Introduction This study explores the solar system and its significance in scientific inquiry and education. The solar system, comprising the sun, planets, moons, asteroids, and comets, is of paramount importance in our comprehension of the universe. In the realm of science education, this research focuses on devising and implementing a solar system-themed board game. This innovative approach aims to enrich students' comprehension of astronomical concepts and planetary science in an interactive and captivating manner. It's worth noting that the board game draws inspiration from classics like Snake and Ladder and Monopoly. Understanding the solar system is profoundly significant for various reasons. Firstly, it provides valuable insights into where Earth stands within the vast cosmos, enhancing our understanding and appreciation of our planet's role. Furthermore, exploring the solar system stimulates advancements in science and technology, leading to the creation of innovative tools and methods for space exploration. Additionally, delving into the intricacies of the solar system sparks curiosity and fascination, potentially inspiring students to pursue careers in scientific fields. Therefore, incorporating a solar system-themed board game into educational settings not only improves learning outcomes but also nurtures a passion for science and exploration among students.

Background/Review of Related Literature According to Iseri et al. (2020) utilizing visual aids in lessons is crucial as they facilitate more enduring learning experiences. Visuals employed during evaluations should also help alleviate student anxiety and ensure accurate assessment. Board games, as part of these visuals, can offer immediate feedback during evaluations and prove highly effective. Establishing standards and increasing the frequency of incorporating such games into evaluations can enhance their accuracy and effectiveness even further. The 2019 study by Esma Bulus Kirikkaya et al. using visual aids in lessons enhances memory retention and alleviates student anxiety during assessments, ensuring more accurate evaluations. Introducing board games into assessments offers immediate feedback, enhancing the efficacy and precision of evaluation methods. Standardizing and increasing the frequency of such game-based assessments can improve their accuracy and effectiveness. This study focuses on employing board games to gauge students' comprehension of celestial bodies, space exploration, optical instruments, and planetary characteristics. Findings suggest that teachers perceive these game-based activities as enhancing student motivation and serving as effective assessment tools, while students find enjoyment in participating in these games. In the study of Mohamad et al. (2017) introduces a game-based learning method for educating children about the Solar System. Research indicates that students often struggle to meet the intellectual and attitudinal requirements of astronomy in school, and many fail to offer scientifically accurate explanations of the subject's concepts. Thus, there is a pressing need for a more captivating approach to Solar System education to tackle these challenges. Utilizing gameplay as a learning tool could increase student engagement and foster a

more effective learning atmosphere. Educators and scholars in the field of science incorporating interactive and entertaining computer-based educational games, fostering knowledge acquisition through hands-on experiences. A detailed case study involving 30 children was carried out to assess the effectiveness of the game. Findings validated that the game facilitates significant learning outcomes within an engaging and enjoyable learning atmosphere, greatly favored by children. A large majority of students (93%) indicated their willingness to explore other subjects using similar interactive gaming approaches (Muntean et al., 2018) Rationale This section outlines the questions under investigation, their relevance to the broader issues introduced earlier, and their implications for the psychology of language. The specific questions being explored are: 1. How can the design of a solar system-themed board game effectively convey complex astronomical concepts to students? 2. What impact does using a board game have on students' motivation, engagement, and retention of astronomical knowledge? 3. How do students perceive and interact with a solar system-themed board game compared to traditional classroom instruction? These questions are closely tied to the larger issues raised in the introduction, particularly regarding the effectiveness of innovative teaching methods in astronomy education and the potential of board games to enhance student learning experiences. By addressing these questions, the study aims to understand how game-based learning can improve students' understanding and interest in astronomy. The main claim being

evaluated is that incorporating a solar system-themed board game into the classroom can significantly enhance students' understanding and interest in astronomy. The researchers hypothesize that students exposed to the board game-based approach will show increased motivation, engagement, and retention of astronomical knowledge compared to those receiving traditional instruction alone. Confirming the hypothesis would provide evidence for the effectiveness of game-based learning in astronomy education, highlighting the value of innovative teaching methods in fostering scientific curiosity. It would demonstrate that interactive learning approaches, such as board games, can be effective tools for enhancing student learning outcomes in STEM subjects. If the hypothesis is not supported, it may indicate that further refinement of the board game's design or consideration of additional factors is needed. This outcome would prompt a reevaluation of our approach and stimulate further research into optimizing game-based instruction in science education. Methods and Design Method For data collection, we will employ a structured gameplay session utilizing the Solar System Odyssey board game. This approach offers an interactive means of assessing junior high school students' understanding of astronomy concepts, their engagement levels, and their attitudes toward science. By immersing participants in gameplay, we can directly observe their responses to questions and their interactions with the game mechanics, providing valuable insights into the

effectiveness of game-based learning in astronomy education. In terms of participants, our sample will consist of junior high school students aged 12-15, aligning with the target demographic for the Solar System Odyssey game. This age range is selected because students at this developmental stage are typically capable of comprehending basic scientific concepts and are likely to engage meaningfully with educational games. To maintain data validity, we will exclude students with significant language or cognitive disabilities that may impede their ability to participate effectively in the gameplay session. Design The design of the Solar System Odyssey board game draws inspiration from the mechanics of classic board games such as Monopoly and Snakes and Ladders. Similar to Monopoly, players navigate through the solar system encountering celestial bodies as properties to interact with. Additionally, akin to the chance elements in Snakes and Ladders, players face the unpredictability of the black hole mechanism, which introduces setbacks and opportunities during gameplay. This amalgamation of traditional board game dynamics aims to enhance engagement and facilitate immersive learning experiences for participants within the context of astronomy education. The design of the stimuli will center around game tiles featuring alternative planets of the solar system, each accompanied by questions tailored to assess participants' comprehension of astronomical concepts. This design choice allows for a varied assessment of participants' knowledge across different celestial bodies and related scientific principles. Additionally, the inclusion of a black hole mechanism introduces an element of risk and reward, enhancing engagement and providing opportunities for learning reinforcement as participants navigate through the game. To ensure the integrity of the study, we will implement controls for various

factors that may influence the outcomes. This includes standardizing the difficulty level of questions, controlling for participants' prior knowledge of astronomy, and maintaining consistency in facilitation during gameplay sessions. By controlling these variables, we aim to minimize potential confounding factors and maintain the reliability of the data collected. Procedure During the procedure, participants will engage in gameplay sessions of the Solar System Odyssey board game, taking turns rolling the dice and moving their game pieces along the board. Upon landing on tiles featuring planets, participants will be presented with corresponding questions. The researchers have meticulously prepared 10 questions for each planet, resulting in a total of 80 questions across the 8 planets. Correct answers allow progression, while incorrect answers result in setbacks via the black hole mechanism. Facilitators will oversee the gameplay sessions to ensure adherence to the established procedures and to address any questions or issues that may arise. Analysis Following data collection, analysis will focus on examining participants' performance on questions, their engagement levels, and any changes in attitudes toward science observed through pre- and post-game surveys. Significant improvements in participants' understanding of astronomical concepts, as evidenced by higher post-game scores and positive shifts in survey responses, would lend support to the hypothesis regarding the effectiveness of game-based learning in astronomy education. Conversely, if minimal improvements or negative shifts in attitudes are observed, it would indicate the need for further refinement of the game or instructional methods.

Significance and Conclusion The proposed research on the Solar System Odyssey board game represents a significant improvement over previous studies by addressing key gaps in the existing literature and providing novel insights into the effectiveness of game-based learning in astronomy education. Firstly, while prior research has explored the use of board games and interactive methods in science education, including astronomy, the Solar System Odyssey game introduces a unique approach by integrating classic board game mechanics with tailored questions focused specifically on celestial bodies and astronomical concepts. This innovative design not only enhances engagement but also allows for a comprehensive assessment of students' understanding across various aspects of astronomy, from planetary characteristics to space exploration techniques. Moreover, by targeting junior high school students aged 12-15, the study fills a critical age gap in existing research, as this demographic represents a pivotal stage in cognitive development where students are transitioning from concrete to abstract thinking. Understanding how game- based learning influences motivation, engagement, and knowledge retention in this age group is essential for designing effective educational interventions that cater to their specific learning needs. Furthermore, the inclusion of pre- and post-game surveys allows for a nuanced analysis of students' attitudes toward science, providing valuable insights into the long-term impact of game-

based instruction on their perceptions of astronomy and STEM fields in general. Positive shifts in attitudes, coupled with improvements in performance on post-game assessments, would not only validate the effectiveness of the Solar System Odyssey game but also highlight its potential to inspire a lifelong interest in scientific inquiry among students. Overall, the proposed research contributes to the field of astronomy education by offering a comprehensive evaluation of the Solar System Odyssey board game as a pedagogical tool. By elucidating the mechanisms through which game-based learning enhances student learning outcomes and fostering a deeper appreciation for the wonders of the cosmos, this study has the potential to inform educational practices and curriculum development initiatives aimed at promoting STEM literacy and fostering a new generation of scientifically literate citizens.