2021).

- **GE3: Goals**

The goals game element is implemented through a system of objectives, quests and sub-quests which becomes more challenging as users progress throughout the

gamified applications (Alexiou & Schippers, 2018). The integration of goals has the potential to increase user motivation in the long term, making the user constantly use the application in order to complete the goals (Passalacqua et al., 2020). For example, developers can set a definite goal for users to complete and sub-goals to guide users in completing the main goals. The implementation of goals and sub-goals can make the users feel more motivated (Murphy et al., 2012).

The combination of the three proposed game elements could contribute to enhancing user motivation. The combination of goals and rewards could enhance user motivation since the user would feel motivated when receiving rewards upon the completion of goals (Murphy et al., 2012). Therefore, the game elements will be integrated into a forest-themed VR application in future works for experimentation. The game elements will be combined into four possible combinations.

4. Conclusion and Future Work

In this paper, a preliminary game-based design model was proposed for integrating identified game elements in the Dual-Loop framework. The enhancement of the framework solely focused on the Feedback component. The review on VR-based therapy applications shows a lack of interaction between users and VEs results in low immersion and sense of presence. This leads to the therapy process becoming repetitive and made the user less motivated. Therefore, a review of suitable game elements for enhancing user motivation was conducted.

The result indicates several game elements that can be integrated; however, the game elements were further grouped into three game elements: feedback, rewards and goals. It should be noted, that the preliminary model is a conceptual model and has not been validated yet. Therefore, in future work, a VR application will be developed using the proposed preliminary game-based design model to test the effectiveness of the game elements, through a series of combinations between the game elements, in increasing user motivation.

Acknowledgement

This study was conducted as a research thesis for Universiti Teknologi PETRONAS. We thank Dr Dayang Rohaya, Dr Suziah and the anonymous reviewers for the comments and suggestions.

References

Akgün, M. & Atici, B. (2022). The Effects of Immersive Virtual Reality Environments on Students' Academic Achievement: A Meta-analytical and Meta-thematic Study. *Participatory Educational Research*, 9(3), 111-131. DOI:<https://doi.org/10.17275/per.22.57.9.3>.

Alexiou, A. & Schippers, M. C. (2018). Digital game elements, user experience and learning: A conceptual framework. *Education and Information Technologies*, 23(6), 2545-2567. DOI:<https://doi.org/10.1007/s10639-018-9730-6>.

Alsawaier, R. S. (2018). The effect of gamification on motivation and engagement. *The International Journal of Information and Learning Technology*, 35(1), 56-79. DOI:<https://doi.org/10.1108/IJILT-02-2017-0009>.

Bardi, J. (2019). What is virtual reality? VR Definition and Examples| Marxent. *Marxent*.

Basten, D. (2017). Gamification. *IEEE Software*, 34(5), 76-81. DOI:<https://doi.ieeecomputersociety.org/10.1109/MS.2017.3571581>.

Blok, A. C., Sadasivam, R. S., Amante, D. J., Kamberi, A., Flahive, J., Morley, J., Conigliaro, J., & Houston, T. K. (2019). Gamification to motivate the unmotivated smoker: The “Take a Break” digital health intervention. *Games for Health Journal*, 8(4), 275-284. DOI:<https://doi.org/10.1089/g4h.2018.0076>.

Bostock, S., Crosswell, A. D., Prather, A. A., & Steptoe, A. (2019). Mindfulness on-the-go: Effects of a mindfulness meditation app on work stress and well-being. *Journal of Occupational Health Psychology*, 24(1), 127-138. DOI:<https://doi.org/10.1037/ocp0000118>.

Cabezas, C. A., Arcos, A. R., Carrillo-Medina, J. L., & Arias-Almeida, G. I. (2022). Effects of virtual reality and music therapy on academic stress reduction using a mobile application. *Lecture Notes in Networks and Systems*, 407. DOI:https://doi.org/10.1007/978-3-030-96147-3_4.

Cechetti, N. P., Bellei, E. A., Biduski, D., Rodriguez, J. P. M., Roman, M. K., & De Marchi, A. C. B. (2019). Developing and implementing a gamification method to improve user engagement: A case study with an m-Health application for hypertension monitoring. *Telematics and Informatics*, 41, 126-138. DOI:<https://doi.org/10.1016/j.tele.2019.04.007>.

Chen, Y. & Pöcze, F. (2021). Harnessing the motivational effect of gamification in depression treatment.

Cheng, V. W. S., Davenport, T., Johnson, D., Vella, K., & Hickie, I. B. (2019). Gamification in apps and technologies for improving mental health and well-being: Systematic review. *JMIR Mental Health*, 6(6), e13717. DOI:<https://doi.org/10.2196/13717>.

Comello, M. L. G., Qian, X., Deal, A. M., Ribisl, K. M., Linnan, L. A., & Tate, D. F. (2016). Impact of game-inspired infographics on user engagement and information processing in an eHealth program. *Journal of Medical Internet Research*, 18(9), e5976. DOI:<https://doi.org/10.2196/jmir.5976>.

Darejeh, A. & Salim, S. S. (2016). Gamification solutions to enhance software user engagement—A systematic review. *International Journal of Human-Computer Interaction*, 32(8), 613-642. DOI:<https://doi.org/10.1080/10447318.2016.1183330>.

Deloitte. (2020). The Deloitte Global 2021 Millennial and Gen Z Survey. Renewing Rhetoric's Relation to Composition.

Dias, L. P. S., Barbosa, J. L. V., Feijó, L. P., & Vianna, H. D. (2020). Development and testing of iAware model for ubiquitous care of patients with symptoms of stress, anxiety and depression. *Computer Methods and Programs in Biomedicine*, 187, 105113. DOI:<https://doi.org/10.1016/j.cmpb.2019.105113>.

Economides, M., Martman, J., Bell, M. J., & Sanderson, B. (2018). Improvements in stress, affect, and irritability following brief use of a mindfulness-based smartphone app: a randomized controlled trial. *Mindfulness*, 9(5), 1584-1593. DOI:<https://doi.org/10.1007/s12671-018-0905-4>.

Emmelkamp, P. M. & Meyerbröker, K. (2021). Virtual reality therapy in mental health. *Annual Review of Clinical Psychology*, 17(1), 495-519. DOI:<https://doi.org/10.1146/annurev-clinpsy-081219-115923>.

ESwaran, V. S. B., VEEzhinathan, M., Balasubramanian, G., & Taneja, A. (2018). Virtual reality therapy for mental stress reduction. *Journal of Clinical & Diagnostic Research*, 12(10), 11-16. DOI:<https://doi.org/10.7860/JCDR/2018/36055.12109>.

Feng, W., Tu, R., & Hsieh, P. (2020). Can gamification increases consumers' engagement in fitness apps? The moderating role of commensurability of the game elements. *Journal of Retailing and Consumer Services*, 57, 102229. DOI:<https://doi.org/10.1016/j.jretconser.2020.102229>.

Fink, G. (2017). *Stress: Concepts, Definition and History*.

Fish, M. T. & Saul, A. D. (2019). The gamification of meditation: A randomized-controlled study of a prescribed mobile mindfulness meditation application in reducing college students' depression. *Simulation & Gaming*, 50(4), 419-435. DOI:<https://doi.org/10.1177/1046878119851821>.

Hoffmann, A., Christmann, C. A., & Bleser, G. (2017). Gamification in stress management apps: A critical app review. *JMIR Serious Games*, 5(2), e7216. DOI:<https://doi.org/10.2196/games.7216>.

Hong, S., Joung, D., Lee, J., Kim, D. Y., Kim, S., & Park, B. J. (2019). The effects of watching a virtual reality (VR) forest video on stress reduction in adults. *Journal of People, Plants, and Environments*, 22(3), 309-319. DOI:<https://doi.org/10.11628/kspe.2019.22.3.309>.

Jent, S. & Janneck, M. (2017). Using gamification to enhance user motivation: the influence of gender and age. In *International Conference on Applied Human Factors and Ergonomics*. DOI:https://doi.org/10.1007/978-3-319-60486-2_1.

Jerdan, S. W., Grindle, M., Van Woerden, H. C., & Boulos, M. N. K. (2018). Head-mounted virtual reality and mental health: critical review of current research. *JMIR Serious Games*, 6(3), e9226. DOI:<https://doi.org/10.2196/games.9226>.

Kardong-Edgren, S. S., Farra, S. L., Alinier, G., & Young, H. M. (2019). A call to unify definitions of virtual reality. *Clinical Simulation in Nursing*, 31, 28-34. DOI:<https://doi.org/10.1016/j.ecns.2019.02.006>.

Kushal, A., Gupta, S., Mehta, M., & Singh, M. M. (2018). Study of stress among health care professionals: a systemic review. *International Journal of Research Foundation of Hospital and Healthcare Administration*, 6(1), 6-11. DOI:<https://doi.org/10.5005/jp-journals-10035-1084>.

Minihan, S., Songco, A., Andrews, J., Grunewald, K., Werner-Seidler, A., Blakemore, S. J., & Schweizer, S. (2022). Development of a gamified cognitive training app “Social Brain Train” to enhance adolescent mental health: a participatory design study protocol. *Wellcome Open Search*, 7(21). DOI:<http://dx.doi.org/10.12688/wellcomeopenres.17441.1>.

Murphy, C., Chertoff, D., Guerrero, M., & Moffitt, K. (2011). Creating flow, motivation and fun in learning games. *The design of learning games*.

Naro, A. & Calabrò, R. S. (2021). What do we know about the use of virtual reality in the rehabilitation field? A brief overview. *Electronics*, 10(9), 1042. DOI:<https://doi.org/10.3390/electronics10091042>.

Nicolaidou, I., Tozzi, F., Kindynis, P., Panayiotou, M., & Antoniadis, A. (2019). Development and usability of a gamified app to help children manage stress: an evaluation study. *Italian Journal of Educational Technology*, 27(2), 105-120. DOI:<https://doi.org/10.17471/2499-4324/1050>.

Pascoe, M. C., Hetrick, S. E., & Parker, A. G. (2020). The impact of stress on students in secondary school and higher education. *International Journal of Adolescence and Youth*, 25(1), 104-112. DOI:<https://doi.org/10.1080/02673843.2019.1596823>.

Passalacqua, M., Léger, P. M., Nacke, L. E., Fredette, M., Labonté-Lemoyne, É., Lin, X., Caprioli, T., & Sénécal, S. (2020). Playing in the backstore: Interface gamification increases warehousing workforce engagement. *Industrial Management and Data Systems*, 120(7), 1309-1330. DOI:<https://doi.org/10.1108/IMDS-08-2019-0458>.

Phillips, C., Johnson, D., Klarkowski, M., White, M. J., & Hides, L. (2018). The impact of rewards and trait reward responsiveness on player motivation. In *Proceedings of the 2018 Annual Symposium on Computer-Human Interaction in Play*, 393-404. DOI:<https://doi.org/10.1145/3242671.3242713>.

Pitoyo, M. D. & Asib, A. (2019). Gamification Based assessment: A Test Anxiety Reduction through Game Elements in Quizizz Platform. *International Online Journal of Education and Teaching*, 6(3), 456-471.

Raevuori, A., Vahlberg, T., Korhonen, T., Hilgert, O., Aittakumpu-Hyden, R., & Forman-Hoffman, V. (2021). A therapist-guided smartphone app for major depression in young adults: A randomized clinical trial. *Journal of Affective Disorders*, 286, 228-238. DOI:<https://doi.org/10.1016/j.jad.2021.02.007>.

Sardi, L., Idri, A., & Fernández-Alemán, J. L. (2017). A systematic review of gamification in e-Health. *Journal of Biomedical Informatics*, 71, 31-48. DOI:<https://doi.org/10.1016/j.jbi.2017.05.011>.

Servotte, J. C., Gousse, M., Campbell, S. H., Dardenne, N., Pilote, B., Simoneau, I. L., Guillaume, M., Bragard, I., & Ghuysen, A. (2020). Virtual reality experience: Immersion, sense of presence, and cybersickness. *Clinical Simulation in Nursing*, 38, 35-43. DOI:<https://doi.org/10.1016/j.ecns.2019.09.006>.

Siriaraya, P., Visch, V., Boffo, M., Spijkerman, R., Wiers, R., Korrelboom, K., Hendriks, V., Saleminck, E., van Dooren, M., Bas, M., & Goossens, R. (2021). Game design in mental health care: Case study-based framework for integrating game design into therapeutic content. *JMIR Serious Games*, 9(4), e27953. DOI:[doi:10.2196/27953](https://doi.org/10.2196/27953).

Syed, U. E. & Kamal, A. (2021). Video game-based and conventional therapies in patients of neurological deficits: an experimental study. *Disability and Rehabilitation: Assistive Technology*, 16(3), 332-339. DOI:<https://doi.org/10.1080/17483107.2019.1679266>.

T.B, Tece Bayrak, A., & C., BW, Wünsche, B. (2021). Player motivation in therapy games for Parkinson's disease: A scoping review: Understanding meaningful play, self-determination and flow. In *2021 Australasian Computer Science Week Multiconference*. DOI:<https://doi.org/10.1145/3437378.3442692>.

Treiblmaier, H. & Putz, L. M. (2020). Gamification as a moderator for the impact of intrinsic motivation: Findings from a multigroup field experiment. *Learning and Motivation*, 71, 101655. DOI:<https://doi.org/10.1016/j.lmot.2020.101655>.

Trifunovic, N., Jatic, Z., & Kulenovic, A. D. (2017). Identification of causes of the occupational stress for health providers at different levels of health care. *Medical Archives*, 71(3), 3, 169-172. DOI:<https://doi.org/10.5455%2Fmedarh.2017.71.169-172>.

van Dooren, M. M., Siriaraya, P., Visch, V., Spijkerman, R., & Bijkerk, L. (2019). Reflections on the design, implementation, and adoption of a gamified eHealth application in youth mental healthcare. *Entertainment Computing*, 31, 100305. DOI:<https://doi.org/10.1016/j.entcom.2019.100305>.

Xu, W., Liang, H. N., Baghaei, N., Ma, X., Yu, K., Meng, X., & Wen, S. (2021). Effects of an immersive virtual reality exergame on university students' anxiety, depression, and perceived stress: pilot feasibility and usability study. *JMIR Serious Games*, 9(4), e29330. DOI:<https://doi.org/10.2196/29330>.

Yuan, S., Tao, F., & Li, Y. (2022). The restorative effects of virtual reality forests on elderly individuals during the COVID-19 lockdown. *Journal of Organizational and End User Computing*, 34(6), 1-22. DOI:<https://doi.org/10.4018/JOEUC.297626>.

Zaharuddin, F. A., Ibrahim, N., Mahidin, E. M., Yusof, A. M., & Ezaneerusli, M. (2019). Virtual reality application for stress therapy: Issues and challenges.