ETCOR Educational Research Center Inc.
SEC Reg. No. 2024020137294-00
Sta. Ana, Pampanga, Philippines
INTERNATIONAL MULTIDISCIPLINARY RESEARCH CONFERENCE
Website: https://etcor.org
iJOINED ETCOR
P - ISSN 2984-7567
E - ISSN 2945-3577
The Exigency
P - ISSN 2984-7842
E - ISSN 1908-3181

Influence of Game-Based Instruction and Students' Motivation to their Computational Thinking Skills

Orland M. Renon*[1], Allen E. Pasia[2]
[1] Adela S. Torres National High School, [2] Laguna State Polytechnique University, Faculty of College of Graduate Studies and Applied Research
* Corresponding Author email: *orland.renon@deped.gov.ph*

Received: 15 June 2024 **Revised**: 20 July 2024 **Accepted**: 22 July 2024

Available Online: 04 August 2024

Volume III (2024), Issue 3, P-ISSN – 2984-7567; E-ISSN - 2945-3577

Abstract
Aim: This study determined the effect of game-based instruction and student's motivation on computational skills.
Methodology: This quantitative correlational study investigates the role of game-based instruction and students' motivation on enhancing computational skills in mathematics among 100 randomly selected Grade 8 students from Adela S. Torres National High School. The methodology includes using survey questionnaires and assessment tests to measure students' perceptions of game-based instruction, their motivation levels, and Computational Thinking Skills. The research involved meticulously preparing game-based instructional materials, conducting bi-weekly game-based sessions over a month, and continuously monitoring students' engagement and progress. Data collection comprised surveys and assessments to evaluate the effectiveness of game-based learning in fostering computational skills and motivation.
Results: The study found that students generally perceive game-based instruction in mathematics positively, appreciating its challenge, imaginative elements, and fun. Most students demonstrated proficiency in Computational Thinking Skills like decomposition, abstraction, and pattern recognition, though many needed improvement in algorithm design. Additionally, students showed high levels of both intrinsic and Extrinsic Motivation towards mathematics learning. Significant positive relationships were identified between game-based instruction and Computational Thinking Skills, as well as between motivation and Computational Thinking Skills.
Conclusion: The research concludes that game-based instruction increased student motivation significantly enhance Computational Thinking Skills.

Keywords: game-based instruction, mathematics, intrinsic, extrinsic, Computational Thinking Skill

INTRODUCTION

Textbooks have long been a staple in formal education, but game-based learning offers a flexible, customizable, and easily updated alternative. Game-based instruction, which uses games to foster critical thinking and problem-solving skills, provides hands-on experience through both digital and non-digital games. This method became particularly relevant during the pandemic when modular setups led to difficulties in comprehending computational processes, highlighting the need for diverse teaching strategies to enhance understanding (Abenojar, 2024).

Game-based instruction effectively improves students' computational skills, offering an engaging and interactive learning environment. Digital games and technology have transformed education, meeting students' high expectations for digital content and varied activities. Effective game-based learning requires well-designed games that fully engage students, making the learning process enjoyable and practical for real-world problem-solving. Studies have shown that multimedia tools like computer games significantly enhance learning outcomes in mathematics.

Educators face the challenge of catering to diverse student needs and learning preferences. Game-based instruction helps address these challenges by providing dynamic and engaging content that resonates with today's

ETCOR Educational Research Center Inc.
SEC Reg. No. 2024020137294-00
Sta. Ana, Pampanga, Philippines
INTERNATIONAL MULTIDISCIPLINARY RESEARCH CONFERENCE
Website: https://etcor.org
iJOINED ETCOR
P - ISSN 2984-7567
E - ISSN 2945-3577
The Exigency
P - ISSN 2984-7842
E - ISSN 1908-3181

digital-savvy students. Mathematics, often perceived as difficult, benefits from innovative teaching strategies that align with students' interests and motivations. Game-based learning helps educators identify and address gaps in students' understanding, making lessons more accessible and inclusive.

Incorporating game-based instruction is essential for modern education, enhancing both teaching and learning experiences. This approach engages students more deeply than traditional methods, promoting active learning and better retention of information. Game-based learning encourages students to apply their knowledge and skills in interactive and practical ways, leading to improved cognitive development and problem-solving abilities.

The purpose of this study is to explore how game-based instruction can enhance computational skills and motivate learners. Theoretical frameworks like the Gamified Learning Theory and the TPACK model support the integration of technology into teaching, emphasizing the importance of creating meaningful learning experiences. By leveraging these strategies, educators can improve the quality of education and better prepare students for real-world challenges, making learning both effective and enjoyable.

Game-based instruction integrates games to reinforce learning outcomes by incorporating engagement, immediate rewards, and healthy competition, keeping students motivated. Its versatility allows for online games, hands-on activities, and both independent and collaborative learning. Lin et al. (2013) demonstrated the effectiveness of game-based instruction by integrating math lessons into the game Monopoly, enhancing sixth-graders' understanding and more effectively than video-based instruction. The study showed that both game-based and video-based methods improved overall math performance, with game-based learning, especially when combined with mastery learning strategies, offering greater benefits. This approach leverages multimedia features and attractive graphics to enhance engagement and the learning experience.

Game-Aided Instruction has a greater impact on student learning than a purely learner-centered approach, efficiently covering multiple concepts quickly while promoting active learning, interaction, and creative thinking. Tajaon (2021) found that this method significantly improves academic performance and critical thinking skills through engaging gameplay mechanics and player interaction. When well-structured and aligned with lessons, Game-Aided Instruction enhances achievement and skills, with teacher guidance and feedback further developing students' abilities.

Objectives

This research aimed to determine the effect of game-based instruction and student's motivation on computational skills.

Specifically, It sought to answer the following:

1. How do the respondents perceive the Game-based Instruction in Mathematics in terms of:
   1.1 Challenge;
   1.2 Fantasy; and
   1.3 Fun?
2. What is the level of Computational Thinking Skills of the students in terms of:
   2.1 Decomposition;
   2.2 Pattern Recognition;
   2.3 Generalization and abstraction; and
   2.4 Algorithm design?
3. What is the level of motivation of the students in terms of:
   3.1 Intrinsic Motivation; and
   3.2 Extrinsic Motivation?
4. Does Game-based instruction significantly correlate with Computational Thinking Skills?
5. Does student's motivation significantly correlate with Computational Thinking Skills?

Hypothesis

Given the stated research problem, the following hypotheses were tested on 0.05 level of significance:
Hypothesis 1: Game-based instruction does not significantly correlate with Computational Thinking Skills.
Hypothesis 2: Student's motivation does not significantly correlate with Computational Thinking Skills.

ETCOR Educational Research Center Inc.
SEC Reg. No. 2024020137294-00
Sta. Ana, Pampanga, Philippines
INTERNATIONAL MULTIDISCIPLINARY RESEARCH CONFERENCE
Website: https://etcor.org
iJOINED ETCOR
P - ISSN 2984-7567
E - ISSN 2945-3577
The Exigency
P - ISSN 2984-7842
E - ISSN 1908-3181

METHODS

Research Design

This quantitative correlational study explores the relationships between game-based instruction, students' motivation, and their development of Computational skills in junior high school mathematics. It aims to understand how game-based instruction influences motivation and, in turn, enhances computational skills, addressing learning difficulties in math. By establishing associations between these variables, the study provides insights into the potential effectiveness of game-based approaches in improving students' learning experiences and outcomes in mathematics.

Population and Sampling

This study involved a randomly selected sample of 100 Grade 8 students from three sections at Adela S. Torres National High School. The researcher gathered data on each student's Computational Thinking Skills developed through game-based instruction, as well as their level of motivation.

Instrument

The research instrument used in this study consisted of multiple components to assess game-based instruction, Computational Thinking Skills, and motivation among respondents. Experts in the field were consulted to ensure the instruments' validity, reliability, and effectiveness. A survey questionnaire measured perceptions of game-based instruction, while an assessment test evaluated Computational Thinking Skills. Additionally, another survey assessed intrinsic and Extrinsic Motivation levels among students, providing insights into their engagement with learning tasks.

Data Collection

The data was administered, collected, examined, and analyzed by the researcher in accordance with the study's objectives and research protocols. All data was collected through offline surveys.

Treatment of Data

In this study, the respondent's perception towards game-based instruction and motivation level were assessed using weighted mean, while frequency distribution was utilized to determine the level of Computational Thinking Skills. Additionally, the relationship between game-based instruction and Computational Thinking Skills, as well as between student's motivation and Computational Thinking Skills, was examined using Pearson's Product Moment Correlation. The researcher use separate correlations for each Computational Thinking Skill.

Ethical Considerations

The researchers diligently adhered to all ethical research protocols to safeguard the well-being and interests of all individuals and organizations involved in the study.

RESULTS and DISCUSSION

Respondents' Perception towards the Game-based Instruction in Mathematics.

Table 1. Respondents' Perception towards the Game-based Instruction in Mathematics in terms of Challenge

	Challenge	Mean	Verbal Interpretation
1.	I like tasks that test my prior knowledge.	3.22	Agree
2.	I can do a series of tasks effectively	3.19	Agree
3.	I work hard more when tasks are done individually.	3.20	Agree
4.	I find problem-solving challenging yet exciting.	3.22	Agree
5.	I try my best to finish the tasks at hand as fast as possible.	3.39	Strongly Agree
	Total Mean	**3.24**	**Agree**

Legend: 3.25-4.00 Strongly Agree, 2.50-3.24 Agree, 1.75-2.49 Disagree, 1.00-1.74 Strongly Disagree

ETCOR Educational Research Center Inc.
SEC Reg. No. 2024020137294-00
Sta. Ana, Pampanga, Philippines
INTERNATIONAL MULTIDISCIPLINARY RESEARCH CONFERENCE
Website: https://etcor.org
iJOINED ETCOR
P - ISSN 2984-7567
E - ISSN 2945-3577
The Exigency
P - ISSN 2984-7842
E - ISSN 1908-3181

Table 1 presents respondents' perceptions of game-based instruction in mathematics, focusing on indicators of challenge. Overall, respondents showed a general agreement with statements indicating a positive perception of the challenge presented by game-based instruction, with some variability observed in their perceptions regarding task effectiveness. The incorporation of the "Bet on Your Points" game further enhanced students' perception of challenge by introducing a competitive element and a reward system based on performance, motivating active engagement and accountability. Effective teachers recognize the importance of challenging tasks to sustain student engagement and motivation, employing strategies within classroom tasks and game-based instruction to stimulate critical thinking and problem-solving skills (Anthony & Walshaw, 2023; Hamari et al., 2016; Filgona et al., 2020).

Table 2. Respondents' Perception towards the Game-based Instruction in Mathematics in terms of Fantasy

Fantasy	Mean	Verbal Interpretation
1. Problem-solving makes my imagination deeper.	3.07	Agree
2. Through games I can be more creative.	3.34	Strongly Agree
3. I am able to translate my thoughts into ideas that I use as solving problems	3.13	Agree
4. Variety of tasks improves my ability to generate ideas specifically when different concepts relate to each other	3.17	Agree
5. I consider solving math problems a mind game.	3.24	Agree
Total Mean	**3.19**	**Agree**

Legend: 3.25-4.00 Strongly Agree, 2.50-3.24 Agree, 1.75-2.49 Disagree, 1.00-1.74 Strongly Disagree

Table 2 illustrates respondents' perceptions of game-based instruction in mathematics, particularly focusing on the aspect of fantasy. The data reveals that students strongly agree that game-based instruction significantly enhances their creativity. Moreover, there is a notable agreement among students regarding the positive impact of game-based instruction on their problem-solving skills and imaginative abilities. This indicates that incorporating imaginative and creative elements into game-based instruction can effectively engage students and improve their overall learning experience in mathematics.Incorporating stimulating activities like "Mystery Island Adventure" and "Mind Maze Quest" further immerses students in imaginative scenarios, fostering creativity and problem-solving skills. These games transport students into imaginative realms, encouraging exploration and critical thinking while engaging with mathematical concepts. By incorporating fantasy elements, game-based instruction goes beyond traditional classrooms, sparking students' imagination and inspiring innovative thinking (Wallace & Russ, 2015; Puspitasari et al., 2018).

Table 3. Respondents' Perception towards the Game-based Instruction in Mathematics in terms of Fun

Fun	Mean	Verbal Interpretation
1. I can have fun when answering math problems.	3.06	Agree
2. I enjoy math problems when done in groups.	3.28	Strongly Agree
3. I don't get stressed in the tasks given by the teacher.	2.77	Agree
4. I feel a certain excitement when I complete my tasks.	3.27	Strongly Agree
5. Learning math problems is an enjoyable experience for me.	3.13	Agree
Total Mean	**3.10**	**Agree**

Legend: 3.25-4.00 Strongly Agree, 2.50-3.24 Agree, 1.75-2.49 Disagree, 1.00-1.74 Strongly Disagree

Table 3 outlines respondents' perceptions of game-based instruction in mathematics, particularly focusing on the aspect of fun. The data shows that students strongly agree they enjoy math problems, especially when done in groups. This indicates a positive attitude towards learning activities, suggesting that game-based instruction makes mathematics more enjoyable and engaging for students. Introducing engaging activities like the "Teamwork Tower Challenge" further enhances students' enjoyment and excitement by fostering collaboration, communication, and critical thinking skills. By incorporating fun elements into instructional design, educators can create dynamic learning environments that promote active participation and deeper engagement with the subject matter. Recognizing the

ETCOR Educational Research Center Inc.
SEC Reg. No. 2024020137294-00
Sta. Ana, Pampanga, Philippines
INTERNATIONAL MULTIDISCIPLINARY RESEARCH CONFERENCE
Website: https://etcor.org
iJOINED ETCOR
P - ISSN 2984-7567
E - ISSN 2945-3577
The Exigency
P - ISSN 2984-7842
E - ISSN 1908-3181

importance of infusing enjoyment into game-based instruction empowers educators to cultivate positive learning cultures that inspire students to explore, experiment, and collaborate effectively (Dele-Ajayi et al., 2016; Yong et al., 2016).

Level of Computational Thinking Skill of the Respondents

Table 4. Level of Computational Thinking Skill of the Respondents in terms of Decomposition

	Decomposition		VI
	f	%	
4	69	69.00	Exemplary
3	17	17.00	Proficient
2	5	5.00	Developing
1	9	9.00	Emerging
N	100	100.00	

Legend: VI- Verbal Interpretation, N- Number of Respondents, 4- Exemplary, 3- Proficient, 2- Developing, 1- Emerging

Table 4 illustrates the levels of Computational Thinking Skills among respondents, particularly focusing on decomposition. The findings indicate a generally positive proficiency level in decomposition skills, with a high number of individuals classified as exemplary or proficient. However, there is a need for further improvement and practice, as indicated by the smaller number of respondents classified as developing or emerging. These insights highlight the importance of tailoring instructional strategies to address varying proficiency levels, with game-based instruction playing a significant role in facilitating understanding and mastery of decomposition skills. By providing engaging and interactive learning experiences, educators can effectively nurture students' computational thinking abilities, ultimately fostering deeper problem-solving skills and conceptual understanding (Ke & Clark, 2020; Moon & Ke, 2020).

Table 5. Level of Computational Thinking Skill of the Respondents in terms of Abstraction

	Abstraction		VI
	f	%	
4	60	60.00	Exemplary
3	17	17.00	Proficient
2	12	12.00	Developing
1	11	11.00	Emerging
N	100	100.00	

Legend: VI- Verbal Interpretation, N- Number of Respondents, 4- Exemplary, 3- Proficient, 2- Developing, 1- Emerging

Table 5 outlines the proficiency levels of abstraction skills among respondents, with a significant number demonstrating exemplary or proficient competency. However, there are individuals classified as developing or emerging, indicating areas for improvement and growth. The findings underscore the importance of providing additional support and intervention to enhance abstraction skills. Effective instructional methods, such as simplifying problems and incorporating interactive learning activities, have contributed to students' exemplary performance in this area (Clark et al., 2016; Byun & Joung, 2018).

ETCOR Educational Research Center Inc.
SEC Reg. No. 2024020137294-00
Sta. Ana, Pampanga, Philippines
INTERNATIONAL MULTIDISCIPLINARY RESEARCH CONFERENCE
Website: https://etcor.org
iJOINED ETCOR
P - ISSN 2984-7567
E - ISSN 2945-3577
The Exigency
P - ISSN 2984-7842
E - ISSN 1908-3181

Table 6. Level of Computational Thinking Skill of the Respondents in terms of Pattern Recognition

	Pattern Recognition		VI
	f	%	
4	8	8.00	Exemplary
3	31	31.00	Proficient
2	33	33.00	Developing
1	28	28.00	Emerging
N	100	100.00	

Legend: 3.25-4.00 Very High, 2.50-3.24 High, 1.75-2.49 Low, 1.00-1.74 Very Low

Table 6 highlights the distribution of proficiency levels in pattern recognition skills among respondents, with the majority falling within the proficient and developing categories. While some individuals demonstrate exemplary proficiency, many require further refinement and practice in this skill area. The complexity of tasks and individual differences in cognitive abilities likely contribute to the varied distribution across proficiency levels. Effective instructional strategies and task design can help bridge gaps and support students in developing stronger pattern recognition skills (Korucu et al., 2017).

Table 7. Level of Computational Thinking Skill of the Respondents in terms of Algorithms

	Algorithms		VI
	f	%	
4	2	2.00	Exemplary
3	27	27.00	Proficient
2	26	26.00	Developing
1	45	45.00	Emerging
N	100	100.00	

Legend: VI- Verbal Interpretation, N- Number of Respondents, 4- Exemplary, 3- Proficient, 2- Developing, 1- Emerging

Table 7 illustrates the distribution of algorithmic skills among respondents, with a majority falling within the proficient and developing categories. While only a small number demonstrate exemplary proficiency, many respondents exhibit solid understanding, although there's room for improvement. Challenges in algorithm design may stem from the complexity of tasks, lack of prior exposure, or insufficient instruction. Creating a supportive learning environment that fosters critical thinking and collaboration can aid in enhancing algorithmic skills among students (González, 2015).

Level of Motivation of the Respondents

Table 8. Level of Motivation of the Respondents in terms of Intrinsic Motivation

Intrinsic Motivation	**Mean**	**Verbal Interpretation**
1. I am excited about learning different Math concepts.	3.28	Very High
2. I challenge myself to pay attention to understand the lesson.	3.38	Very High
3. I find the purpose of Math lessons.	3.20	High
4. It feels good to share my ideas with my classmates.	3.33	Very High
5. I am able to express my question, ideas, and answer to my teacher and classmates.	3.05	High
Total Mean	**3.25**	**Very High**

Legend: 3.25-4.00 Very High, 2.50-3.24 High, 1.75-2.49 Low, 1.00-1.74 Very Low

Table 8 illustrates respondents' high level of Intrinsic Motivation toward mathematics learning, with indicators such as challenging oneself and sharing ideas receiving notably high mean scores. The incorporation of

ETCOR Educational Research Center Inc.
SEC Reg. No. 2024020137294-00
Sta. Ana, Pampanga, Philippines
INTERNATIONAL MULTIDISCIPLINARY RESEARCH CONFERENCE
Website: https://etcor.org
iJOINED ETCOR
P - ISSN 2984-7567
E - ISSN 2945-3577
The Exigency
P - ISSN 2984-7842
E - ISSN 1908-3181

"Territory Siege" in the fourth session of game-based instruction further enhances Intrinsic Motivation by providing collaborative gameplay and personal rewards, aligning well with students' positive attitudes and engagement. The excitement expressed by respondents about exploring math concepts and challenging themselves resonates with the dynamic nature of game-based learning. Moreover, their enjoyment of collaboration suggests a favorable disposition toward interactive instructional methods. This supports the effectiveness of game-based instruction in fostering critical thinking and engagement in mathematics learning (Ninaus et al., 2017).

Table 9. Level of Motivation of the Respondents in terms of Extrinsic Motivation

Extrinsic Motivation	Mean	Verbal Interpretation
1. I can obtain a higher score when there is a reward.	3.02	High
2. I work efficiently expecting a high grade.	3.00	High
3. I am a team player in group tasks in order to win.	2.99	High
4. I attentively listen to the topic to avoid failure in quizzes or tests.	3.29	Very High
5. I put a lot of effort into activities to be recognized.	3.16	High
Total Mean	**3.09**	**High**

Legend: 3.25-4.00 Very High, 2.50-3.24 High, 1.75-2.49 Low, 1.00-1.74 Very Low

Table 9 reveals respondents' positive Extrinsic Motivation towards mathematics learning, with indicators such as attentiveness to avoid failure and desire for high grades receiving notably high mean scores. The incorporation of "City Builder Tycoon" in the seventh session of game-based instruction further enhances Extrinsic Motivation by offering external rewards such as recognition, achievement, and success within the game. These rewards serve as strong motivators for students to actively participate and excel, reinforcing positive behaviors and encouraging persistence in mathematical problem-solving tasks. By balancing extrinsic and intrinsic motivators, game-based instruction can create a dynamic learning experience that promotes both short-term engagement and long-term academic growth (Chen & Lin, 2020).

Test of Relationship between Game-based Instruction, Motivation, and Computational Thinking Skills

Table 10. Test of Relationship between Game-based Instruction, Motivation, and Computational Thinking Skills

Correlations		
	COMPUTATIONAL THINKING SKILLS	
	r	p
GAMEBASED	.216*	0.000
MOTIVATION	.239*	0.016

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Table 10 illustrates a positive correlation between Game-based Instruction and Computational Thinking Skills, suggesting that integrating game-based methods into education can positively influence students' computational thinking abilities. Similarly, a positive correlation between Motivation and Computational Thinking Skills underscores the importance of fostering Intrinsic Motivation to enhance critical thinking capacities. However, while game-based instruction stimulates motivation, it alone may not significantly improve Computational Thinking Skills. This highlights the need for a multifaceted approach to instructional design, considering various factors beyond instructional methods. The findings emphasize the potential of game-based instruction in promoting engagement and critical thinking but also underscore the complexity of skill development in education (Foster & Shah, 2020).

Summary, Conclusions, and Recommendations

This research investigates the influence of game-based instruction on enhancing motivation and computational skills in Mathematics among Junior High School students. It employs a quasi-experimental design with mediation analysis, involving Grade 8 students from Adela S. Torres National High School. The study assesses students' perceptions of game-based instruction's challenge, fantasy, and fun aspects, alongside Computational Thinking Skills such as decomposition and algorithm design. It also evaluates intrinsic and Extrinsic Motivation levels

ETCOR Educational Research Center Inc.
SEC Reg. No. 2024020137294-00
Sta. Ana, Pampanga, Philippines
INTERNATIONAL MULTIDISCIPLINARY RESEARCH CONFERENCE
Website: https://etcor.org
iJOINED ETCOR
P - ISSN 2984-7567
E - ISSN 2945-3577
The Exigency
P - ISSN 2984-7842
E - ISSN 1908-3181

and explores whether motivation mediates the relationship between game-based instruction and computational skills. Through eight sessions of game-based instruction, the research aims to provide insights into the effectiveness of this approach in fostering motivation and computational abilities in Mathematics at the Junior High School level.

The findings reveal that students generally perceive game-based instruction positively in mathematics, agreeing on its challenge, fantasy, and fun aspects, indicating enhanced creativity and problem-solving skills. While most students demonstrate proficiency in Computational Thinking Skills like decomposition, abstraction, and pattern recognition, there's a notable need for improvement in algorithm design. Moreover, students exhibit high levels of motivation, both intrinsic and extrinsic, towards mathematics learning, highlighting the importance of considering motivational factors in effective education. Additionally, significant positive relationships are observed between game-based instruction and Computational Thinking Skills, as well as between motivation and computational skills, emphasizing the potential synergy between instructional methods and motivational factors in enhancing students' mathematical abilities.

In conclusion, the research findings indicate a highlighting the effectiveness of this instructional approach in fostering students' problem-solving abilities. Additionally, the study reveals a significant correlation between students' motivation and their Computational Thinking Skills, emphasizing the importance of intrinsic and Extrinsic Motivational factors in promoting effective learning outcomes in mathematics.

In light of the conclusions drawn, several recommendations emerge for various stakeholders. Math teachers are encouraged to integrate game-based instruction into their teaching methods to boost student motivation and comprehension of mathematical concepts, using online game platforms to specifically enhance students' Computational Thinking Skills. School administrators should support teachers in this endeavor by providing resources and fostering collaboration among educators. Parents play a vital role in fostering a conducive learning environment at home and collaborating with teachers to monitor progress. Lastly, future research should delve deeper into the long-term effects of game-based instruction on student motivation and computational skills, exploring different approaches and individual differences to further enhance mathematics education.

REFERENCES

Abenojar, M. B. (2024). Effectiveness of Directed Reading Thinking Activity (DRTA) in Improving the Reading Comprehension of Grade Three Pupils. International Journal of Open-access, Interdisciplinary and New Educational Discoveries of ETCOR Educational Research Center (iJOINED ETCOR), 3(2), 435-446. https://etcor.org/storage/iJOINED/Vol.%20III(2),%20435-446.pdf

Anthony, G., & Walshaw, M. (2023). Characteristics of effective teaching of mathematics: A view from the West. *Journal of Mathematics Education*, 147-164.

Byun, J., & Joung, E. (2018). Digital game-based learning for K–12 mathematics education: A meta-analysis. *School Science and Mathematics*, *118*(3-4), 113-126.

Chen, S. Y., & Lin, S. W. (2020). A cross-cultural study of mathematical achievement: From the perspectives of one's motivation and problem-solving style. *International Journal of Science and Mathematics Education*, *18*, 1149-1167.

Clark, D. B., Virk, S. S., Barnes, J., & Adams, D. M. (2016). Self-explanation and digital games: Adaptively increasing abstraction. *Computers & Education*, *103*, 28-43.

Dele-Ajayi, O., Sanderson, J., Strachan, R., & Pickard, A. (2016, October). Learning mathematics through serious games: An engagement framework. In *2016 IEEE Frontiers in Education Conference (FIE)* (pp. 1-5). IEEE.

Filgona, J., Sakiyo, J., Gwany, D. M., & Okoronka, A. U. (2020). Motivation in learning. *Asian Journal of Education and social studies*, *10*(4), 16-37.

Foster, A., & Shah, M. (2020). Principles for advancing game-based learning in teacher education. *Journal of Digital Learning in Teacher Education*, *36*(2), 84-95.

ETCOR Educational Research Center Inc.
SEC Reg. No. 2024020137294-00
Sta. Ana, Pampanga, Philippines
Website: https://etcor.org
INTERNATIONAL MULTIDISCIPLINARY RESEARCH CONFERENCE
iJOINED ETCOR
P - ISSN 2984-7567
E - ISSN 2945-3577
The Exigency
P - ISSN 2984-7842
E - ISSN 1908-3181

González, M. R. (2015). Computational thinking test: Design guidelines and content validation. In *EDULEARN15 Proceedings* (pp. 2436-2444). IATED.

Hamari, J., Shernoff, D. J., Rowe, E., Coller, B., Asbell-Clarke, J., & Edwards, T. (2016). Challenging games help students learn: An empirical study on engagement, flow and immersion in game-based learning. *Computers in human behavior*, *54*, 170-179.

Ke, F., & M. Clark, K. (2020). Game-based multimodal representations and mathematical problem solving. *International Journal of Science and Mathematics Education*, *18*, 103-122.

Korucu, A. T., Gencturk, A. T., & Gundogdu, M. M. (2017). Examination of the Computational Thinking Skills of students. *Journal of Learning and Teaching in Digital Age*, *2*(1), 11-19.

Lin, C. H., Liu, E. Z. F., Chen, Y. L., Liou, P. Y., Chang, M., Wu, C. H., & Yuan, S. M. (2013). Game-based remedial instruction in mastery learning for upper-primary school students. *Journal of Educational Technology & Society*, *16*(2), 271-281.

Moon, J., & Ke, F. (2020). In-game actions to promote game-based math learning engagement. *Journal of Educational Computing Research*, *58*(4), 863-885.

Ninaus, M., Moeller, K., McMullen, J., & Kiili, K. (2017). Acceptance of game-based learning and Intrinsic Motivation as predictors for learning success and flow experience. *International Journal of Serious Games*, *4*.

Puspitasari, L., In'am, A., & Syaifuddin, M. (2018). Analysis of students' creative thinking in solving arithmetic problems. *International Electronic Journal of Mathematics Education*, *14*(1), 49-60.

Taja-on, E. P. (2019). Game-Aided Instruction: Enhancing Critical Thinking through Logical-Mathematical Games. *Online Submission*, *1*(1), 1-15.

Wallace, C. E., & Russ, S. W. (2015). Pretend play, divergent thinking, and math achievement in girls: A longitudinal study. *Psychology of Aesthetics, Creativity, and the Arts*, *9*(3), 296.

Yong, S. T., Gates, P., & Harrison, I. (2016). Digital Games and Learning Mathematics: Student, Teacher and Parent Perspectives. *International Journal of Serious Games*, *3*(4).