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Development of Student Worksheet Assisted by Stellarium Website Through Design-Thinking Framework

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Abstract

The purpose of this study is to develop a student worksheet assisted by Stellarium website through a design-thinking framework on the topic of the solar system which is stated to be theoretically feasible based on_validation results by the experts. The development of this student worksheet was carried out because students in seventh grade at one of the State Middle Schools in Bandung experienced obstacles in completing the student worksheet due to lack of time and feel less understanding of the material contained in the student worksheet. This study uses the Design & Development Research with a design-thinking framework consisting of 5 principles, namely empathize, define, ideate, prototype, and test. The initial stage was conducting interviews with 15 students, identifying problems in seventh grade, then making a prototype in the form of student worksheet and validated by experts. Findings indicate that the average overall percentage of validation is 91.9% which means that the student worksheet is included in the very good category, This data also shows that the student worksheet is worthy of being tested in schools with improvements according to the suggestions and input given. However, this student worksheet has not been tested yet, due to limited time, so a trial process needs to be conducted in improving conceptual understanding, increasing interest in learning and developing 21st century skills.

Keywords: design thinking, solar system, stellarium, student, worksheet

INTRODUCTION

Learning objectives involve the development of aspects of attitudes, knowledge, and skills that are developed specifically for each educational unit (Sudana, 2018; Ansyah et al., 2021). Each of these competency domains experiences different acquisitions in its psychological process. Differences in competency characteristics and acquisition also have impacts on the characteristics of process standards.

These characteristics must be possessed by every teacher and student. Students' characteristics and needs include various aspects that are important for teachers to understand. Among them are age factors, physical, cognitive and social development. Moreover, most of the students in the learning process sometimes feel less understanding of the topic being taught, because it is not in accordance with the method or model used. Therefore, students have difficulty in completing the tasks given, one of which is in completing student worksheet.

Student worksheet is a sheet that is combined into one book that contains

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instructions for completing assignments that must be completed by students in learning with reference to learning achievements (Amawa et al., 2019; Vonna et al., 2022). The use of student worksheet is very important, especially in subjects that require experimental or practical activities, such as science subjects (Aini et al., 2019; Tanjung et al., 2024; Malinda & Nisa, 2024). The purpose of compiling student worksheet is to facilitate and assist teachers in the learning process. Therefore, there is active interaction and communication between learners and teachers. In addition to realizing learning activities, learners are able to improve learning achievement. Furthermore, good learning is when teachers are able to create innovative learning so that students do not get bored easily in participating in learning activities (Istiqomah, 2021; Distrik et al., 2024). Fun learning can also be done through investigations or observations. In observation activities, it can be done directly or virtually, one of which is using the Stellarium-website to study the solar system material.

Website-based learning is advantageous since it can provide attractive learning activities and enable students to learn independently. In addition, website-based learning also can engage students to be more responsible in the learning process since they can learn anytime and anywhere without any limit. Utilization of this website-based learning can make the learning process more effective and optimal (Buluş Kırıkkaya & Yıldırım, 2021; Ikhsan et al., 2024; Demirezer et al., 2024).

Stellarium is a software that allows users to create virtual planetariums that can be used as an educational tool to teach about calculation of the position of the Sun, moon, planets, and stars, as well as visualization of the sky according to location and time. This website can also display constellations and simulations of astronomical phenomena such as meteor showers, solar eclipses, and lunar eclipses (Setiawan and Putranaga, 2020). However, the design thinking approach as one of effective learning methods should be implemented to engage students in learning science through the Stellarium-website.

Design thinking is a constructivist learning method that strengthens core skills, such as exploration, creativity, and openness to new ideas (Ladachart et al., 2022). In this context, this approach is directed at developing 21st century skills by encouraging student exploration, building trust between students and teachers, and strengthening collaborative abilities in teams. In addition, this formal process helps teachers direct constructive learning. Design thinking realizes what is theoretically recommended in constructivism theory. Especially experiential learning and complex problem solving among other aspects that are fulfilled in design thinking and can be used in all age groups (Scheer et al, 2012).

In education, design thinking is defined as a learning orientation that includes active problem solving and directing student's ability to create impactful change. It is built on the development of a resilient and highly optimistic creative self-confidence.

Educators who have implemented design thinking in education argue that design thinking encourages innovation, problem solving, creativity, and collaboration (Lor, 2017). This design thinking approach is expected to provide an alternative color in a solution-based science learning system, provide a description of how to implement design thinking appropriately in science learning and provide a description of success through measuring students' self-performance in science learning (Suprobo, 2012).

The failure of students can be seen from the completion of student worksheet. Obstacles in completing student worksheet are caused by different levels of understanding and learning speed of each student. Another influencing factor is the lack of understanding of instructions or materials, which can hinder students' ability to complete tasks effectively. In addition, time constraints or lack of motivation can be obstacles for students in completing student worksheet properly. In particular, the problem in the topic of the solar system is that the technology-based learning media used is still limited. Therefore, it is necessary to develop interesting student worksheet so that students can learn effectively, such as developing student worksheet with the help of the Stellarium web through a design thinking framework.

Based on the problems above, the aim of this research is to develop student worksheet assisted by the Stellarium website through the framework of design-thinking on the topic of the solar system.

METHOD

This study is included in the Design & Development Research with a design-thinking framework, conducted from April to May 2024 at one of the State Junior High Schools in Bandung City. The procedure for developing student worksheet assisted by the Stellarium website with a design-thinking framework includes five principles, namely empathize, define, ideate, prototype, and test (Sari et al., 2020). Preliminary research was conducted by means of a field survey in the 2nd week of April using interview techniques. Interviews were conducted with 15 grade VII students, 9 boys and 6 girls related to science learning in class. The selection of students to be interviewed was carried out randomly, both from students who were active in class to students who were less active in class.

Initial product development planning for student worksheet assisted by the Stellarium websitey through a design-thinking framework, namely the creation of initial product specifications, student worksheet developed using the steps of the science process activities guided by the Discovery Learning learning syntax. The validation results by expert validators, science teachers, and colleagues are used as a basis for revising the initial product. After being declared theoretically feasible based on validation results by experts, then a trial can be carried out.

The data collection technique in this study was the assessment of the feasibility of the developed student worksheet. The assessment of the feasibility of

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the student worksheet assisted by the Stellarium website through the design-thinking framework was carried out by 1 lecturer who had 8 years of teaching experience, 3 science teachers, and 1 colleague. The assessment aspects of the student worksheet developed included the completeness of the student worksheet components, the suitability of the content and material, the suitability of the language, the suitability of the construction requirements, and the suitability of the technical requirements. The assessment score consists of 5 categories of assessment scales, namely very poor (score 1), poor (score 2), quite good (score 3), good (score 4), and very good (score 5).

The instrument used to collect data is the student worksheet validation sheet. The student worksheet validation sheet instrument is used to obtain data on assessments, comments, and suggestions from expert validators, science teachers, and colleagues. In addition, data analysis techniques for the feasibility of student worksheet are carried out by tabulating all data obtained from validators, namely lecturers, science teachers, and colleagues for each aspect of the assessment items available in the assessment instrument. The following is table 1 of the validation test result criteria:

Table 1. Validation Test Result Criteria

Mark (%)	Category
80 < x ≤ 100	Very good
60 < x ≤ 80	Good
40 < x ≤ 60	Moderate
20 < x ≤ 40	Bad
0 x ≤ 20	Very bad

RESULT AND DISCUSSION

The development of student worksheet assisted by the Stellarium website through the design-thinking framework includes the preliminary research, planning, and initial product development stages.

Preliminary Research

At this stage, preliminary research is carried out in two ways, namely field surveys and literature studies. Based on the results of interviews with 15 grade VII junior high school students in Bandung city, they stated that they experienced obstacles in completing student worksheet, this was due to the different levels of understanding and learning speed of each student. Another factor that influences is the lack of understanding of instructions or materials, which can hinder students' ability to complete tasks effectively.

Time constraints or lack of motivation can be obstacles for students in completing student worksheet properly. According to Royan and Supriatna (2024), one of the factors causing learning failure is the incompatibility of student worksheet, so that they have difficulty understanding concepts in the solar system, such as orbit, rotation, and revolution, which are difficult for students to visualize and understand concretely. In addition, Solar system topics are often considered boring and difficult for students to understand because they are complex.

Planning

Based on the results of preliminary research, the initial product specifications developed in this study are student

worksheet. The characteristics of the student worksheet developed are: (a) student worksheet has stages of Discovery Learning (stimulus, problem identification, data collection, data processing, proof and conclusion); (b) student worksheet presents a series of virtual observation activities assisted by the Stellarium website regarding planets in the Solar System; and (c) The questions presented are related to the results of virtual observations.

Initial Product Development

This initial product development stage includes the preparation of a draft of the developed student worksheet; validation; and the results of the revised student worksheet. The following is Figure 1 of the initial LKPD that was developed.

The development of the student worksheet was then validated by lecturers (D), science teachers (G), and colleagues (TS). The results of the assessment from the validator lecturers, science teachers, and colleagues in the form of scores which were then converted into a scale assessment of 5 (five) can be seen in table 2.

Table 2. Validation Test Result Criteria

Expert Validation	Score	Percentage	Category
Expert I (Science Teacher)	92	87.6%	Very good
Expert II (Science Teacher)	105	100%	Very good
Expert III (Science Teacher)	90	85.7%	Very good
Expert IV (Lecturer)	104	99%	Very good
Expert V (Peers)	92	87.6%	Very good
Average	96.6	91.9%	Very good

Based on the table above related to the assessment of student worksheet, it shows an average percentage of 91.9%, including the very good category. This

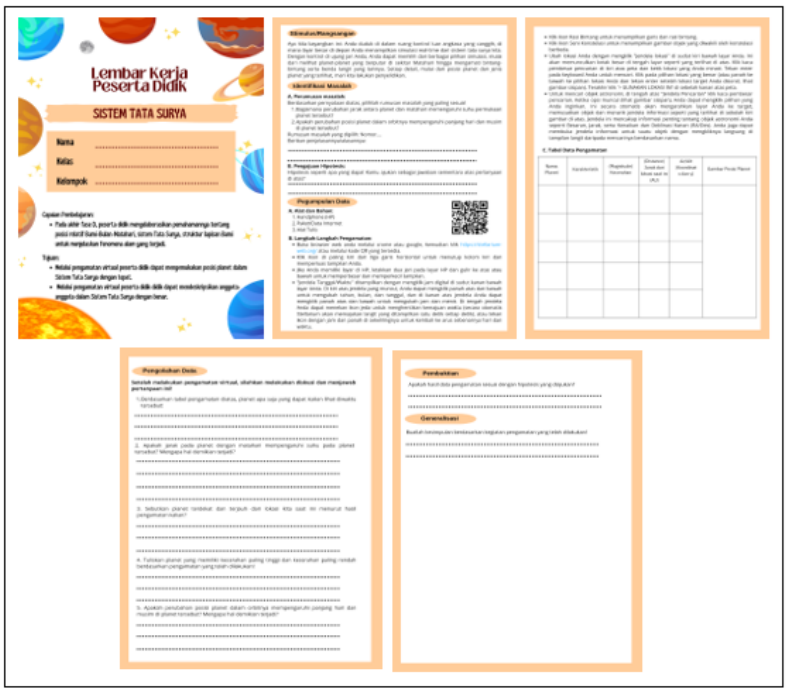

Figure 1. Initial Product of Student Worksheet

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shows that the student worksheet that was developed is worthy of being tested in schools with improvements according to the suggestions and input given. However, this student worksheet has not been carried out until the trial, due to limited time. According to Arianti (2018) who stated that student worksheet is said to be valid if the three development requirements obtain a validity score of ≥ 75% with a valid category.

Product Revision

The student worksheet assisted by the Stellarium website through the design-thinking framework developed in this study should be revised after being assessed by validators, namely lecturers, science teachers, and colleagues. At this stage, the initial product draft was revised based on the results of the assessment, suggestions, and input from validators from lecturers, science teachers, and colleagues, as well as input from the supervising lecturer. Improvements to the initial product draft include: (1) Adjusted to the characteristics of students; (2) improvements to simpler sentences in the observation step; (3) punctuation in the observation step was re-examined; (4) adding a hypothesis guide related to the explanation that there are independent variables, dependent variables and controls in it; and (5) questions in the student worksheet are better off using interrogative sentences.

According to Hasanah (2016), the validity of technical requirements with valid categories will produce student worksheet with good layout, have a clear display of font type and size, and attractive images, so that it can increase students' learning motivation. This is supported by Rahmi (2018); Khairunnisa et al. (2022); Wijayadi et al. (2023); who stated that the appearance of images in student worksheet can have a high influence on students' interest in learning.

CONCLUSION

This study aims to develop student worksheet assisted by the Stellarium website through the framework of design-thinking on the topic of the solar system Findings of the research indicate that the validation of the student worksheet reachs the overall percentage of 91.9% which means it is included in the "very good" category, showing that the student worksheet that has been developed is worthy of being tested in schools with improvements according to the suggestions and input given. However, this student worksheet has not been carried out until the trial, due to limited time, so it is necessary to conduct a trial process to measure the improvement of students' conceptual understanding, increase of interest in learning and development of 21st century skills.

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