

# Playtime: Educational Entertainment for Children with ASD Via Cross-Platform Game with Merge Sort Algorithm and Performance Analysis for PBLC

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## ABSTRACT

In this project, the researcher describes PlayTime, a cross-platform education entertainment program that was created to serve children aged between 4 and 6 years of age with Autism Spectrum Disorder (ASD). The system incorporates interactive mini-games that are aimed at developing cognitive skills including attention, memory, and solving problems and encouraging social interaction and involvement through play. PlayTime was created according to the ISO/IEC 25010 software quality model with the help of the Spiral Model of the System Development Life Cycle (SDLC) in order to provide the iterative improvement and stability of the system.

The research design used was quantitative, and the authors collected information from a total of 50 respondents, consisting of 8 gamers (16%), 12 educators (24%), 5 teachers (10%), 5 therapists (10%), and 20 technical experts (40%). The gamer respondents evaluated the application using the PASS Theory of Intelligence, while the technical experts assessed it based on software quality standards. Educators, teachers, and therapists also provided valuable insights into the educational and therapeutic effectiveness of the game. Findings revealed that PlayTime performed well across all respondent groups. Gamers cited the application as effective in maintaining attention and enhancing focus, while educators and therapists noted its potential as a supportive learning and intervention tool. Meanwhile, technical experts reported that the game is highly usable, performs efficiently, and demonstrates strong reliability. These results collectively affirm the overall quality and educational value of the PlayTime application.

## INTRODUCTION

Learning can be challenging for many children, especially for those who need help developing focus, memory, and social interaction skills. Traditional teaching strategies often do not meet the needs of diverse learners, particularly children with developmental conditions such as Autism Spectrum Disorder (ASD). Research shows that interactive and play-based learning increases engagement and understanding. Plass, Homer, and Kinzer (2015) explained that game-based learning promotes cognitive growth through immersive and emotionally engaging activities, while Vygotsky's (1978) Social Development Theory stresses the importance of interaction and active participation in the learning process. These ideas highlight the growing need to merge technology and play to make learning more inclusive and effective.

Foreign and local studies support this approach. Gray (2018) and Bediou et al. (2018) found that video games can improve perception, attention, and problem-solving, while Gallud et al. (2023) revealed that serious games enhance both cognitive and social skills, particularly for children with autism. Locally, Carandang (2021) and Rosales et al. (2023) confirmed that play-based instruction encourages motivation, communication, and emotional engagement in Filipino learners, especially those with special needs. Mendoza and Santos (2019) also observed that educational games foster teamwork, focus, and confidence. Collectively, these studies affirm that game-based learning helps strengthen both academic and personal development.

PlayTime is an educational entertainment platform designed to integrate learning with play. It aims to transform traditional instruction into an adaptive and interactive experience that helps children with ASD improve their cognitive and social skills. The system features mini-games focused on memory, logic, and problem-solving, complemented by a reward system to encourage engagement and motivation.

A key feature of PlayTime is its adaptive learning process, powered by the Merge Sort Algorithm, which adjusts game difficulty based on a learner's performance. By analyzing accuracy, task completion, and response time, the system customizes activities that match each child's ability level. This adaptive design promotes steady progress, boosts confidence, and ensures that learning remains both enjoyable and developmentally appropriate.

Guided by the ISO/IEC 25010 software quality model, this study aims to design and develop a user-friendly, efficient, and reliable platform that promotes engagement, cognitive development, and collaboration. Overall, PlayTime seeks to provide an innovative, inclusive, and entertaining learning experience for children with ASD while supporting educators and caregivers in tracking learner growth and development.

## Scope

The study focuses on the design, development, and evaluation of PlayTime, an educational entertainment platform created for children with Autism Spectrum Disorder (ASD) aged 3 to 6. Specifically, the study covers the following scope:

- **Development Focus:** The project involves creating an interactive, adaptive, and cross-platform game-based learning system that enhances children's cognitive, memory, and problem-solving skills through educational mini-games
- **Adaptive Algorithm:** The system utilizes the Merge Sort Algorithm to automatically adjust the difficulty level of activities based on a child's performance, ensuring a personalized and engaging learning experience.
- **Platform and Tools:** The game is developed using tools such as Godot Game Engine, Visual Studio Code, Adobe Illustrator, Procreate, Figma, Audacity, and GitHub, following the Game Development Life Cycle (GDLC) model to ensure systematic and iterative development.
- **Evaluation Framework:** The platform is assessed using the PASS Theory of Intelligence to evaluate cognitive performance and the ISO/IEC 25010 standard to evaluate functionality, usability, and reliability.
- **Stakeholders:** The study involves children with ASD, teachers, caregivers, and technical experts who provide feedback on usability, accessibility, and learning outcomes.
- **Objective of the System:** PlayTime serves as both a learning tool and an assessment platform by offering feedback, performance tracking, and progress monitoring that assist educators and parents in understanding a child's developmental progress.

## LIMITATION

The paper is narrow and confined to developmental and evaluation of the PlayTime system but lacks longitudinal or medical analysis of behavioral improvements in children with ASD. The respondents are also limited to 50 respondents (30 gamer respondents (children with ASD observed under the guidance of adults) and 20 technical experts who tested the functionality of the system and the quality of the software).

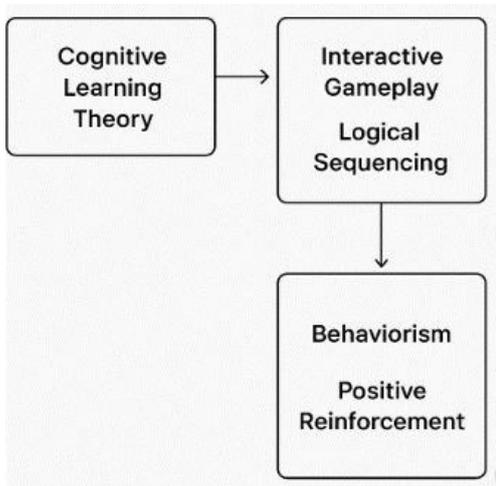
The age group of the participants is limited to 4-6 years of the age, as the games are tailored to the cognitive abilities at early childhood. The application deals with the fundamental educational principles like recognizing colors, matching, logical and memory tasks. The external conditions such as home environment, difference in attention span, and familiarity with the device are not included in the study.

Also, the evaluation of the platform is restricted to the prototype of PlayTime. Although the system was cross-platform tested, the differences in the performance of these devices or even the internet connection can affect user experience. The prospective enhancements (e.g. multiplayer networking, more sophisticated AI-based adaption, a wider content coverage) were pointed out but not realized in the course of the present research.

## THEORETICAL FRAMEWORK

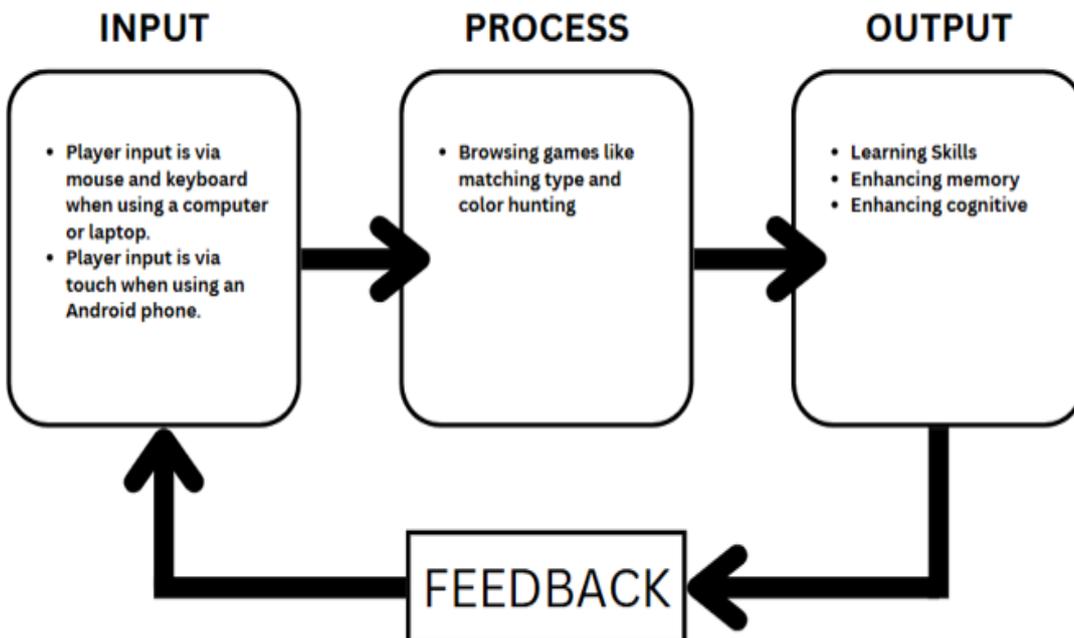
The theoretical framework of PlayTime is based on Cognitive Learning Theory and Behaviorism. Cognitive Learning Theory emphasizes the enhancement of mental skills such as attention, memory, and problem-solving through interactive gameplay and logical sequencing using the Merge Sort Algorithm. Behaviorism supports the system's use of feedback and rewards to reinforce positive behaviors and learning progress. Combined, these theories guide PlayTime in providing a structured, engaging, and data-driven learning experience that promotes both cognitive and behavioral development in children with ASD.

Figure 1: Theoretical Framework



## Conceptual Framework

Figure 2: Conceptual Framework



### Input

It starts with the Input, during which players children with special needs play with the platform with the help of various devices. A laptop or a computer is used, whereby the player interacts with different games by using a mouse and a keyboard as the input. Per Android phones or tablets, they are played with touch controllers, providing easy access to gameplay features which are easy to use and reach.

## Process

During the Process stage, the players will be browsing and playing games that are educational and aimed at the improvement of the main areas of development. The activities such as matching types (e.g., shapes or letters) and color hunting are part of such games, arranged in a way that facilitates repetition, recognition, and problem-solving. The games are considered to be visually stimulating, age appropriate and fun, and this provides the learner with a low-pressure atmosphere that allows them to engage in continuous learning through play. Since the players interact with the games, they train vital skills such as recalling information, reasoning, and socializing where cooperation aspects are used.

## Output

Output stage is the indication of the developmental benefits that have been realized during the gameplay. These involve increase in the learning skills, better recollection, and the cognitive capabilities. With constant involvement of students, teachers and parents can see clear improvement in the child responses to activities, process of information and social relations. These observational outputs are the sign of the effectiveness of the platform in dealing with special needs education.

## Significance of the Study

The creation of PlayTime, as a learning platform that follows a game format, is important to a number of key stakeholders in the learning and care of special needs children:

- **Administrators and Teachers:** PlayTime gives educators the new tool that improves traditional teaching methods. Its game-based strategy is more interactive, and the students, who might not learn well with traditional approaches, will be more engaged, and the teachers will be able to target the different learning needs of the students. It can be smoothly incorporated into the classroom routine, individual learning plans, or even therapy, which allows tracking the progress of students better and modifying teaching strategies according to the results observed.
- **Students and Professionals:** In the case of students with special needs, PlayTime provides a learning experience that is fun, less stressful, and helps them to acquire the necessary skills, namely memory, thinking, and interaction. Its gameplay has been created to enhance learning by playing, enhancing learning results and emotional results. To those working in the field, i. e. the therapists and special education coordinators, it provides a malleable platform that enhances the involvement of specific development of skills with some pertinent learning objectives.
- **Future Researchers:** The research offers a basis on future developments in special education and educational technology. This framework can be further developed by the researchers to test other patterns of algorithms, construct more inclusive learning games, or assess the long-term effects of gamified learning on neurodevelopmental progress. It also has the potential to trigger additional research in adaptive learning systems and AI-based special needs education personalization.

## REVIEW OF RELATED LITERATURE

Foreign researchers have found that video games can significantly enhance cognitive abilities such as attention, perception, and problem-solving. Studies by Gray (2018) and Bediou et al. (2018) highlight that well-designed games can serve as effective learning tools that stimulate mental activity and support educational development.

Gallud et al. (2023) found that game-based and technology-assisted learning significantly enhance cognitive and social development in children with special needs, particularly those with autism. Likewise, Gee (2003) and Prensky (2001) emphasized that incorporating play into learning increases motivation, engagement, and problem-solving through experiential and exploratory activities.

In the Philippines, studies by Carandang (2021) and Rosales et al. (2023) demonstrated that play-based instruction enhances motivation, cooperation, and cognitive development, especially for children with special needs. Similarly, Mendoza and Santos (2019) confirmed that educational games improve focus, teamwork, and self-confidence, highlighting the effectiveness of interactive learning in fostering holistic growth among young learners.

| Related System  | Platform       | Main Functionality  | Algorithm/Technology Used    |
|---|----------------|---|------------------------------|
| Playtime: Educational Entertainment For Children With Asd Via Cross-Platform Game With Merge Sort Algorithm And Performance Analysis for PBLC | Cross-Platform | Children with ASD can learn to recognize colors, shapes, and patterns through interactive games.  | Merge Sort Algorithm         |
| Autism Learning Games (ALGs)  | Mobile/Tablet  | Provides interactive games that teach color, shape, and pattern recognition to children with ASD. | Pattern-matching algorithm   |
| ABA Therapy App   | Mobile         | Delivers Applied Behavior Analysis (ABA)-based learning activities for children with autism.      | Rule-based behavioral logic  |
| LearnWithFun  | Web            | Offers gamified learning modules for children with special needs.                                 | Decision tree classification |
| SmartPlay ASD Trainer   | Cross-Platform | Engages children in interactive tasks that develop memory and attention.                          | Reinforcement learning (AI)  |
| EduSort Game  | Desktop        | Teaches sorting and categorization skills through game-based activities.                          | Merge Sort Algorithm         |

The PLAYTIME system stands out from other related systems because it integrates educational entertainment with cognitive skill development through the Merge Sort algorithm, enhancing logical sequencing and critical thinking among children with ASD. Unlike others that focus only on single learning modes or therapy-based routines, PLAYTIME also includes performance-based learning analysis (PBLC) for real-time assessment of user progress. Furthermore, its cross-platform design ensures accessibility and consistency of learning experiences across different devices, making it more versatile and inclusive than the other systems.

### Synthesis

The synthesis of the above information highlights how various educational and therapeutic systems aim to support children with Autism Spectrum Disorder (ASD) through interactive and game-based learning. Each related system—such as Autism Learning Games, ABA Therapy App, LearnWithFun, SmartPlay ASD Trainer, and EduSort Game—offers unique functionalities that enhance cognitive, behavioral, or emotional development in children. However, **Playtime: Educational Entertainment for Children with ASD via Cross-Platform Game with Merge Sort Algorithm and Performance Analysis for PBLC** stands out for integrating both educational entertainment and data-driven performance analysis. Unlike others, it utilizes the **Merge Sort Algorithm** to enhance logical sequencing while assessing learning outcomes across platforms. Furthermore, the inclusion of **Performance-Based Learning Analysis (PBLC)** allows for measurable tracking of progress, which is not emphasized in other systems. Overall, Playtime provides a balanced combination of engagement, cognitive improvement, and analytical assessment—making it a more comprehensive and effective learning solution for children with ASD.

### METHODOLOGY OF THE STUDY

The study **PLAYTIME: Educational Entertainment for Children with ASD via Cross-Platform Game with Merge Sort Algorithm and Performance Analysis for PBLC** is classified as an Applied Developmental Research. It focuses on designing and developing an interactive educational game that enhances cognitive and behavioral learning for children with ASD using algorithmic logic and performance evaluation. The research applies both software engineering and educational psychology principles to create a functional, adaptive, and evidence-based digital learning tool.

Before system creation, data were gathered through surveys and interviews with gamers, educators, teachers, therapists and technical experts to identify behavioral patterns, user interface preferences, and personalization needs of children with ASD. After system implementation, evaluation followed the ISO 25010 software quality model focusing on behavior, user interface, personalization, accuracy, effectiveness, and robustness to assess system quality and user satisfaction. Respondents rated each criterion using a 5-point Likert Scale (1–Strongly

Disagree to 5–Strongly Agree) for verbal interpretation and analysis. This approach ensured that the system was both technically reliable and behaviorally effective in promoting engagement and learning among children with ASD.

The study utilized the System Development Life Cycle (SDLC) as the main process for system creation. The SDLC provided a structured series of phases—planning, designing, developing, testing, and deployment—that guided the efficient production of the PlayTime application. This model ensured that each stage of the project was systematically executed, from the initial concept and design to the final testing and implementation. It also allowed the researchers to continuously refine the system, ensuring that it met the intended objectives and maintained high standards of functionality and reliability.

Figure 3: Spiral Model

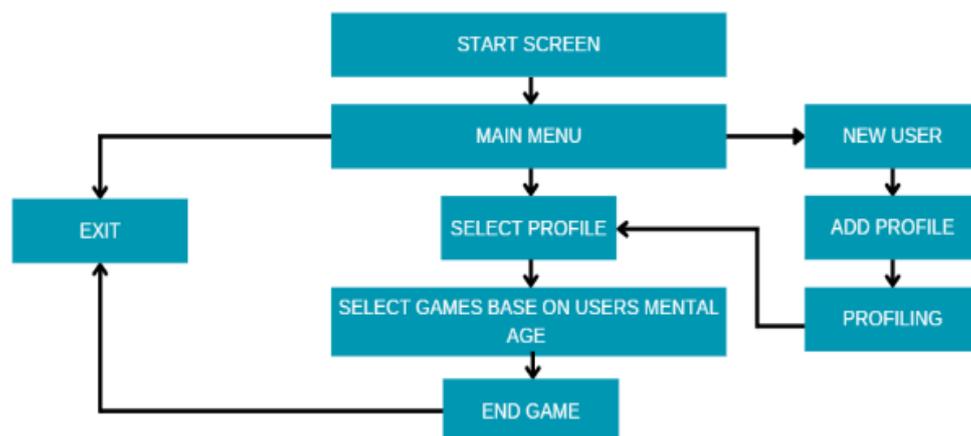


For the development of PlayTime, we are following the Spiral Model, a flexible and iterative approach that combines elements of design, prototyping, and evaluation.

This model allows us to develop the system in gradual phases, starting with planning and requirement gathering, followed by prototype creation, user feedback, and continuous improvement. With each loop or “spiral,” we build a more complete version of the system, reducing risks and making space for new ideas as the project evolves.

The Spiral Model supports continuous testing and user input, which is essential for educational platforms. Since PlayTime is intended to grow and adapt based on user feedback especially in how games are selected and how progress is measured this methodology ensures we can refine and improve the system over time without starting from scratch.

Figure 4: Game Flow Diagram



A game flow diagram is a visual representation that outlines the sequence and structure of a game’s processes. It uses boxes or shapes connected by arrows to indicate the logical flow and progression of gameplay, helping to illustrate how players navigate through different stages or actions within the game.

## Respondents of the Study

The study involved two groups of respondents: (a) gamers, educators, parents, and therapists and (b) technical experts. The first group is made up of child learners with ASD aged 4 to 6 years old, who are the intended users of the PlayTime platform. These children are observed while interacting with the educational games to assess usability, engagement, and learning impact. Their responses are gathered indirectly through observation checklists and input from parents, guardians, or SPED educators, who monitored their behavior, attention, and enjoyment during gameplay. This group is essential in determining how appropriate and effective the platform is for children with Autism Spectrum Disorder in a real learning setting. They are guided by an adult when using the PASS evaluation form. The gamers, educators, parents, and therapists group is composed of 30 respondents.

The second group is composed of technical experts who helped evaluate the platform from a system quality perspective. This group is composed of 20 technical experts with backgrounds in software development, educational technology applications, and game design. They are selected based on their knowledge of system performance, usability standards, and programming. Their evaluation focused on aspects such as functionality, performance efficiency, interface design, and adherence to the ISO/IEC 25010 software quality model. Their insights helped improve the system's technical reliability and overall user experience.

A total of 50 respondents participated in the evaluation of the game platform. Their evaluations allowed the researchers to assess both the learning experiences and the software's technical quality.

## Development and Evaluation Procedure

The development of PlayTime utilized various tools and technologies to ensure efficient programming, design, and collaboration throughout the creation process. The tools used are as follows:

- Visual Studio Code – A source code text editor used for writing, testing, and debugging the program scripts.
- Godot Game Engine – A free and open-source engine utilized to develop the cross-platform 2D game environment.
- Adobe Illustrator – Used to design scalable vector graphics such as logos, icons, and interface illustrations.
- Audacity – An open-source audio editor applied for recording, editing, and producing sound effects (SFX) and background music.
- GDScript – A high-level scripting language designed for creating the game's logic and interactive functions within the Godot engine.
- GitHub – A web-based platform for collaborative development, project management, and version control.
- JSON (JavaScript Object Notation) – A lightweight data format used for structured data exchange and implementing the game's save-and-load mechanism.
- Git – A version control system used to track code changes, support collaboration, and manage multiple versions of the game project.
- Procreate – A digital illustration tool used for sketching, painting, and designing detailed game characters and background art.
- Figma – A collaborative interface design tool utilized for wireframing, planning, and developing user interface (UI) layouts.
- Pinterest – Used as a visual inspiration board for gathering design references, color palettes, and mood board ideas to guide the game's artistic style.

## Data Analysis Plan

The data gathered from the respondents were organized, analyzed, and interpreted using quantitative methods to assess the performance and effectiveness of the PlayTime application. The researchers employed descriptive statistics to summarize and interpret the responses obtained from the evaluation instruments. Specifically, weighted mean was used to determine the average responses of the participants for each criterion under the

ISO/IEC 25010 software quality model and the PASS Theory of Intelligence. This method allowed the researchers to identify the overall level of functionality, usability, reliability, and user satisfaction of the system.

Each indicator was rated using a Likert scale, where responses were assigned numerical values to quantify perceptions and experiences. The computed means were then interpreted using qualitative descriptions such as “Excellent,” “Very Good,” “Good,” “Fair,” or “Poor,” depending on the resulting score range. These interpretations provided a clear understanding of how users and evaluators perceived the system’s technical and educational performance.

The results were presented in tabular and graphical form to highlight the trends and relationships among the variables. Comparative analysis was also conducted between cognitive and technical evaluations to determine whether the system met its intended learning objectives while maintaining acceptable software quality standards. Through this systematic analysis process, the researchers were able to draw evidence-based conclusions regarding the overall effectiveness, efficiency, and reliability of PlayTime as an educational tool for children with ASD.

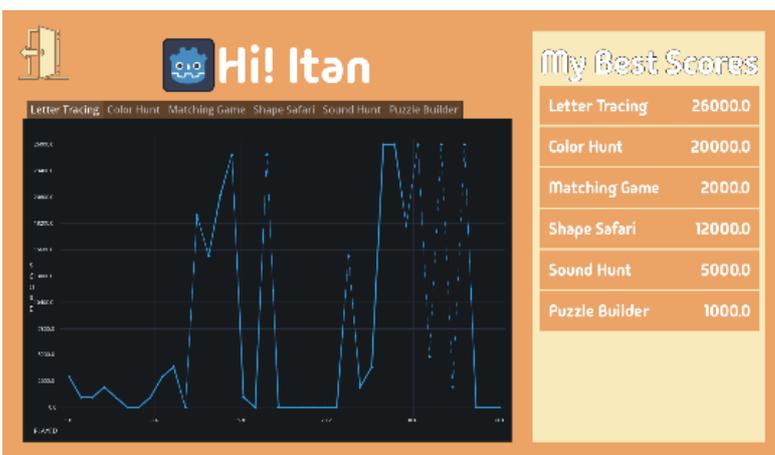
**The System** The study produced PlayTime, a cross-platform educational entertainment application developed for children aged 4 to 6 with Autism Spectrum Disorder (ASD). The system features engaging and interactive mini-games designed to enhance cognitive skills such as memory, focus, problem-solving, and social interaction. It also assists parents, teachers, and special education professionals by providing tools to monitor learner progress and identify specific areas for improvement. The platform was developed using various tools, including Visual Studio Code, Godot Game Engine, Adobe Illustrator, Audacity, GDScript, GitHub, JSON, Git, Procreate, Figma, and Pinterest all utilized for coding, designing, creating multimedia assets, and managing project collaboration. The quality of PlayTime was assessed based on ISO/IEC 25010 standards to ensure that it meets the necessary criteria for functionality, usability, efficiency, reliability, maintainability, and portability, making it a stable and user-friendly system.

Figure 5: Main Menu Interface



The Main Menu Interface serves as the game’s starting point. It features colorful visuals, large icons, and minimal text to ensure accessibility for young users and children with developmental differences. From this screen, players can easily navigate to various game modes such as memory, logic, and matching activities.

Figure 6: Game Progress Interface



The Game Progress Interface displays each learner’s performance summary, including scores, completed tasks, and earned rewards. This interface allows teachers and parents to monitor progress and provides visual indicators such as stars and progress bars that motivate learners and reinforce achievement.

**Assessment: Summary Of Respondents on the System**

Five types of respondents evaluated the PlayTime system to ensure that both user experience and technical performance were properly assessed. The first group was composed of gamers, educators, teachers, and therapists respondents, who evaluated the application’s functionality, usability, and overall engagement based on the PASS Theory of Intelligence. The second group consisted of technical respondents, who assessed the system’s dependability, efficiency, and quality using the ISO/IEC 25010 software quality standards. This approach ensured a comprehensive and reliable evaluation covering both educational and technical perspectives.

Table 1. Distribution of Respondents

| Respondents (groupings) | Size (n) | Percentage |
|-------------------------|----------|------------|
| Gamers                  | 8        | 12%        |
| Educators               | 12       | 24%        |
| Teachers                | 5        | 10%        |
| Therapist               | 5        | 10%        |
| Technical               | 20       | 40%        |
| Total (n)               | 50       | 100.0%     |

The general breakdown of the respondents who took part in the evaluation is provided in Table 1. Among all the 50 respondents, 8 gamers (16%), 12 educators (24%), 5 teachers (10%), 5 therapists (10%), and 20 technical experts (40%), were identified. This assembly implies that the larger portion of the feedback was offered by the technical specialists and educators, but the proportion of the gamers, teachers, and therapists was also important. Having a wide range of respondents will guarantee that the assessment will cover a variety of opinions- between the gameplay experience and the value of the game and the therapeutic utility and technical performance.

The findings of the evaluation process, collected using the ISO 25010 evaluation form of technical experts and PASS Theory of Intelligence evaluation form of gamers are shown in the tables below. The game was rated by each group based on the expertise and professional insight. Summary tables are also given to provide a better picture of the results and simplify the overall trends. The analysis of these responses combined makes sure that the evaluation is not one sided, thus making the evaluation of conclusions made in the study credible and sound.

Table 2. Summary and Comparison of Evaluations of Technical-Respondents

| Criteria<br>(ISO25010) | Technical ( 20 ) |    |
|------------------------|------------------|----|
|                        | WM               | VI |
| User Interface         | 3.8              | SA |
| Personalization        | 3.7              | SA |
| Accuracy               | 3.7              | SA |
| Effectiveness          | 3.8              | SA |
| Robustness             | 3.7              | SA |
| Overall Average Mean   | 3.7              | SA |

Table 2 shows the summary and comparison of evaluations of Technical-Respondents based on the criteria of ISO25010. It can be noted that technical respondents’ average means have slight differences between 3.7 and 3.8 on the criteria interpreted as “Strongly Agree”. Overall, technical respondents strongly agree on the acceptability and ussability of the application based on the criteria of ISO 25010 with a 3.7 overall average mean.

Table 3: Summary of Evaluation of Gamers, Educators, Parents and Therapists based on PASS Theory of Intelligence

| PASS Theory of Intelligence | Gamers ( 30 ) |    |
|-----------------------------|---------------|----|
|                             | WM            | VI |
| Planning                    | 3.6           | SA |
| Attention                   | 4.0           | SA |
| Simultaneous                | 3.6           | SA |
| Successive                  | 3.7           | SA |
| Overall Average Mean        | 3.7           | SA |

Table 3 shows the summary and comparison of evaluations of Gamer-Respondents based on PASS Theory of Intelligence. It can be noted that their average means for all the criteria ranges from 3.6 to 4.0 with all interpreted as “Strongly Agree”. Also notable is the 4.0 average mean attained by the Attention criteria compared to the other criteria. Finally, with a 3.7 overall average mean interpreted as “Strongly Agree”, indicate that cognitive abilities of gamer respondents are utilized when playing the application based on the criteria of the PASS Theory of Intelligence.

### Ethical Considerations

The study also makes certain that data obtained on respondents is treated in a confidential and integrity manner. The information of the respondents remains confidential and no personally identifiable information is released without the consent of the respondents. The study complies or follows the principles of voluntary participation, which means that the respondents are at liberty of dropping out of the research any time without any repercussions. There is also a good data security so that the information is not accessed and misused by unauthorized users. Lastly, the presentation of all findings is honest and precise, without any kind of manipulation and bias in order to preserve the validity of the research.

### CONCLUSION

The results of the study affirm that the PlayTime application successfully met its objectives as an educational entertainment platform for children with Autism Spectrum Disorder (ASD). From the gamers’ perspective, the game was highly engaging, easy to navigate, and effective in enhancing focus, attention, and problem-solving abilities. Meanwhile, technical respondents evaluated the system as reliable, accurate, and well-performing in accordance with the ISO/IEC 25010 software quality standards. These findings complement one another—gamer feedback validated the game’s educational value and user appeal, while technical assessments confirmed its stability and efficiency. Overall, the study concludes that PlayTime is a functional, effective, and dependable tool that seamlessly integrates learning and entertainment, making it well-suited for supporting the cognitive development of children with ASD.

### RECOMMENDATION

1. Administrators and Teachers: PlayTime can be effectively integrated into classroom instruction, individualized learning plans, or therapy sessions as a supplementary educational tool. Its game-based structure enables educators to engage learners with varying needs while maintaining an element of fun and motivation. The platform’s built-in progress tracking also allows teachers to monitor student performance and adjust instructional strategies accordingly to improve learning outcomes.
2. Students and Professionals: For children with special needs, PlayTime offers a low-pressure and interactive environment that supports the development of memory, cognitive, and social skills through play. Meanwhile, professionals such as therapists and special education coordinators can utilize the application as a flexible and adaptive platform to achieve specific learning objectives, assess developmental progress, and design more effective interventions tailored to individual learners.
3. Future Researchers: This study serves as a foundation for future research in educational technology and special education. Future researchers may build upon this work by integrating new algorithms, expanding

the inclusivity of game design, or examining the long-term impact of gamified learning on children with ASD.

4. It is recommended that future enhancements of the system integrate an AI-driven adaptive learning module to tailor game difficulty and content according to each child's performance and progress. This addition would make the system more responsive to individual learning patterns, thereby improving engagement and educational outcomes for children with ASD.

## REFERENCES

1. Bellotti, F., Berta, R., De Gloria, A., Lavagnino, E., Antonaci, A., Dagnino, F., ... & Mayer, I. (2013). Serious games for education and training. *International Journal of Serious Games*, 1(1), 29–44. <https://doi.org/10.17083/ijsg.v1i1.11>
2. De Leon, J., Ramos, A., & Dela Cruz, M. (2017). Developing mobile learning applications for early grade learners. De La Salle University Research Congress, Manila, Philippines.
3. Figma. (n.d.). Figma: The collaborative interface design tool. <https://www.figma.com>
4. Garcia, R., & Ramos, L. (2021). Cognitive engagement through mobile game-based learning tools in elementary students. *Ateneo de Manila University Journal of Education*, 18(2), 45–58.
5. Godot Engine. (n.d.). Free and open source 2D and 3D game engine. <https://godotengine.org>
6. Griffiths, M. D. (2002). The educational benefits of video games. *Education and Health*, 20(3), 47–51.
7. Mendoza, C., & Santos, M. (2019). The use of educational games in classroom instruction: A study on learner motivation and collaboration. *University of the Philippines College of Education Journal*, 27(1), 66–80.
8. Piaget, J. (1952). *The origins of intelligence in children* (M. Cook, Trans.). International Universities Press. (Original work published 1936)
9. Plass, J. L., Homer, B. D., & Kinzer, C. K. (2015). Foundations of game-based learning. *Educational Psychologist*, 50(4), 258–283. <https://doi.org/10.1080/00461520.2015.1122533>
10. Torres, E., & Dela Cruz, A. (2018). The effectiveness of locally developed educational games for early learners. *Polytechnic University of the Philippines Journal of Research*, 13(2), 123–137.
11. Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.
12. Wang, A. I., & Tahir, R. (2020). The effect of using Kahoot! for learning: A literature review. *Computers & Education*, 149, 103818. <https://doi.org/10.1016/j.compedu.2020.103818>
13. Aguilera, M., & Mendiz, A. (2003). Video games and education: (Education in the Face of a “Parallel School”). *Computers in Entertainment (CIE)*, 1(1), 1–10. <https://doi.org/10.1145/950566.950583>
14. Anastasiades, P. S., & Vitalaki, E. (2011). Promoting internet safety in Greek primary schools: The teacher's role. *Educational Technology & Society*, 14(2), 71–80.
15. Brusilovsky, P., & Millán, E. (2007). User models for adaptive hypermedia and adaptive educational systems. In *The adaptive web* (pp. 3–53). Springer. [https://doi.org/10.1007/978-3-540-72079-9\\_1](https://doi.org/10.1007/978-3-540-72079-9_1)
16. Gee, J. P. (2003). What video games have to teach us about learning and literacy. *Computers in Entertainment*, 1(1), 20–32. <https://doi.org/10.1145/950566.950595>
17. Glover, I., Campbell, A., Latif, F., O'Reilly, E., & Sharp, J. (2012). Use of formative feedback to support learning through a game-based mechanism. In *Proceedings of the European Conference on Games Based Learning* (pp. 235–243).
18. Griffiths, M. D. (2002). The educational benefits of video games. *Education and Health*, 20(3), 47–51.
19. ISO/IEC 25010:2011. (2011). *Systems and software engineering — Systems and software Quality Requirements and Evaluation (SQuARE) — System and software quality models*. International Organization for Standardization. <https://www.iso.org/standard/35733.html>
20. Papastergiou, M. (2009). Digital game-based learning in high school computer science education: Impact on educational effectiveness and student motivation. *Computers & Education*, 52(1), 1–12. <https://doi.org/10.1016/j.compedu.2008.06.004>
21. Prensky, M. (2001). *Digital game-based learning*. McGraw-Hill.
22. Wang, F., & Hannafin, M. J. (2005). Design-based research and technology-enhanced learning environment

23. Peter Gray (2018). Benefits of Play Revealed in Research on Video Gaming. Article posted March 27, 2018 verified by Psychology Today. Retrieved from <https://www.psychologytoday.com/us/blog/freedom-learn/201803/benefits-play-revealed-in-research-video-gaming>
24. John Ferrara (2011). The Elements of Player Experience: A framework for understanding player experiences to build successful, engaging, and enjoyable games. Article No : 651 | April 7, 2011. . Retrieved from <https://uxmag.com/articles/the-elements-of-player-experience>)
25. RIJUMOL KC, S. THANGARAJATH, R. ANANTHASAYANAM (2010). The PASS Theory of Cognitive Processing. *i-manager's Journal on Educational Psychology*, Vol. 3 No. 4 February - April 2010. Retrieved on June 25, 2024 from <https://files.eric.ed.gov/fulltext/EJ1102307.pdf>
26. Derksen, G. (2024). A SMART TOY SYSTEM TO EDUCATE CHILDREN WITH AUTISM. University of Illinois. <https://www.ideals.illinois.edu/items/132659/bitstreams/440026/data.pdf>
27. Atherton, G. (2021). The Use of Analog and Digital Games for Autism. Review article. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8384560/>
28. Chaidi, I., & Drigas, A. (2024). Gaming Platforms for People with ASD. MDPI. <https://www.mdpi.com/2079-3200/12/12/122>
29. Du, G., et al. (2024). The effectiveness of applied behavior analysis program for children with autism spectrum disorder. PMC. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC11487924/>