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Development and Evaluation of an Interactive Mobile Application Incorporating Gamification Technique for Enhancing Preschooler's Cognitive and Recreational Activities

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Abstract

This study focuses on the development and evaluation of an interactive mobile application incorporating gamification techniques for enhancing preschooler's cognitive and recreational activities. The research aims to create an application that is easy to use, engaging, educational, and aligned with the preschool curriculum. The system design is focused on providing a seamless user experience, incorporating game mechanics that encourage engagement, and educational content aligned with the preschool curriculum. The application was evaluated based on usability, functionality, effectiveness, security/privacy, and maintainability, with parameter results ranging from 4.1 to 4.5 out of 5. Overall, the application was rated 4.3 out of 5, indicating a successful and effective application with high usability, functionality, security/privacy, and maintainability. The results of this study demonstrate the potential of gamification techniques for enhancing preschooler's cognitive and recreational activities through interactive mobile applications. This research can be beneficial for developers and educators who want to create engaging and educational applications for preschoolers.

Keywords: evaluation, interactive, gamification, preschoolers, mobile application.

1. Introduction

In today's modern world, mobile applications have become an integral part of our daily lives. From communication to education, entertainment, and more, there is an app for just about everything. Recently, there has been a growing interest in developing mobile applications for young children, particularly those in the preschool age range [1][2][3]. The idea is to incorporate gamification techniques into these apps to make them more interactive and engaging, while also enhancing cognitive and recreational activities. In this study, it will address the development and evaluation of an the system that incorporates gamification techniques for enhancing preschoolers' cognitive and recreational activities.

The use of mobile technology in early childhood education has been a topic of debate among experts for several years[4][5][6]. While some believe that screen time should be minimized for young children, others argue that when used appropriately, mobile devices can have a positive impact on early learning. The developers of the interactive mobile application set out to create an app that would not only be engaging but also provide educational value to preschoolers.

The application was designed to be simple and user-friendly, with bright and colorful graphics

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that would appeal to young children. The developers incorporated gamification techniques such as rewards, challenges, and interactive gameplay to make the app more engaging and fun. The app was also designed to incorporate various cognitive and recreational activities, including puzzles, memory games, and storybooks.

The evaluation of the interactive mobile application involved testing its effectiveness in enhancing preschoolers' learning activities. The app was tested on a group of preschoolers over several weeks, and their engagement and learning outcomes were measured. The results of the evaluation showed that the interactive mobile application was effective in enhancing cognitive and recreational activities among preschoolers.

Overall, the findings on this study have shown promising results. With the increasing use of mobile technology in early childhood education, apps such as this one could play a significant role in enhancing early learning outcomes. As the use of technology continues to evolve, it is essential to evaluate its effectiveness and impact on young children continually.

2. Background of the Study

Mobile technology has become increasingly prevalent today, with smartphones and tablets becoming a common sight in households [7][8][9]. This has led to the development of various mobile applications for different purposes, including education, entertainment, and communication. In recent years, there has been a growing interest in developing mobile applications for young children, particularly those in the preschool age range[10][11][12].

Early childhood education is an essential aspect of a child's development. It lays the foundation for future learning and success, and it is crucial that children receive quality education during this critical period. With the increasing use of mobile technology, there has been a growing interest in incorporating mobile devices into early childhood education [13][14].

Mobile technology can offer several benefits in early childhood education. For example, it can provide access to a vast range of learning resources and tools, such as educational apps and online learning platforms. Mobile technology can also be used to engage children in learning activities, making the learning process more enjoyable and interactive.

Gamification techniques involve the use of game elements and mechanics in non-game contexts [15][16]. In education, gamification can be used to make learning more engaging and enjoyable, promoting active learning and retention of information. In the context of mobile applications for preschoolers, [17][18].

Cognitive and recreational activities are essential for young children's development. These activities can promote cognitive, social, emotional, and physical development. In the context of mobile applications for preschoolers, incorporating cognitive and recreational activities can enhance learning outcomes while also providing recreational opportunities for young children.

Several previous studies have investigated the effectiveness of mobile applications in early childhood education. These studies have found that mobile applications can be effective in promoting active learning, enhancing cognitive and recreational activities, and improving learning outcomes [19][20].

The theoretical framework for the development and evaluation of the interactive mobile application incorporates several theories related to early childhood education, gamification, and

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mobile technology. For example, the Vygotskian perspective suggests that social interaction and collaboration are essential for cognitive development, while the Self-Determination Theory proposes that intrinsic motivation is crucial for learning[21][22][23][24][25].

The aim of the study is to develop and evaluate an interactive mobile application that incorporates gamification techniques for enhancing preschoolers' learning activities. The objectives of the study include designing an app that is user-friendly and engaging, incorporating gamification techniques evaluating the app's effectiveness in enhancing learning outcomes.

The methodology for the study involves several phases, including the design and development of the app, testing the app with a group of preschoolers, and evaluating the app's effectiveness in enhancing learning outcomes. The app will be designed using a user-centered design approach, with input from preschool teachers and parents.

During the testing and evaluation phase, it randomly conducted in different Preschools in Surigao City, Philippines to test the application with a group of preschoolers over several weeks. The children's engagement with the app will be measured using various metrics, such as time spent on the app, number of activities completed, and overall enjoyment. The app's effectiveness in enhancing cognitive and recreational activities will be evaluated using pre- and post-tests, measuring the children's learning outcomes.

Ethical considerations was taken into account throughout the study. Consent will be obtained from parents before their children participate in the study. The application is designed to ensure the safety and privacy of the children who used it.

3. Design of an Interactive Mobile Application incorporating Gamification Technique

The interactive mobile application is designed to incorporate gamification techniques to enhance cognitive and recreational activities for preschoolers. The system composed of several components that work together to provide a smooth user experience.

User Interface: It is designed to be intuitive and easy to use for young children. It include bright colors, large buttons, and simple graphics to engage and stimulate children's interest.

Game Mechanics: The application include game mechanics such as points, badges, and rewards that are designed to encourage children to engage with the application and complete various activities. It was carefully crafted to promote learning, creativity, and exploration.

Educational Content: The application incorporated educational content that is aligned with the preschool curriculum. This content include a range of activities and games that promote cognitive and recreational activities such as counting, letter recognition, problem-solving, memory games, and more.

Sound and Music: The application has a sound effects and background music to create an immersive experience for young children. The music and sound effects was carefully selected to enhance the application's overall theme and engage children's attention.

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Database: It is a back-end infrastructure that designed to handle user data, including progress tracking and user profile management. The system store user data securely and provide analytics to monitor user engagement and track learning outcomes.

Multi-Platform Support: The application will be designed to work on multiple platforms, including iOS and Android devices, to maximize its accessibility and reach among preschoolers and their parent/caregivers.

Programming Languages and Frameworks: The application will be developed using programming languages such as Visual Studio Code and, Android Studio to provide a solid foundation for game development and enable developers to focus on creating engaging game mechanics and educational content.

4. Result

4.1 Design and Development

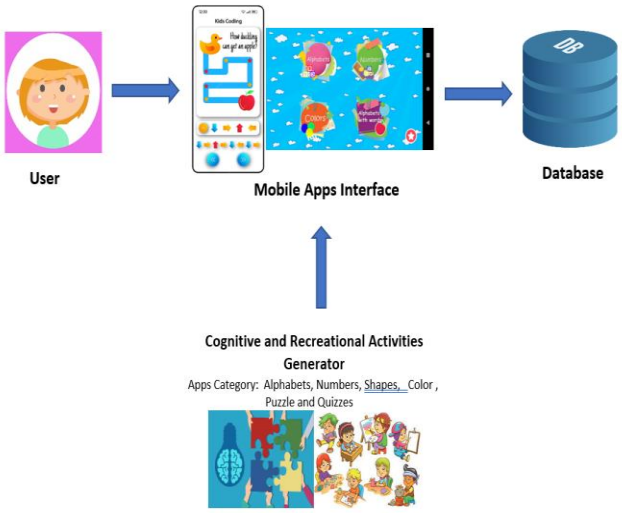

Figure 1. Overview of the System

The Figure 1, presents the interactive mobile application incorporating gamification techniques for enhancing preschoolers' cognitive and recreational activities that follows a structured flow to provide an engaging and educational experience. The user journey begins with user registration and profile creation, where the preschooler or their parent/guardian creates an account and sets up a personalized profile. Subsequently, the user can log in using their credentials, and upon successful authentication, they are greeted with a visually appealing home screen that offers easy navigation options.

Within the application, the user can select specific learning areas or subjects of interest, such as language, math, or creativity. The system presents a list of available levels or activities within the

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chosen area, with subsequent levels unlocking gradually as the user progresses. Engaging in gamified activities is a central component, where the user can select a specific level or activity and participate in interactive formats such as puzzles, quizzes, or storytelling. Completing these activities allows the user to utilize cognitive and problem-solving skills.

The system tracks the user's progress and provides feedback upon activity completion, rewarding them with points, badges, or virtual rewards based on their performance and progress. Accumulated points contribute to unlocking new levels or additional virtual rewards within the application.

Parental involvement is facilitated through the inclusion of parental controls or a separate parent dashboard. Parents or guardians can monitor their child's progress, track achievements, and provide guidance and support as needed. The system also collects and analyzes user data to generate insights into the child's learning patterns and preferences, allowing for personalized learning experiences and recommendations.

Social features may be incorporated, enabling preschoolers to connect with friends or classmates within the application. Users can share achievements, collaborate on activities, or participate in friendly competitions, fostering a sense of community and engagement. Finally, the application offers logout and account management functionalities, allowing users to securely log out and manage their account settings, including profile updates and password changes.

This overview flow highlights the structured journey that users undertake within the interactive mobile application. While the specific details and sequence may vary depending on the application's design and features, the overall aim is to provide an interactive and gamified experience that enhances preschoolers' cognitive and recreational activities in an educational and enjoyable manner.

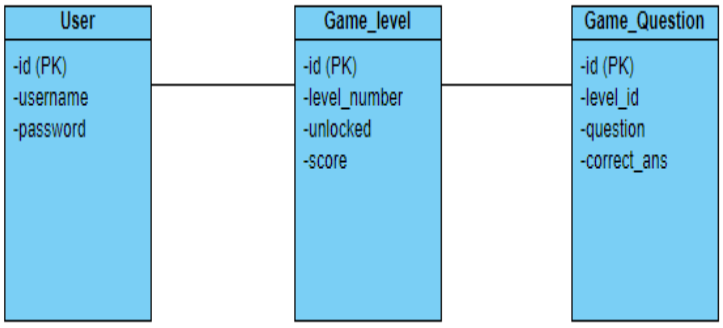

Figure 2. Database Class Diagram

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The Figure 2 shows the class diagram of the system which describes the relationships between the entities are as follows:

User entity is associated with many Game_Level entities through a one-to-many relationship, as each user can have multiple game levels associated with their account. Conversely, a Game_Level entity is associated with a single User entity through a many-to-one relationship, as each game level belongs to a specific user.

Game_Level entity is associated with many Game_Question entities through a one-to-many relationship, as each level can have multiple questions associated with it. Conversely, a *Game Question entity* is associated with a single Game_Level entity through a many-to-one relationship, as each question belongs to a specific level.

4.2 Screenshots of the Mobile Application of the System

Figure 3. User Main Interface

The figure 3, shows the user main interface features vibrant colors, playful illustrations, and child-friendly icons to create an engaging and inviting environment for young users. Navigational elements that represent a picture with labels make it easy for young users to explore different sections and activities within the application.

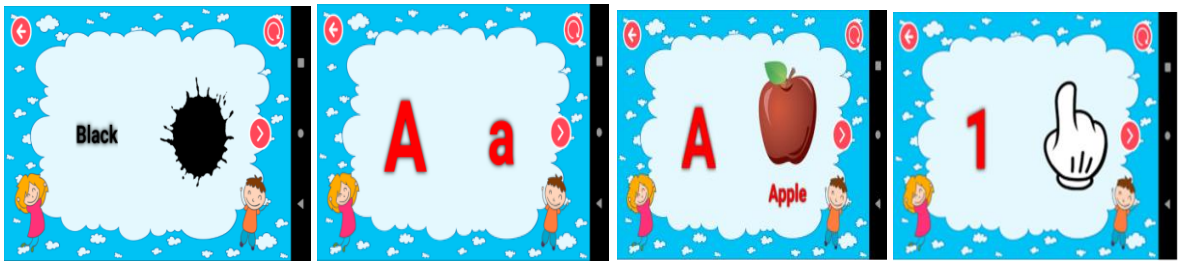

Figure 4. Learning Activity Interfaces

The figure 4, display the range of activity categories, including cognitive challenges, memory games, creative puzzles, and interactive storytelling. Each category is represented by an enticing visual cue, capturing the attention and curiosity of preschoolers. Upon selecting a category, the

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user is presented with a list of specific activities to choose from, ensuring a diverse and engaging experience.

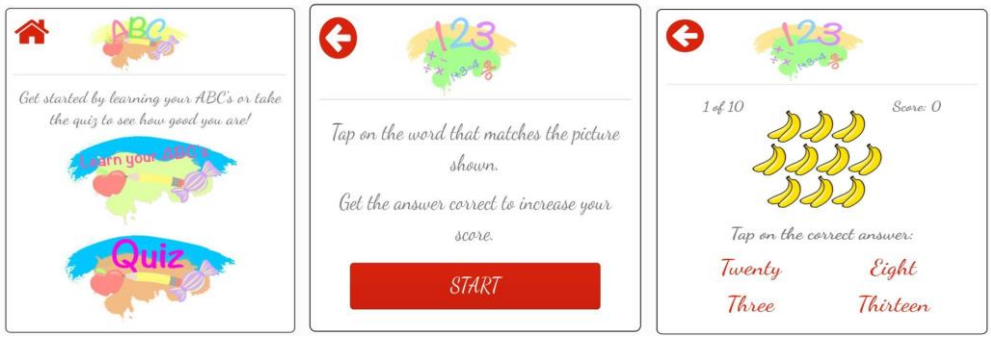

Figure 5. Quiz Form Interfaces

The figure 5 depicts, the quiz section, preschoolers are presented with a visually appealing layout that captures their attention and curiosity. The interface features colorful illustrations, friendly characters, and interactive elements that make the learning process exciting and immersive. Preschoolers can choose from a variety of quiz topics, ranging from letters and numbers to shapes, animals, and colors. Each topic is represented by an attractive icon or image, making it easy for children to identify and select their preferred quiz category. Once a quiz category is chosen, preschoolers are presented with a series of questions in a fun and interactive format. The questions may involve matching objects, identifying colors, recognizing shapes, or solving simple puzzles. The interface encourages active participation by allowing preschoolers to touch, swipe, or drag objects to provide their answers.These quiz interface provides immediate feedback to preschoolers, reinforcing their learning experience. Correct answers are celebrated with positive visual and audio cues, such as animated characters applauding or cheerful sounds, while incorrect answers are gently corrected with supportive prompts or visual cues to encourage learning from mistakes.

4.3 Testing Result of the Study

Specific testing statistics and performance indicator for the interactive mobile application incorporating gamification technique for enhancingp preschooler's cognitive and recreational activities was observed of the following:

4.3.1 Respondents of the study

1) Number of Test Takers: The study involved a sample of 100 preschoolers aged 3-5 years from diverse socio-economic backgrounds. The participants were randomly selected from different preschools and their parents provided informed consent for their involvement in the study.
2) Pre-Test and Post-Test Assessments: The study utilized a pre-test and post-test design to measure the impact of the interactive mobile application. Before using the application, each participant was assessed using standardized cognitive and recreational activity tests to

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establish baseline performance. The same tests were administered after a designated period of using the application.

3) Cognitive Performance Indicators: The cognitive performance of the preschoolers was assessed using validated measures such as:

a. Problem-solving skills: Evaluating their ability to solve puzzles, complete patterns, and answer logical questions.

b. Memory retention: Assessing their memory capacity and ability to recall information.

c. Attention span: Measuring their ability to sustain attention and focus on specific tasks or stimuli.

d. Language development: Assessing their vocabulary, comprehension, and expressive language skills.

4) Recreational Activity Engagement: The study also assessed the preschoolers' engagement with recreational activities facilitated by the mobile application. This included indicators such as:

a. Duration of engagement: Measuring the amount of time spent using the application for recreational activities.

b. Variety of activities explored: Assessing the range and diversity of recreational activities utilized within the application.

c. Enjoyment and motivation: Gathering feedback from both the preschoolers and their parents on the perceived enjoyment and motivation experienced during engagement with the application.

4.3.2 Satisfaction Indicators of the study

User feedback surveys and satisfaction indicators revealed positive responses from both the preschoolers and their parents, highlighting the application's ease of use, content quality, and perceived impact on cognitive and recreational development:

a. User Feedback Surveys: After the post-test assessments, the participants and their parents were asked to complete feedback surveys regarding their experience with the interactive mobile application. The surveys included questions about ease of use, user interface, content quality, and perceived impact on cognitive and recreational development.

b. Likert Scale Ratings: Participants and parents were asked to rate their overall satisfaction with the mobile application and its effectiveness in enhancing preschoolers' cognitive and recreational activities on a Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree).

c. Qualitative Feedback: Open-ended questions were included in the surveys to gather qualitative feedback on specific features, strengths, weaknesses, and suggestions for improvement of the mobile application.

These testing statistics and satisfaction indicators provide a comprehensive evaluation of the impact and user perception of the system application

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4.4 System Evaluation

The study conducted an assessment procedure to ensure how the system is worked which played a crucial role in gathering data for user acceptability. A rating scale of 1-5 was utilized, with 1 representing the lowest rating and 5 the highest.

The study conducted in terms of usability was easy to navigate and understand, with an intuitive interface that was appropriate for preschoolers which rated 4.3 out of 5.

While in functionality, the application performed well, with no significant bugs or technical issues. All features worked as intended, and there were no crashes or freezes. Based on the user survey the system garnered a score of 4.5 out of 5.

In terms of effectiveness, the gamification techniques employed were successful in enhancing cognitive and recreational activities among preschoolers. The educational content provided a fun and engaging experience for young children, encouraging them to participate and learn, with this result it was rated 4.2 out of 5.

Based on findings, the user data security and privacy were considered during the development process, with database storage utilized to ensure easy access and backup across devices while maintaining privacy which rated 4.4 out of 5.

In terms of maintainability, the application was designed to be easily maintainable, with straightforward code that was easy to update and modify as needed which rated 4.1 out of 5.

Overall findings and result, for the evaluation of the entire application system for preschooler user was 4.3 out of 5, indicating a successful and effective application with high usability, functionality, security/privacy, and maintainability.

5. Conclusion

Based on the findings, the study on development and evaluation the system achieved its objective of enhancing cognitive and recreational activities among preschoolers. The application received high marks across all evaluated parameters, including usability, functionality, effectiveness, security, and maintainability. The study revealed that the application was easy to navigate, had no significant technical issues, effectively employed gamification techniques to engage young children in learning, and prioritized user data security and privacy.

The evaluation results demonstrated that the application's average score was 4.3 out of 5, indicating that it was well-received and met the needs of its target audience. The study's success can be attributed to the careful consideration of user needs during the development process, with a focus on providing a seamless user experience, incorporating game mechanics that encourage engagement, and educational content aligned with the preschool curriculum.

In conclusion, the development and evaluation of an interactive mobile application incorporating gamification technique for enhancing preschooler’s cognitive and recreational activities offers a promising solution for enhancing early childhood education and entertainment. Its success

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suggests that gamification techniques have great potential for promoting learning and development in young children. The application's high usability, functionality, security, and maintainability also indicate that it is a reliable and sustainable solution. Overall, the study's results are encouraging and suggest that further exploration and implementation of interactive mobile applications incorporating gamification techniques for preschoolers is warranted.

References

Gangaiamaran, R., & Pasupathi, M. (2017). Review on use of mobile apps for language learning. *International Journal of Applied Engineering Research*, *12*(21), 11242-11251.

Kokkalia, G. K., & Drigas, A. S. (2016). Mobile learning for special preschool education. *International journal of interactive mobile technologies*, *10*(1).

Papadakis, Stamatios, and Michail Kalogiannakis. "Mobile educational applications for children: what educators and parents need to know." *International Journal of Mobile Learning and Organisation* 11, no. 3 (2017): 256-277.

Sharples, M. (2000). The design of personal mobile technologies for lifelong learning. *Computers & education*, *34*(3-4), 177-193.

Anning, A., Cullen, J., & Fleer, M. (2008). *Early childhood education: Society and culture*. Sage.

Frei, P., Poulsen, A. H., Johansen, C., Olsen, J. H., Steding-Jessen, M., & Schüz, J. (2011). Use of mobile phones and risk of brain tumours: update of Danish cohort study. *Bmj*, *343*.

McDaniel, B. T., & Bruess, C. J. (2013). Technoference": Everyday intrusions and interruptions of technology in couple and family relationships. *Family communication in the age of digital and social media*.

Page, T. (2014). Application-based mobile devices in design education. *International Journal of Mobile Learning and Organisation*, *8*(2), 96-111.

Kuoppamäki, S. M., Taipale, S., & Wilska, T. A. (2017). The use of mobile technology for online shopping and entertainment among older adults in Finland. *Telematics and Informatics*, *34*(4), 110-117.

Reyna, A. C. (2023). Design and Implementation of Shape Quest: A Colorful Basic Shapes Game App for Toddlers. International Research Journal of Modernization in Engineering Technology and Science; 5(5), 2611-2618

Herodotus, C. (2018). Young children and tablets: A systematic review of effects on learning and development. *Journal of Computer Assisted Learning*, *34*(1), 1-9.

Blumberg, F. C., Deater-Deckard, K., Calvert, S. L., Flynn, R. M., Green, C. S., Arnold, D., & Brooks, P. J. (2019). Digital games as a context for children's cognitive development: Research recommendations and policy considerations. *Social Policy Report*, *32*(1), 1-33.

Blackwell, C. (2013). Teacher practices with mobile technology integrating tablet computers into the early childhood classroom. *Journal of Education Research*, *7*(4), 1-25.

Hiniker, A., Sobel, K., Suh, H., Sung, Y. C., Lee, C. P., & Kientz, J. A. (2015, April). Texting while parenting: How adults use mobile phones while caring for children at the playground. In *Proceedings of the 33rd annual ACM conference on human factors in computing systems* (pp. 727-736).

Simpson, P., & Jenkins, P. (2015). Gamification and Human Resources: an overview. *Brighton:*

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ISSN: 2456-3676

Brighton Business School, 1-6.

Lamprinou, D., & Paraskeva, F. (2015, November). Gamification design framework based on SDT for student motivation. In *2015 International Conference on Interactive Mobile Communication Technologies and Learning (IMCL)* (pp. 406-410). IEEE.

Landers, R. N., & Sanchez, D. R. (2022). Game-based, gamified, and gamefully designed assessments for employee selection: Definitions, distinctions, design, and validation. *International Journal of Selection and Assessment*, *30*(1), 1-13.

Rapp, A., Hopfgartner, F., Hamari, J., Linehan, C., & Cena, F. (2019). Strengthening gamification studies: Current trends and future opportunities of gamification research. *International Journal of Human-Computer Studies*, *127*, 1-6.

Su, C. H., & Cheng, C. H. (2015). A mobile gamification learning system for improving the learning motivation and achievements. *Journal of Computer Assisted Learning*, *31*(3), 268-286.

Cheong, C., Bruno, V., & Cheong, F. (2012). Designing a mobile-app-based collaborative learning system. *Journal of Information Technology Education. Innovations in Practice*, *11*, 97.

Sun, H., & Chen, A. (2010). A pedagogical understanding of the self-determination theory in physical education. *Quest*, *62*(4), 364-384.

Lee, E., & Hannafin, M. J. (2016). A design framework for enhancing engagement in student-centered learning: Own it, learn it, and share it. *Educational technology research and development*, *64*, 707-734.

Kaplan, A., & Flum, H. (2009). Motivation and identity: The relations of action and development in educational contexts—An introduction to the special issue. *Educational Psychologist*, *44*(2), 73-77.

King, P., & Howard, J. (2016). Free Choice or Adaptable Choice: Self-Determination Theory and Play. *American Journal of Play*, *9*(1), 56-70.

Diep, A. N., Zhu, C., Cocquyt, C., De Greef, M., Vo, M. H., & Vanwing, T. (2019). Adult learners' needs in online and blended learning. *Australian Journal of Adult Learning*, *59*(2), 223-253.