

Picture-Definition Matching Game Board: An Educational Tool for Active Learning on 5 Human Organ Senses

Lyranae A. Custoya ¹, Erwin B. Berry ²

¹ *Teacher I, Elementary School, Tag-anito Elementary School, Surigao del Sur, Philippines*

² *Graduate School Faculty, North Esatern Mindanao State University-Main Campus, Philippines*

ABSTRACT

This study investigates the effectiveness of a picture-definition matching game board as an educational tool for enhancing active learning about the five human senses among elementary pupils. A total of 14 pupils from Tag-anito Elementary School participated in the study, which involved administering a pre-test and post-test to assess knowledge acquisition. The pre-test mean percentage score was 61.67%, while the post-test score significantly increased to 97.14%, indicating substantial improvement in student mastery. The normalized gain calculated from these results was approximately 0.924, reflecting a high level of learning gain. Qualitative feedback from focus group discussions further supported the positive impact of the game on student engagement and understanding. This research underscores the potential of interactive instructional materials in fostering deeper comprehension and retention of scientific concepts in educational settings.

Keyword: *5 human Organ Senses, Game-Based Learning, Student Literacy, Normalized Gain, Educational Tool, Active learning.*

1. INTRODUCTION

The integration of game-based learning into educational settings has gained significant attention for its potential to enhance student engagement and retention of knowledge. The research titled "Picture-Definition Matching Game Board: An Educational Tool for Active Learning on 5 Human Organ Senses" explores this innovative approach, focusing on the human senses as a subject matter. According to Hwang et al. (2020), game-based learning can facilitate deeper understanding by allowing learners to actively participate in their learning process, thereby promoting critical thinking and problem-solving skills.

Incorporating visual aids, such as images paired with definitions, has been shown to improve memory retention and comprehension among learners (Mayer, 2014). This aligns with the principles of dual coding theory, which posits that information is more effectively processed when it is represented both visually and verbally (Paivio, 1986). By utilizing a matching board game format, this research aims to engage the learners in a dynamic learning experience that reinforces their understanding of the five human senses through interactive play.

Furthermore, the application of educational games in classrooms has been supported by various studies indicating that such tools can lead to increased motivation and enjoyment in learning (Gee, 2003). This research contributes to the existing literature by providing empirical evidence on the effectiveness of a picture-definition matching game specifically designed for teaching about human organ senses, thus offering a new avenue for educators seeking to implement active learning strategies in their curricula.

2. RESEARCH QUESTIONS

The study aimed to investigate the effectiveness of a picture-definition matching game board as an educational tool for enhancing active learning about the five human senses among Elementary learners. It sought to answer the following questions:

1. What is the mean score before and after the implementation of Picture-definition matching game board among learners?
2. Is there a significant difference before and after its implementation?
3. What challenges and feedback of learners on the implementation of Picture-definition matching game board?

3. RESEARCH METHODOLOGY

3.1 RESEARCH DESIGN

This research employed a mixed-method design approach for developing and evaluating Picture-Definition Matching Game Board as an educational materials to enhance the active learning on 5 human organ senses. The quantitative method, through pretests and post-tests, is designed to measure how students learning's of 5 human organ senses has changed. Additionally, qualitative data is gathered through focus group discussions (FGDs) and interviews to assess how students engage and their perceptions of Picture-Definition Matching Board Games. These combined methods allow a comprehensive assessment of both the cognitive improvements and the interactive, engaging attributes of the game in promoting active learning on 5 human organ senses among Grade 3 pupils at Tag-anito Elementary School.

3.1 RESEARCH LOCALE

The study was conducted in Tag-anito Elementary School, Tag-anito, Carrascal, Surigao del Sur Philippines. It was selected as the research site because of its relevance to the goal of the study of an educational Toll for Active Learning on 5 Human Organ Senses among Grade 3 pupils, which falls within the target population of the intervention.

3.2 RESEARCH PARTICIPANTS

The participants are 14 Grade 3 pupils from Tag-anito Elementary School. Participants comprised 14 Grade 3 pupils from Tag-anito Elementary School (5 females and 10 males). The participants' ages ranged from 7 to 8 years. The selected participants represented the entire population of Grade 3 learners enrolled in the Grade 3 level. The participants were chosen to evaluate their current learning levels in Science 3 specifically on 5 Human Organ Senses and assess the potential development in active learning, mastery and proficiency in literacy resulting from the developed instructional materials.

3.3 RESEARCH INSTRUMENT

The researchers utilized a self-formulated questionnaire consisting of 30 items with table of specifications focused on the five organ human senses. The development process included several key steps:

Validation: The questionnaire was validated by two Science Master Teachers II in the district, ensuring that the content accurately reflects the educational objectives and is appropriate for the target audience (Harlacher et al., 2016).

Pilot Testing: The questionnaire was pilot tested at Tabon-Tabon Elementary School to assess its clarity, relevance, and overall effectiveness in measuring students' understanding of the subject matter. Feedback from this pilot test was used to refine the questionnaire further.

To ensure the reliability of the questionnaire, a Cronbach's alpha coefficient was calculated. This statistical measure assesses internal consistency, indicating how closely related a set of items are as a group. A Cronbach's alpha value of 0.70 or higher is generally considered acceptable for educational research (Aliero & Miswar, 2023). The reability test of the instrument was substantiated, showing a Cronback's alpha score of 92% for the pre-test ad post-test questionnaires and 90% for the engagement questionnaires.

3.4 DATA GATHERING PROCEDURE

The data collection process encompassed multiple stages. Initially, permissions were obtained from the school administration to facilitate the study. Following successful pilot testing and validation, a pre-test was administered to 14 respondents (5 females and 9 males) from Tag-anito Elementary School, specifically from section Custoya. This small sample size was determined based on practical constraints while aiming for meaningful insights into student understanding.

Implementation of Instructional Materials

After administering the pre-test, the developed instructional materials (the picture-definition matching game board) were introduced to the participants. This intervention aimed to engage students actively in learning about the five human senses through interactive board gameplay.

Post-Test and Evaluation

Upon completion of the game sessions, a post-test was administered to measure any changes in knowledge and understanding resulting from the intervention. This allowed for a direct comparison between pre-test.

Focus Group Discussion

To gain deeper insights into student experiences and perceptions regarding the game board as an educational tool, a focus group discussion was conducted with participants after the post-test. This qualitative data provided context to quantitative findings and helped identify areas for improvement in both the game design and instructional approach.

Statistical Analysis

The data collected from the test questionnaires were systematically tallied, tabulated, and organized. Descriptive statistics were used to analyze the students' scores including frequency, mean, and percentage. A t-test was conducted to determine the statistical significance the differences between the pretest and post-test scores.

3.5 ETHICAL CONSIDERATIONS

The study adhered to ethical guidelines to safeguard the rights and well-being of the participants. Prior permissions were secured from the school administration and the student's parents or guardians. Participants were duly informed about the study's objectives and their option to withdraw at any point without facing repercussions. Moreover, strict confidentiality and anonymity concerning the participants' information were upheld throughout the study.

3.6 SCOPE AND LIMITATION

The scope of the study focused on implementing Picture-Definition Matching Game Board to enhance active learning on 5 Human Organ Senses, hence allowing the generalizability of findings only to similar contexts. The study's limitations included variance in student engagement, resulting from the differences in their levels engagement and understanding.

4. RESULTS

Table 1. Mean Percentage Scores and Mastery Levels in Pre-test and Post-test Assessments

Assessment	Percentage (%)	Mastery Level
Pretest	61.67%	Near Mastery
Posttest	97.14%	Mastery

Table 1 above of the pre-test and post-test assessments reveal a significant improvement in the students' mastery of the subject matter related to the five human senses. The pre-test mean percentage score of 61.67% indicates that

students had a basic understanding of the concepts prior to the intervention. However, the post-test score of 97.14% demonstrates a marked increase in knowledge and comprehension following the use of the picture-definition matching game board as an educational tool.

In mastery learning frameworks, a score of 80% or higher is typically considered indicative of mastery (Otus, 2024). Given that the post-test score of 97.14% far exceeds this threshold, it suggests that the majority, if not all, of the students achieved a high level of understanding regarding the five human senses after engaging with the instructional materials. This aligns with findings from previous studies that emphasize the effectiveness of interactive and engaging learning tools in promoting student mastery (Whiting et al., 2022).

The substantial increase from pre-test to post-test scores can also be attributed to the active learning strategies employed during the intervention. Mastery learning emphasizes formative assessments and corrective feedback, which can significantly enhance student learning outcomes (A Practical Review of Mastery Learning, 2022). The focus group discussions conducted after the post-test further support this conclusion by revealing positive student perceptions regarding their engagement and understanding during gameplay.

Table 2. Normalized Gain Results

Assessment	Percentage (%)	Normalized Gain (g)
Pretest	61.67%	0.924 or
Posttest	97.14%	92.4%

Table 2 above of the normalized gain calculation from the pre-test and post-test assessments provide valuable insights into the effectiveness of the educational intervention. The normalized gain of approximately 0.924 indicates that the students experienced a substantial increase in their understanding of the five human senses after engaging with the picture-definition matching board game.

Normalized gain, as defined by Hake (1998), is a measure that quantifies the effectiveness of educational interventions by comparing the amount of knowledge gained to the amount of knowledge that could have been gained (Hake, 1998). This metric allows educators to assess learning outcomes in a way that accounts for students' varying initial knowledge levels, making it particularly useful in diverse classroom settings (PhysPort, n.d.).

The high normalized gain observed in this study suggests that the instructional materials were effective in promoting conceptual understanding among students. This aligns with previous research indicating that interactive and engaging learning tools can significantly enhance student learning outcomes (Coletta & Steinert, 2020).

The calculated normalized gain serves as a strong indicator of the effectiveness of the picture-definition matching board game as an educational tool. It highlights not only the improvement in student mastery but also reinforces the importance of utilizing innovative instructional materials to facilitate active learning.

Table 3. Statistical Analysis of Picture-Definition Matching Board Game: Pretest vs. Post-test Results

T-Test: Paired Two Sample for Means		
	<i>Pretest</i>	<i>Posttest</i>
Mean	18.5	29.14285714
Variance	12.26923077	0.747252747
Observations	14	14

Pearson Correlation	0.914569514	
Hypothesized Mean Difference	0	
df	13	
t Stat	-14.56226339	
P(T<=t) one-tail	9.94154E-10	
t Critical one-tail	1.770933396	
P(T<=t) two-tail	1.98831E-09	
t Critical two-tail	2.160368656	

Table 3, on the other hand, reveals the analysis of pretests and post-tests, which explicitly indicates that there is a significant increase in active learning among students of grade 3 at the Tag-anito Elementary School. The additional means were 18.5 for the pre-test and 29.14 for the post-test, marking a more significant development in student performance post-intervention. Hence, slight variations were observed in the pretest score of 12.26 and the post-test score of 0.74. Hence, the deviation from the score of pretests indicated a more significant variation, which means the performance level is substituted with higher conformity during the post-test. The Pearson correlation coefficient of 0.914 indicates highly positive relationships between the pretest and post-test results, which means that students who scored higher in the pretest tended to continue doing so. Hypothesis testing resulted in a p-value (one-tail = 0.00000000000195, two-tail = 0.00000000000390). The calculated t-statistic of -14.56 significantly exceeds the critical t-value for a two-tailed test (approximately 2.16), which leads to the rejection of the null hypothesis that posits no difference in means between the pre-test and post-test scores. This strong statistical evidence, supported by an extremely low p-value of 1.98831E-09, indicates that the observed differences in student mastery are not due to random chance but rather reflect a meaningful impact of the educational intervention. Such results suggest that implementing the picture-definition matching board game has profoundly enhanced students' understanding of the five human senses.

These findings align with existing literature that highlights the effectiveness of interactive educational tools. For instance, board games have been shown to promote critical thinking, problem-solving skills, and collaboration among students, thereby enhancing learning outcomes (User Generated Education, 2022). Furthermore, research emphasizes that game-based learning can significantly improve cognitive, social, and emotional development in children, making learning more engaging and enjoyable (Frontiers in Psychology, 2024). The positive results from this study underscore the potential for similar interventions in diverse educational contexts. Future research could explore the application of board games with larger and more varied samples to validate these findings further. Additionally, investigating different types of games or educational settings could yield insights into optimizing learning experiences for students across various age groups and learning styles.

Table 4. Thematic Analysis Based on Focus Group Discussions

Theme	Description	Key Findings
Engagement and Enjoyment	Participants expressed that the game was fun and engaging, which enhanced their motivation to learn.	Students reported increased enjoyment and interest in learning about the five human senses through gameplay.
Enhanced Understanding	The game facilitated better comprehension of complex concepts related to the human senses.	Many respondents indicated that the interactive nature of the game helped clarify their understanding of sensory functions.

Collaboration and Interaction	The game encouraged teamwork and communication among students, fostering a collaborative learning environment.	Participants noted that working in teams allowed them to share knowledge and support each other's learning.
Immediate Feedback	The game provided instant feedback on answers, which helped reinforce learning and correct misconceptions.	Students appreciated the immediate verification of their responses, which contributed to a deeper understanding of the material.
Applicability to Real-Life Contexts	Participants felt that the knowledge gained from the game could be applied to real-life situations.	Many students mentioned how understanding their senses could enhance their everyday experiences and interactions.

Table 4 gives the thematic analysis of focus group discussions regarding the Picture-Definition Matching Board Game as an educational tool for active learning reveals several key insights into its impact on student learning. Participants expressed high levels of engagement and enjoyment, noting that the game made learning about the five human senses fun and interactive, which significantly increased their motivation to participate (Chou, 2014). The enhanced understanding theme emerged as students reported that the game's interactive nature helped clarify complex concepts, allowing them to grasp the material more effectively (O'Neill & Holmes, 2022). Furthermore, the game fostered collaboration and interaction, as students worked together in teams, sharing knowledge and supporting each other's learning experiences (Baker et al., 2024). The provision of immediate feedback during gameplay was highlighted as a critical factor in reinforcing learning, enabling students to correct misconceptions on the spot (Miller et al., 2024). Lastly, participants noted the applicability to real-life contexts, emphasizing how their newfound understanding of sensory functions could enhance their everyday experiences (Davis et al., 2020). Overall, these findings underscore the effectiveness of board games in promoting active learning and highlight their potential as valuable educational tools in elementary education.

5. CONCLUSIONS

The study on the "Picture-Definition Matching Game Board: An Educational Tool for Active Learning on 5 Human Organ Senses" demonstrates the significant impact of interactive learning materials on student mastery. The pre-test and post-test results revealed a remarkable increase in mean percentage scores, from 61.67% to 97.14%, indicating that students not only improved their understanding but also engaged actively with the content. The calculated normalized gain of approximately 0.924 further underscores the effectiveness of the game as an educational tool, suggesting that students achieved a high level of conceptual mastery.

These findings align with existing literature that emphasizes the benefits of game-based learning in enhancing student engagement and knowledge retention (Hake, 1998; Coletta & Steinert, 2020). The positive feedback gathered from focus group discussions reinforces the notion that such innovative instructional materials can significantly enhance learning experiences in educational settings. Overall, this study highlights the importance of incorporating active learning strategies to foster deeper understanding and retention of complex concepts in science education.

6. ACKNOWLEDGEMENT

The researchers express their heartfelt gratitude to all individuals who contributed to the successful conduct of this study. Special thanks are extended to the respondents from Tag-anito Elementary School for their enthusiastic participation and valuable insights. The support and guidance provided by the Science master teacher Mrs. Maricel R. Jimenez and the School Head of Tag-anito Elementary School Ms. Lovely Jean G. Trugillo in validating the research instruments in ensuring the study's rigor. Additionally, appreciation is due to the authors of the educational materials utilized in this research, whose work inspired innovative approaches to active learning. Special mention goes to Dr. Erwin B. Berry, who reviewed this paper and suggested invaluable recommendations to improve this piece. The contributions have greatly aided us in making this study worthwhile.

7. REFERENCES

- A Practical Review of Mastery Learning. (2022). PMC. Retrieved from <https://pmc.ncbi.nlm.nih.gov/articles/PMC10159400/>
- Baker, A., Smith, J., & Johnson, L. (2024). Do you play in class? Board games to promote cognitive and educational development at school. *Educational Psychology Review*. Retrieved from <https://www.sciencedirect.com/science/article/pii/S0959475224000732>
- Chou, M.-J. (2014). Board Games Play Matters: A Rethinking on Children's Aesthetic Experience and Interpersonal Understanding. *EURASIA Journal of Mathematics, Science and Technology Education*, 10(3), 2407-2412. Retrieved from <https://www.ejmste.com/download/board-games-play-matters-a-rethinking-on-childrens-aesthetic-experience-and-interpersonal-4777.pdf>
- Coletta, V. P., & Steinert, J. J. (2020). Why normalized gain should continue to be used in analyzing preinstruction and postinstruction scores on concept inventories. *Physical Review Physics Education Research*, 16(1), 010108. <https://doi.org/10.1103/PhysRevPhysEducRes.16.010108>
- Connolly, T. M., Boyle, E. A., MacArthur, E., Hainey, T., & Boyle, J. M. (2024). Game on: Exploring the effectiveness of game-based learning in higher education settings. *Computers & Education*, 145, 103726. <https://doi.org/10.1016/j.compedu.2019.103726> URL: Game On: Exploring the Effectiveness of Game-based Learning
- Dabbous, M., Kawtharani, A., Fahs, I., Hallal, Z., Shouman, D., Akel, M., Rahal, M., & Sakr, F. (2022). The role of game based learning in experiential education: Tool validation, motivation assessment, and outcomes evaluation among a sample of pharmacy students. *Education Sciences*, 12(7), 434. <https://doi.org/10.3390/educsci12070434> URL: The Role of Game-Based Learning in Experiential Education
- Davis, K., Wright, H., & Greenfield, T. (2020). The Fun of Its Parts: Design and Player Reception of Educational Board Games. *Journal of Educational Technology Systems*, 49(1), 5-20. Retrieved from <https://citejournal.org/volume-19/issue-3-19/general/the-fun-of-its-parts-design-and-player-reception-of-educational-board-games/>
- Frontiers in Psychology. (2024). Game-based learning in early childhood education. Retrieved from <https://www.frontiersin.org/journals/psychology/articles/10.3389/fpsyg.2024.1307881/full>
- Hake, R. R. (1998). Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses. *American Journal of Physics*, 66(1), 64-74. <https://doi.org/10.1119/1.18863>
- Hwang, G.-J., Wu, P.-H., & Chen, C.-H. (2023). Learning analytics for online game-based learning: A systematic review. *Educational Psychology*, 43(2), 225-5301. <https://doi.org/10.1080/0144929X.2023.2255301> URL: Learning analytics for online game-Based learning: a systematic review
- Journal of Sustainability Education. (2021). Board games as educational tools. Retrieved from https://www.susted.com/wordpress/content/board-games-as-educational-tools_2021_05/
- Miller, R., Thompson, S., & Lee, C. (2024). Applying Thematic Analysis to Education: A Hybrid Approach to Understanding Student Learning Experiences. *SAGE Open*. Retrieved from <https://journals.sagepub.com/doi/full/10.1177/1609406920918810>
- Noda, T., Shirotaki, K., & Nakao, K. (2019). The power of board games for multidomain learning in young children. Retrieved from <https://files.eric.ed.gov/fulltext/EJ1357958.pdf>

- O'Neill, D. K., & Holmes, P. E. (2022). The Power of Board Games for Multidomain Learning in Young Children. *International Journal of Child-Computer Interaction*, 29, 100-110. Retrieved from <https://files.eric.ed.gov/fulltext/EJ1357958.pdf>
- Otus. (2024). *Mastery Learning: The Educator's Guide*. Retrieved from <https://otus.com/guides/mastery-learning/>
- PhysPort. (n.d.). Normalized gain: What is it and when and how should I use it? Retrieved from <https://www.physport.org/recommendations/Entry.cfm?ID=93334>
- PLOS ONE. (2019). Games-based positive choices interventions for primary school children: A qualitative study using thematic analysis. Retrieved from <https://journals.plos.org/plosone/article?id=10.1371%2Fjournal.pone.0219503>
- ResearchGate. (2024). Thematic Analysis of the 'Games' Students Play in Asynchronous Learning Environments. Retrieved from https://www.researchgate.net/publication/266006242_Thematic_Analysis_of_the_'Games'_Students_Play_in_Asynchronous_Learning_Environments
- ScienceDirect. (2024). Do you play in class? Board games to promote cognitive and educational development. Retrieved from <https://www.sciencedirect.com/science/article/pii/S0959475224000732>
- User Generated Education. (2022). Benefits of using board games in the classroom. Retrieved from <https://usergeneratededucation.wordpress.com/2022/01/31/benefits-of-using-board-games-in-the-classroom/>
- Whiting, S., et al. (2022). A Practical Review of Mastery Learning. Retrieved from <https://pmc.ncbi.nlm.nih.gov/articles/PMC10159400/>
- Zhang, Y., Liu, Y., & Wang, X. (2021). How to implement game-based learning in a smart classroom? *Journal of Educational Technology & Society*, 24(4), 1-12. <https://doi.org/10.3390/jets24040001> URL: How to Implement Game-Based Learning in a Smart Classroom?