

DEVELOPMENT OF INTERACTIVE WEB-BASED MEDIA ON OUTER SPACE AND THE SOLAR SYSTEM IN GRADE 6 ELEMENTARY SCHOOL IPAS LEARNING TO MEASURE STUDENTS' LEARNING OUTCOMES



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Abstract

This study is motivated by the limited availability of instructional media in elementary schools, which encourages the need for innovations in the development of learning resources. The problem addressed in this research is the lack of interactive, web-based media for science learning, particularly on the topic of space and the solar system for sixth-grade elementary school students. The objective of this study is to develop an interactive web-based instructional medium and to evaluate its effectiveness in improving students' learning outcomes in Science (IPAS) learning. This research applied a Research and Development (R&D) approach using the ADDIE development model, consisting of the stages of Analysis, Design, Development, Implementation, and Evaluation. The research sample involved 20 sixth-grade students from Mawar Class at SD Perjuangan Terpadu Depok. The product produced in this research is an interactive web-based learning media on space and the solar system, created through Google Sites and equipped with learning materials and interactive features. The results indicate that the interactive web-based media is suitable for classroom use and has a positive impact on students' learning outcomes. The product's effectiveness was measured through pretest and posttest scores, analyzed using a paired t-test, which yielded a Sig. (2-tailed) value of $0.000 < 0.05$, indicating a significant improvement. The N-Gain analysis showed a value of 0.79, categorized as high. Therefore, it can be concluded that the developed media effectively enhances students' learning outcomes. The findings are expected to be beneficial for school principals, teachers, parents, students, and future researchers.

Keywords: Learning Media, Interactive Web, Google Site

INTRODUCTION

Education is an interaction between individuals. According to Law Number 20 of 2003 Article 1 concerning the National Education System, education is a conscious and planned effort to create a learning atmosphere and learning process in which students actively develop their potential to possess spiritual-religious strength, self-control, personality, intelligence, noble character, and skills needed by themselves, society, the nation, and the state. Education is a continuous process that begins at birth. Throughout the developmental process, individuals require education, which facilitates their progress by providing an environment that supports human growth. The fundamental aim of education is to create a secure environment for children's growth, enabling them to develop their potential optimally. Education is often characterized as an individual's effort to develop themselves in accordance with societal ideals and culture. It serves as the foundation of life that must be built optimally. Education is a controlled effort to foster a learning environment that allows students to improve their talents in religious life, self-discipline, character development, intellectual growth, moral integrity, and personal skills.

Learning is a process of modifying student behavior, influenced by internal and external variables. In educational processes, there is an interaction between educators and learners. Learning is an adaptive, gradual process of behavior adjustment. It occurs when experiences cause changes in individuals that influence their behavior. New behavior modifications resulting from learning occur consciously, consistently, and functionally; they are affirmative, proactive, continuous, intentional, and encompass all behavior dimensions. Students involved in learning activities are psychologically influenced by elements such as motivation, focus, response, organization, understanding, and repetition. Special learning media are needed to attract students' interest in learning and to foster their creative thinking skills. Learning is a process by which students acquire methodically organized information using educational resources. Every educational procedure is expected to produce satisfactory learning outcomes. The evaluation of learning outcomes is based on the Minimum Completeness Criteria (KKM), which serves as a benchmark for the effectiveness of educational processes. Learning is described as an educational interaction process that actively involves students and allows them to modify their behavior through experiential learning. It is a communicative exchange between students and educators, wherein information is transmitted, including thoughts, ideas, intentions, sentiments, or emotions. Effective learning creates an environment that allows children to engage actively and explore their curiosity through their talents, which requires adequate supervision and professional expertise from educators. Learning activities are driven by intentional educational contact and occur progressively through several phases characterized by specific attributes.

Achieving learning objectives in educational activities requires the use of learning tools or media. The term media refers to anything that functions as a channel or intermediary for conveying messages from the sender to the receiver. Gagne (1970) emphasized that media include various people, materials, and equipment within the learning environment that can assist learners. Briggs (1970:1) asserted that media are tangible tools capable of delivering lessons and encouraging students to engage in the learning process. Examples of media in education include books, films, cassettes, and other formats. Today, educational media play a vital role in the success of classroom teaching and learning processes. Educational media facilitate the transmission of instructional content from teachers to students. Students

improve their ability to comprehend instructional content delivered. A major challenge for educators is to deliver high-quality instruction, which has led to several initiatives to enhance this process. One such initiative is the improvement of learning media usage. Learning media serve as supporting tools that facilitate teaching and learning activities, enabling educational objectives to be achieved effectively and efficiently. These media function as channels and repositories of knowledge from educators to learners, fostering motivation and encouraging comprehensive and meaningful student engagement. The use of learning media enhances the teaching and learning process, allowing students to assimilate information, develop creativity, and cultivate their potential. A supportive learning environment fosters student interest in education by providing incentives and opportunities to explore and evaluate their learning experiences. Students' enthusiasm for learning serves as a driving force in their educational pursuits. Learners with high learning interest and self-discipline tend to focus their attention on lessons, enabling them to concentrate effectively. Various factors influence learning interest and discipline, including the use of engaging educational media.

Based on a brief discussion with the homeroom teacher of Grade VI at SD Perjuangan Terpadu, it was revealed that the use of educational media in the classroom has been widely adopted. However, the most frequently used media are printed books, along with occasional PowerPoint presentations. Teachers at SD Perjuangan Terpadu have not yet utilized interactive online media. This is due to limitations in accessing or operating interactive digital media among educators. A lack of knowledge about creating or developing interactive digital media restricts the availability of educational resources for teachers. Additionally, a simple interview conducted with students regarding their classroom learning outcomes indicated that many sixth-grade students at SD Perjuangan Terpadu expressed greater enthusiasm for participating in the learning process when teachers employed engaging learning media. Students were more attentive and better understood the material when the learning media provided were suitable for the subject matter. This factor contributes to student learning outcomes. Students with high learning motivation for a particular subject tend to achieve better outcomes, while those with low motivation tend to have poorer results. Therefore, the use of learning media also becomes a determinant of students' learning outcomes.

Data show that the use of interactive web-based media in Grade VI at SD Perjuangan Terpadu is still lacking, despite its significant potential to support the learning process and serve as an effective means of delivering materials, thereby enhancing the learning experience. Interactive web-based learning media significantly assist educators in delivering instructional materials to students. Attractive educational resources are crucial for teachers in the learning process. The use of educational media is essential as it can reduce learning time, making it easier for students to understand new and unfamiliar concepts. This research was inspired by a study by Ningsih, Murtadol, and Farisi (2023) titled *"The Development of Web-Based Learning Media Using Google Sites to Improve Elementary Students' Learning Outcomes"*. The study revealed that the development of web-based media using Google Sites for the topic *"The Beauty of Cultural Diversity in My Country"* successfully passed all phases of the ADDIE model. The validity of the media was confirmed by expert validation, with percentages of 93% from media experts, 93.3% from content experts, 92.8% from language experts, and 91.6% from instructional design experts, all categorized as highly valid. The practicality of the media was assessed through questionnaires distributed to students, resulting in a 93.96% rating, indicating that the media was highly practical. The media's

effectiveness was measured by analyzing pretest and posttest scores using an N-Gain test, yielding an 81.13% score for the experimental group, categorized as effective.

Munir defines interactive media as media designed with effective displays for conveying information or messages to students while providing interaction for users. As a result, users have autonomy in navigating the progress of the interactive multimedia. Interaction is characterized by reciprocal communication involving actions and responses, activities, relationships, and mutual connections between entities. Interactive media integrate several components, including text, graphics, images, photos, audio, video, and animations, into a cohesive unit. Through interactive multimedia learning, educators can innovate educational experiences, making the learning process more engaging and dynamic. Thus, interactive media are media equipped with control mechanisms that allow users to manage the multimedia experience independently, designed to effectively convey information or messages to students. Responding to this urgency, the researcher intends to create a learning media titled "Interactive Web". This media serves as a solution to improve student learning outcomes. It is designed to simplify the delivery of instructional material by educators, enabling students to achieve predetermined learning objectives.

Web-based media serve as effective alternatives to traditional learning media in the contemporary digital era. Google Sites is a web platform suitable for this purpose. Google Sites is an online application introduced by Google in 2008, designed to simplify the creation of websites for classes, schools, or projects, as easily as editing documents. It aims to enhance visual appeal and boost students' enthusiasm for learning. Google Sites was selected for the creation of this web-based interactive learning resource for several reasons. Its use provides easy access to content. Ferismayanti, as cited in Maskar et al. (2021), identified several ideal advantages of using Google Sites: (1) posting educational resources, (2) archiving syllabi, (3) assigning tasks, (4) disseminating announcements, and (5) downloading and reviewing student submissions.

The use of technology-based educational materials aligns with Islamic principles. The application of technology in communication, particularly in education, is referenced in Surah An-Naml (27): 29–30:

قَالَتْ يَا أَيُّهَا الْمَلَأُ إِنِّي أُلْقِيَ إِلَيَّ كِتَابٌ كَرِيمٌ
إِنَّهُ مِنْ سُلَيْمَانَ وَإِنَّهُ بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

Which recounts the story of Prophet Solomon (Sulaiman) and the Queen of Sheba (Balqis), where advanced communication technology of the time was demonstrated through the delivery of written messages via the Hoopoe bird (Hud-hud).

Additionally, Surah An-Naml (27): 44

قِيلَ لَهَا ادْخُلِي الصَّرْحَ فَلَمَّا رَأَتْهُ حَسِبَتْهُ لُجَّةً وَكَشَفَتْ عَنْ سَاقِهَا قَالَتْ إِنَّهُ صَرْحٌ مُّمَرَّدٌ مِنْ قَوَارِيرَ قَالَتْ رَبِّ إِنِّي ظَلَمْتُ نَفْسِي وَأَسْلَمْتُ مَعَ سُلَيْمَانَ لِلَّهِ رَبِّ الْعَالَمِينَ

Narrates the advanced technology of Solomon's palace, which created a comfortable, modern environment. This historical example relates to learning as a form of communication in education. Prophet Solomon's use of the Hoopoe bird to deliver messages exemplifies effective communication technology of the era, enhancing the efficiency and effectiveness of message delivery. The availability of advanced technology and adequate infrastructure created a conducive and supportive environment. Accordingly, in the educational process, it

is essential to use media that enhance communication and facilities that ensure student comfort, thereby maximizing the achievement of learning objectives. The application of technology in contemporary education undoubtedly manifests in various sophisticated forms, with significant potential for future development. Based on a preliminary study, it was found that in Grade VI at SD Perjuangan Terpadu, many students still struggled to understand the material on Space and the Solar System due to the limited use of instructional media by teachers. In response to the problems identified in Grade VI, the researcher developed an interactive web-based innovation to make it easier for students to comprehend the subject matter on Space and the Solar System.

REVIEW OF LITERATURE

Learning Media

The learning process is an effort made by students to achieve the expected educational goals. Communication between students and teachers occurs during the learning process, and to improve this communication, instructional media play an essential role in facilitating effective interaction. The term "media" originates from Latin, meaning intermediary or channel, as explained by Sadirman in Hasan et al. (2021). In the context of pedagogy, media serve as channels for delivering information from educators to students to achieve educational objectives efficiently (Naz & Akbar in Hasan et al., 2021). Rohani (2020) also emphasizes that media act as a mechanism for conveying messages in educational activities, including instructional elements that ease student comprehension. An effective, engaging, enjoyable, and meaningful learning experience for students can be shaped through various elements, including the accessibility of interesting and enjoyable educational materials. One of these resources is the use of instructional media. Briggs (in Ekayani, 2017) defines educational media as tangible means for conveying learning content, such as books, films, and videos. Additionally, Jennah (2009) states that learning media encompass all tools used to convey messages (educational materials) that attract students' attention, interest, cognition, and emotions during learning activities to achieve educational goals. In conclusion, learning media are tangible tools used by educators to provide educational content, facilitating the achievement of predetermined learning objectives and covering various formats like books, films, videos, and similar resources.

The Function of Learning Media

In the educational process, two critical components are teaching methods and instructional media, which are undoubtedly interconnected. The choice of a particular teaching method will influence the type of learning materials used in the educational process. According to Darwyn Syah et al. (in Sari et al., 2019), the functions of learning media include acting as teaching aids, learning resources, attracting students' attention, accelerating the teaching-learning process, and improving learning quality. From a psychological perspective, learning media can facilitate the psychological development of elementary students by making abstract concepts more concrete. Sudarsono and Evelin (in Sari et al., 2019) also highlight the functions of learning media, such as providing knowledge about learning objectives, motivating learners, delivering information, stimulating discussions, guiding student activities, conducting exercises and evaluations, reinforcing learning, and offering simulated experiences. Furthermore, Wina Sanjaya (in Aghni, 2018) elaborates on several functions related to different types of instructional media. These include communicative

functions to enhance communication between message senders and receivers, motivational functions to boost students' enthusiasm for their studies, and significant functions to ensure that education goes beyond disseminating facts to developing both lower and higher-order cognitive skills. Other functions include perception equalization to standardize student understanding of presented information and individualization functions that cater to diverse learning interests and styles. In essence, learning media play a vital role in evaluating the effectiveness and efficiency of achieving educational objectives by delivering instructional information either individually or in groups.

RESEARCH METHOD

This research employed a Research and Development (R&D) method. According to Sugiyono as cited in Prayudi and Anggriani (2022), R&D is a research method used to produce specific products and test their effectiveness. The development model applied in this study is the ADDIE model, which consists of five phases: Analysis, Design, Development, Implementation, and Evaluation. The focus of this research was the development of interactive web-based learning media. The product generated is an interactive website-based learning medium for sixth-grade elementary school students, packaged as a Google Sites web page that can be accessed online anytime and anywhere via electronic devices such as smartphones, tablets, computers, and laptops. Data collection techniques in this study included observation, questionnaires, and expert validation. Preliminary observations were conducted at SD Perjuangan Terpadu to identify existing problems in the learning process, particularly the lack of interactive media used by teachers. Questionnaires were distributed to gather responses from students and teachers regarding the practicality and effectiveness of the developed web-based learning media. Additionally, expert validation was carried out involving language experts, material experts, and instructional design experts to assess the validity of the media before it was implemented in the learning process.

The sources of data in this study consisted of primary and secondary data. Primary data were obtained directly through observations, questionnaires filled out by 20 sixth-grade students, and assessments from the experts. The types of data collected included qualitative data, such as descriptions from observations and expert suggestions, and quantitative data derived from questionnaire responses and pretest-posttest results. Data analysis techniques used descriptive qualitative analysis for the observational and validation results, while quantitative data were analyzed using paired t-tests to measure the difference in students' learning outcomes before and after the implementation of the interactive web-based learning media. The N-Gain formula was also employed to determine the level of improvement in students' learning outcomes.

RESULTS AND DISCUSSION

Description of Development Results

This research and development study of teaching materials adopted the ADDIE development model. The researcher chose the ADDIE model because it offers a systematic and structured framework for instructional product development. The development process followed five stages: (A) Analysis, (D) Design, (D) Development, (I) Implementation, and (E) Evaluation. Throughout these phases, the study involved three expert validators: a language expert, Dr. Ahmad Fadly, M.Hum; a subject matter expert, Apri Utami Parta Santi,

M.Si; and a media expert, Dr. Muhammad Sofian Hadi, M.Pd. The product trial phase was conducted in three stages: one-to-one trying out, small group tryout, and field tryout. These trials were carried out at SD Perjuangan Terpadu, Sawangan, Depok, with Grade VI students as participants. The small group tryout involved six students, while the field tryout involved 20 students. The following is a description of each development stage of the interactive web-based learning media using the ADDIE model.

The Analysis stage consisted of two main activities: a Needs Assessment and a Front-End Analysis. The Needs Assessment was conducted through classroom observations involving teachers and students at SD Perjuangan Terpadu to identify existing issues in the learning process, particularly within Grade VI classrooms. The observations revealed several challenges, including the limited development of instructional media by teachers, the use of technology-based media that was largely impractical and lacked interactivity, restricted access to learning resources for students, low student reading interest, and the suboptimal use of available facilities such as computers and internet networks for collaborative learning. As a result of these findings, the researcher determined the need to develop an interactive web-based learning medium as an instructional tool for Grade VI students at SD Perjuangan Terpadu. The subsequent Front-End Analysis involved gathering references, including learning objectives, instructional materials, and relevant textbooks necessary for developing the learning media. Based on this analysis, the chosen topic for media development was "Outer Space and the Solar System" for the IPAS subject. In the Design stage, the development process focused on designing the interactive learning media, which involved formulating instructional objectives tailored to students' needs, creating a flowchart to outline the instructional media's navigation, developing a storyboard as an initial concept draft, gathering visual and multimedia components aligned with the learning content, and preparing evaluation instruments to assess the media's feasibility as a learning resource. At this stage, a conceptual design and content plan for the interactive web-based learning media were drafted using Google Sites. The preliminary product design included several menu components such as the homepage, teaching module menu, learning material menu, video learning menu, educational games menu, practical learning menu, assessment menu, and glossary menu.

As part of the design process, the researcher formulated specific instructional objectives for the interactive learning media based on the ABCD model (Audience, Behavior, Condition, Degree). This approach required defining: (1) the target audience, focusing on what students should accomplish; (2) measurable behaviors or competencies students should demonstrate following instruction; (3) the conditions under which learning outcomes would be assessed; and (4) the degree or standard for measuring the success of learning outcomes. The instructional objectives formulated for the development of this interactive web-based learning media included: (1) enabling students to accurately explain celestial objects and the sun; (2) enabling students to simulate planetary movements using simple media correctly; (3) enabling students to describe the characteristics of solar system members correctly; and (4) enabling students to construct a well-ordered, simple model of the solar system.

Flowchart

A flowchart is a type of diagram used to visually represent the sequence of processes within the interactive learning media. It serves to illustrate the structure and navigation pathways between the various menus and features available in the media. The flowchart

outlines how users, in this case students, can access different sections of the interactive media, starting from the homepage to other menus such as the teaching modules, learning materials, learning videos, learning games, practical activities, assessments, and glossary. The flowchart of the interactive learning media developed in this study is presented in Figure 1. It shows a systematic sequence of user interactions, beginning with the homepage as the starting point, followed by the selection of instructional menus based on students' learning needs. Each menu is interconnected, allowing users to navigate easily and return to the homepage when necessary. The design of this flowchart ensures clarity, user-friendly navigation, and an efficient learning experience through well-organized interactive content.

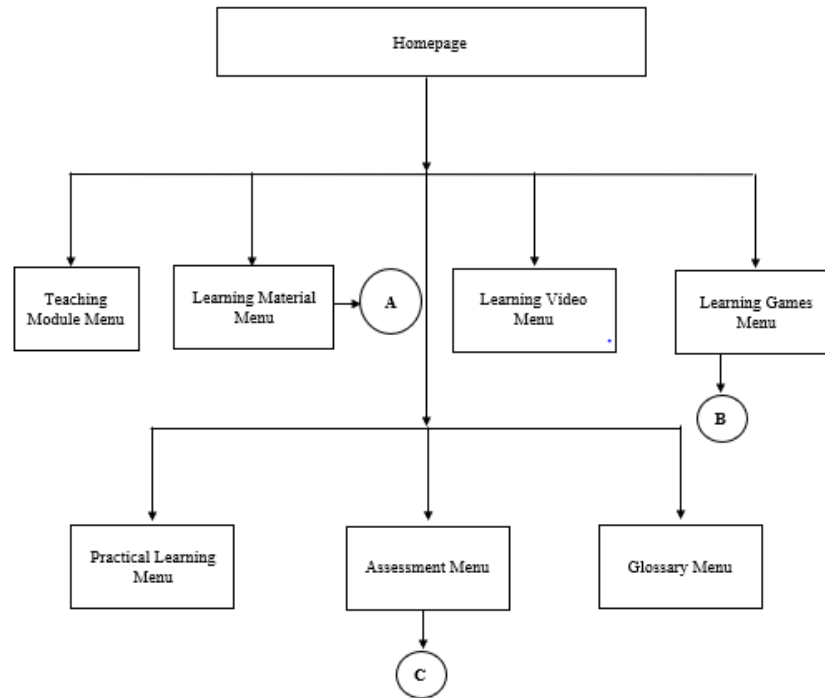


Figure 1.
Flowchart Interaktif Web

Description:

A = Material about celestial objects in the solar system (the sun, planets, asteroids, meteoroids, comets, and satellites).






B = Educational games using the Wordwall website.




C = Assessment activities using the Quizziz website.

The flow of the learning media in Figure 4.1 begins with the homepage. On the homepage, there are seven menus: Teaching Modules, Learning Materials, Learning Videos, Learning Games, Practical Activities, Learning Assessments, and Glossary. Each menu serves a specific function. The Teaching Modules menu provides instructional modules that teachers can use as teaching aids. The Learning Materials menu contains subject matter related to outer space and the solar system. The Learning Videos menu features videos discussing various topics about space and the solar system. The Learning Games menu includes engaging educational games with questions about space and the solar system. The

Practical Activities menu offers exercises that students can perform independently. The Learning Assessments menu contains practice questions that students can work on for self-evaluation. Finally, the Glossary menu provides an alphabetically organized list of important terms and definitions related to the subject matter.

Table 1.
Storyboard Web

No	Picture	Description	Content
1.		Main Menu Display	Learning Menu: <ul style="list-style-type: none"> - Teaching Module - Learning Materials - Learning Videos - Learning Games - Practical Activities - Learning Assessments - Glossary
2.		Teaching Module Menu Display	Contains teaching modules that can be used by teachers.
3.		Learning Materials Menu Display	Contains learning materials about outer space and the solar system.
4.		Learning Video Menu Display	Contains learning videos related to outer space and the solar system.
5.		Learning Games Menu Display	Contains practice exercises in the form of games using the Wordwall website.

6.		Learning Practice Menu Display	Contains procedures or practical activities that students can perform related to the topics of outer space and the solar system
7.		Assessment Menu Display	Contains assessment questions about outer space and the solar system using the Quizziz website.
8.		Glossary Menu Display	Contains a collection of important terms arranged alphabetically, providing definitions of specific fields of knowledge.

Implementation

At the implementation stage, the interactive web-based learning media on space and the solar system was tested on Grade VI students at SD Perjuangan Terpadu on February 19, 2025. The activity began with a pre-test, followed by a demonstration of the media, and concluded with a post-test and a questionnaire for students to assess their responses to the learning media. The evaluation process was then carried out by analyzing data collected from both teachers and students. Validation results from language, material, and media experts showed validity percentages of 94%, 86%, and 92%, respectively all categorized as “very valid” and only requiring minor revisions. In terms of practicality, the media was evaluated by both teachers and students using questionnaires. The practicality score from the teacher reached 100%, while small group trials with students resulted in a score of 94%, and field trials achieved 97%, all categorized as “very practical.” An instrument test was also conducted on 25 multiple-choice items, resulting in 15 valid and 10 invalid items. Reliability testing showed a Cronbach’s Alpha value of 0.903, indicating high reliability. The difficulty index analysis revealed a proportional distribution: 4 easy, 17 moderate, and 4 difficult questions.

Furthermore, a normality test using the Shapiro-Wilk method obtained a Sig value of $0.114 > 0.05$, indicating a normal data distribution. A homogeneity test resulted in a Sig value of $0.087 > 0.05$, showing the data was homogeneous. The paired sample t-test produced a Sig (2-tailed) value of $0.000 < 0.05$, indicating a significant difference between the pre-test and post-test results. The N-Gain score analysis showed an average improvement of 0.79, categorized as high, proving that the use of the interactive web-based learning media was effective in improving students’ learning outcomes.

CONCLUSION

This research produced an Interactive Web-Based Learning Media on Space and the Solar System for Grade 6 Elementary School Science (IPAS) developed using the ADDIE model. The stages involved analysis of teachers' and students' needs through observation, designing learning objectives and interactive media concepts, developing a Google Sites-based web by assembling materials, images, videos, and assessments, implementing the media to students with pre-test and post-test, and finally evaluating the feasibility through data analysis of trials and questionnaires. The assessment results showed that the interactive web was considered feasible and effective for classroom use. Product feasibility was confirmed by validation from language experts at 94%, material experts at 86%, and media experts at 92%. In terms of practicality, it obtained very good responses from teachers (100%), small group participants (94%), and field trials (97%). This indicates that the media is easy to use, engaging, and meets the students' learning needs.

Regarding effectiveness, the paired sample t-test results showed a significant difference between pre-test and post-test scores, with a Sig (2-tailed) value of $0.000 < 0.05$. The increase in students' learning outcomes was measured using the N-Gain score, which reached 0.79, categorized as high. Therefore, this interactive web-based learning media proved to be effective in improving students' mastery of topics related to space and the solar system.

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