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Development of the RAKHMATTRIX Gamification Platform Based on the Mystery Object Challenge

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ABSTRACT

This study aimed to develop RAKHMATTRIX gamification media based on Mystery Object Challenge in Computer Aided Design (CAD) learning using the ADDIE development model. The research was conducted at SMK Muhammadiyah 1 Kepanjen for tenth-grade students in CAD learning. The developed media combines gamification elements, mystery box challenges, and blind design challenge activities to encourage students' spatial visualization and creativity in creating 2D and 3D designs using Autodesk Inventor. The research stages consisted of analysis, design, development, implementation and evaluation. Data collection techniques included expert validation and students response questionnaires. Media validation was carried out by media experts and material experts to determine the RAKHMATTRIX gamification media obtained a very feasible category based on expert validation results. In addition, students responses indicated that the developed media was able to create a more interactive, interesting, and student-centered learning environment in CAD learning. Therefore, the RAKHMATTRIX gamification media is feasible to be used as a learning medium in CAD subjects.

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1. INTRODUCTION

Technological advancements in the fields of design and manufacturing require the vocational education sector to produce graduates with competencies that meet industry needs, particularly in the mastery of Computer-Aided Design (CAD) software [1], [2] . CAD instruction does not focus solely on technical skills in operating design software; it also

requires students' spatial visualization skills, creativity, and imagination in developing design objects from 2D to 3D forms. Visualization skills are a crucial aspect of CAD instruction because they influence students' ability to understand the shape, size, and interpretation of objects. Therefore, instruction is needed that can enhance students' active engagement in visual and creative thinking processes [3].

Based on observations of 10th-grade students taking the CAD course at SMK Muhammadiyah 1 Kepanjen, several issues were identified in the learning process. Most students still struggle to design simple part, take a relatively long time to complete assignments, and lack the ability to develop designs creatively [4]. Several previous studies have shown that the use of gamification and challenge-based learning in the classroom can boost students motivation, creativity, and participation in the learning process [5] ,[6]. Therefore, the development of gamification-based learning materials can serve as a more interactive learning alternative for CAD courses.

Based on these issues, this study developed the RAKHMATTRIX gamification platform, based on the Mystery Object Challenge, for CAD instruction using Autodesk Inventor software [7] . The media was developed using the "blind design challenge" concept, in which students were asked to create object based on descriptions (Primary & Beautiful, 2022). In practice, the RAKHMATTRIX educational tools uses a "mystery box" system containing design challenges, game rules, and group discussion activities, making the learning process more active and engaging for students. The novelty of this research lies in the development of gamification-based educational tool centered on "Mystery Object Challenge" to help students independently develop their spatial visualization skills and creativity [9]. Therefore, this study aims to develop the RAKHMATTRIX gamification platform based on the Mystery Object Challenge using the ADDIE development model for CAD instruction in the 10th-grade class at SMK Muhammadiyah 1 Kepanjen.

2. RESEARCH METHOD

2.1. Research Design

This research uses the Research and Development (R&D) method with the ADDIE development model which consists of five stages, namely *Analysis*, *Design*, *Development*, *Implementation*, and *Evaluation*. The ADDIE model was chosen because it has systematic stages ranging from needs analysis to product evaluation, so that it is suitable for use in the development of learning media. Through this model, the media development process is carried out starting from needs analysis, media design, product development, implementation to students, to evaluation of the feasibility of the developed media [10],[11].

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2.2. Research Subjects

This research was carried out at SMK Muhammadiyah 1 Kepanjen in the subject of Computer Aided Design (CAD) class X. The research subjects consisted of 30 students of class X as respondents to the learning media trial. Before being implemented to students, the learning media is validated by one media expert and two material experts**.** The media expert is a lecturer in the S2 Mechanical Engineering Education Study Program, State University of Malang who has competence in the field of technology-based learning media development. Meanwhile, the material expert is a lecturer of the S2 Mechanical Engineering Education Study Program, State University of Malang and a teacher of *Computer Aided Design* (CAD) at SMK Muhammadiyah 1 Kepanjen who has more than five years of experience teaching CAD subjects. Validation is carried out to assess the feasibility of the media from the media aspect and the suitability of the learning material.

2.3. Research Instruments

The instruments used in this study consisted of media expert validation sheets, material expert validation sheets, and student response questionnaires. The media expert validation sheet is used to assess the quality of the learning media developed, while the material expert validation sheet is used to assess the suitability of the material with the learning outcomes of CAD subjects. Furthermore, the student response questionnaire was used to find out the students' responses after using the RAKHMATTRIX learning media. All instruments use a 5-level Likert scale**,** namely a score of 1 (very poor), a score of 2 (poor), a score of 3 (adequate), a score of 4 (good), and a score of 5 (very good).

Table 1. Research Instrument Grid

Instruments	Aspects Assessed	Indicator	Number of Items
Media expert validation sheet	Media display	Layout, color combinations, readability, image quality	3
	Ease of Use	Ease of navigation, instructions for use, interactivity	3
	Content eligibility	Suitability of the media with learning objectives and student characteristics	3
	Attraction	Attractive appearance, gamification elements, learning motivation	2
	Total		11
Media Expert Validation	2D Sketch	Suitability of sketch material with learning outcomes	4
	Part Modeling 3D	Accuracy of 3D modeling materials	4
	Drawing/IDW	Suitability of the working picture material	4
	Total		12
Student Response Questionnaire	Ketertarikan	Interest in media	5
	Learning Motivation	Enthusiasm for learning	5
	Ease of Use	Ease of Using Media	5
	Activeness	Activeness during learning	5

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Total	20

2.4. Data Analysis Techniques

The data obtained from the results of the validation of media experts, material experts, and student response questionnaires were analyzed using quantitative descriptive analysis techniques by calculating the percentage of the level of feasibility of learning media [12],[13]. The analysis was carried out to determine the level of media feasibility based on the scores given by the validators and students on each aspect assessed.

$$P = \frac{\sum X}{\sum X_i} \times 100\ \% \quad (1)$$

Description:
P = Eligibility Percentage (%) ∑ Xi = Maximum total score
∑ X = Total score obtained

2.5. Development procedure

1) **Phase of Analysis**: The analysis stage was carried out to identify the conditions of CAD learning at SMK Muhammadiyah 1 Kepanjen. Analysis is carried out through observation activities during the learning process. The results of the analysis showed that most students still had difficulty visualizing three-dimensional objects and still relied on video tutorials in completing drawing tasks using Autodesk Inventor. Therefore, based on the results of the needs analysis, learning media that is able to increase student involvement in the learning process is needed[11],[14].
2) **Design:** The design stage was carried out by designing a RAKHMATTRIX learning media concept based on the Mystery Object Challenge**.** At this stage, the game flow, game rules, media display, and challenges that will be used in the CAD learning process are prepared.

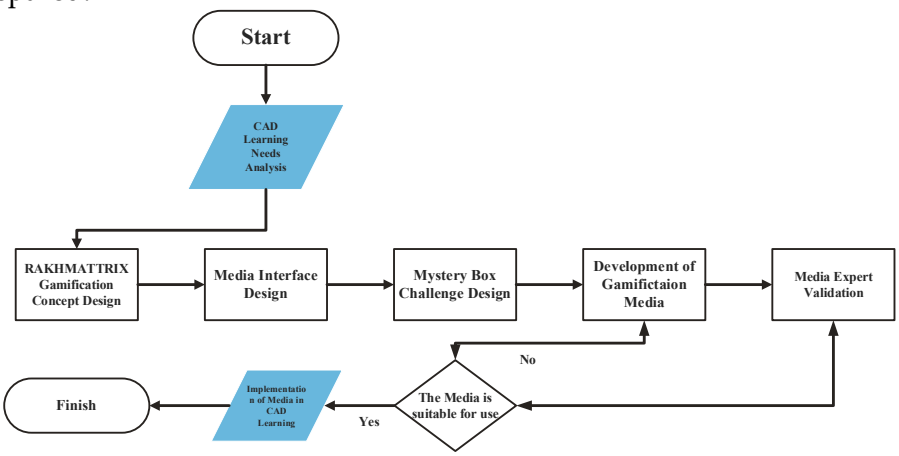


Figure 1. RAKHMATTRIX Learning Media Development Design Design

3) **Development Stage:** The development stage is carried out by making learning media according to the design that has been prepared. The media is then validated by media experts and material experts to determine the level of feasibility of the product before it is applied to students. Input and suggestions from validators are used as a basis for making improvements to learning media.
4) **Implementation Stage:** The implementation stage is carried out by applying RAKHMATTRIX learning media to class X students in CAD subjects. In its implementation, students use learning media based on Mystery Object Challenge to complete the challenge of drawing objects using Autodesk Inventor according to the predetermined game rules.
5) **Evaluation Stage:** The evaluation stage is carried out after the implementation process is completed. The evaluation aims to determine the level of media feasibility and obtain student responses to the use of learning media. Evaluation data was obtained through expert validation sheets and student response questionnaires which were then analyzed using percentage descriptive analysis techniques.

3. RESULTS AND DISCUSSION

3.1. Development of Learning Media

RAKHMATTRIX learning media is developed as a web-based application that can be run through a web *browser* on a computer or laptop without requiring additional installation processes. The system utilizes HTML technology as the page structure, CSS to set the interface display, and JavaScript to organize user interaction, mystery box selection, and dynamically display challenges using ADDIE's development mode. With this technology, teachers can operate media using computers connected to *smartboards* so that all students can participate in learning activities together.

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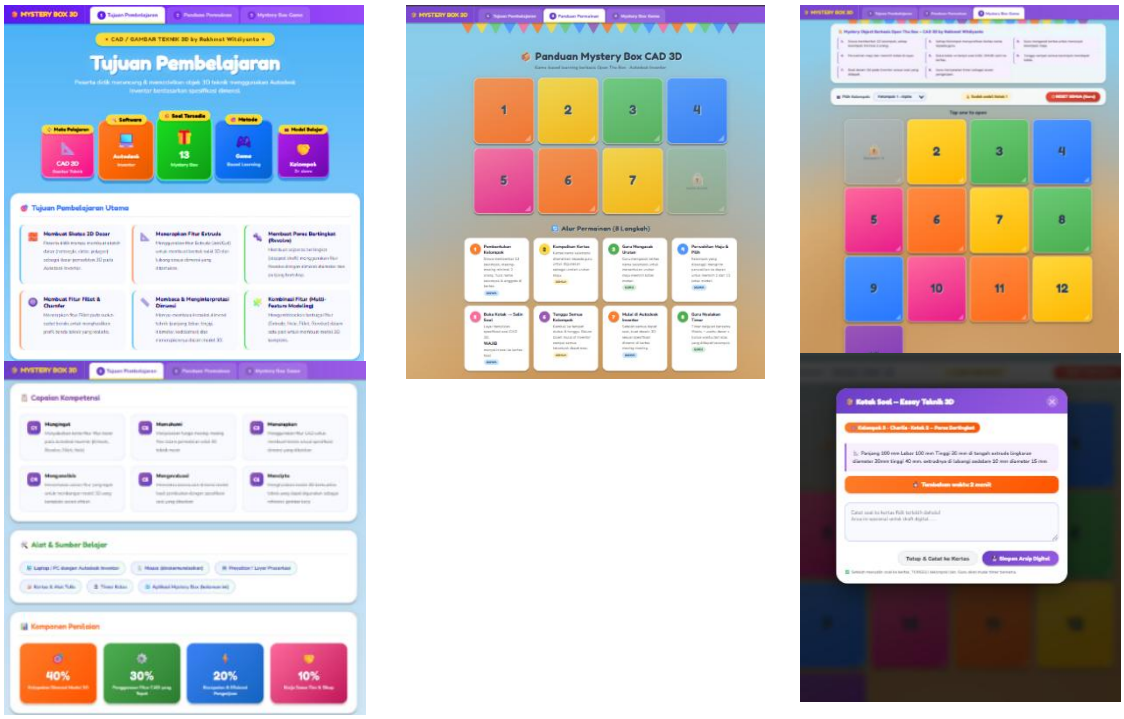


Figure 2. Visual Display of RAKHMATTRIX Learning Media Technology Website-based

Figure 2. shows the initial look, game instructions, and main interface of the Mystery Object Challenge on the RAKHMATTRIX gamification platform. The initial display contains information about learning objectives, competency achievements, materials, learning resources, and assessment components. Furthermore, the game's instructions explain the flow of the activity, while the main interface features 13 mystery boxes that contain the challenge of drawing 2D or 3D objects using Autodesk Inventor. Through this activity, students are invited to interpret object descriptions into 3D models in groups according to the specifications given. Student involvement during the CD learning process is supported by these activities.

RAKHMATTRIX learning media is developed using the HTML programming language and uses CSS for its web display so that it can be run through a web *browser* on a computer or laptop without the need for additional software installation. During the learning implementation, the application is displayed using a smartboard in the classroom so that all students can see the game interface together. The use of smartboards also facilitates interaction between teachers and students during the learning process.

The game mechanics begin with students choosing one of the mystery boxes available on the application interface. Each box contains a challenge in the form of a description of a three-dimensional (*3D*) object in the form of text along with a specification

of the size or characteristics of a specific object. After the challenge is displayed, students in groups discuss the shape of the object in question, then create a three-dimensional model using Autodesk Inventor software according to the description obtained. Each challenge in RAKHMATTRIX such as the dimensions and characteristics of the object given as a form of interpretation of textual information becomes a 3D model for students

3.2. Media Expert Validation Results

The RAKHMATTRIX learning media that has been developed is then validated by media experts using a validation sheet to determine the level of feasibility before being applied in the learning process. The analysis was carried out to determine the level of media feasibility based on the scores given by the validators and students on each aspect assessed. The assessment was carried out on four aspects, namely media suitability, content feasibility, media display quality and media attractiveness. The feasibility presentation is calculated using equation (1) and then interpreted based on the criteria presented in table 2.

Table 2. Interpretation Criteria for the Eligibility Level of RAKHMATTRIX Learning Media

Percentage (%)	Category
81-100	Highly Worth It
61-80	Worthy
41-60	Quite Decent
21-40	Less Worthy
0-20	Not Eligible

Validation is carried out on several aspects, namely media suitability, content feasibility, and media display quality. The results of the media expert's research are presented in table 3.

Table 3. Media Members' Results on RAKHMATTRIX Learning Media Qualification

Assessment Aspects	Scores Obtained	Score Maximum	Percentage (%)	Category
Media Suitability	14	15	93,33 %	Highly Worth It
Content Eligibility	14	15	93,33%	Highly Worth It
Media Display Quality	13	15	86,67 %	Highly Worth It
Daya Tarik Media	14	15	93,33%	Highly Worth It
Average	13,75	15	91,67%	Highly Worth It

Based on the results of the validation of media experts, an average score of 13.75 was obtained from an average of a maximum of 14. Based on equation (1), the feasibility percentage can be determined at 91.67%. As the reference of the interpretation criteria is obtained from table 3 which is included in the category of very feasible. Based on the obtained data, it shows that RAKHMATTRIX learning media has met the aspects of media suitability, content feasibility, display quality and attractiveness so that it is very feasible to be used as a learning media in CAD subjects. The high percentage in this aspect indicates that the media has been designed in accordance with the principles of digital learning media

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development that emphasizes ease of use, clarity of information, and an attractive appearance. The findings of this study show that RAKHMATTRIX learning media obtained a very feasible category based on expert validation and received excellent responses from students. These results are in line with research that reports that the application of gamification elements is able to create more interesting learning activities so as to encourage student motivation and involvement in the learning process. In addition, the study also explains that the application of game elements, such as challenges, points, and rewards, can increase students' interest in learning through a more interactive learning experience.

3.3. Material Expert Validation Results

Validation of material experts is carried out to determine the suitability of the material contained in the learning media with the learning outcomes of Computer Aided Design (CAD) subjects. The assessment includes aspects of Sketch 2D, Part Modeling 3D, and Drawing/IDW material. The results of the validation of the subject matter experts are presented in Table 4.

Table 4. Results of Material Expert Validation of RAKHMATTRIX Learning Materials

Assessment Aspects	Scores Obtained	Score Maximum	Percentage (%)	Category
Sketch 2D	14	15	93,33 %	Highly Worth It
Part Modeling 3D	13	15	86,67 %	Highly Worth It
Drawing/IDW	13	15	86,67 %	Highly Worth It
Average	13,33	15	88,89 %	Highly Worth It

Based on the results of the validation of material experts, a total score of 40 out of a maximum score of 45 was obtained, so that a feasibility percentage of 88.89% was obtained. The high percentage of feasibility in the validation of subject matter experts indicates that the material presented is in accordance with the CAD learning outcomes. This is important because the suitability of the material with the curriculum is one of the main indicators in the development of learning media. Based on the interpretation criteria in Table 2, RAKHMATTRIX learning media is included in the *Very Feasible* category. The results show that the material presented is in accordance with the learning outcomes of Computer Aided Design (CAD) subjects, both in 2D Sketch, 3D Part Modeling, and Drawing/IDW materials.

3.4. Implementation of Learning Media

The implementation of gamification based on the Mystery Box Challenge elicited a positive response from students throughout the learning activity. Based on the results of observations and questionnaires, the majority of students demonstrated greater interest and participation compared to the lecture-based method previously used [15].

Figure 7. Shows the interface of the mystery box game used in the learning process. Through this system, students can select a box containing a random challenge to receive a

design problem that they must solve with their group. This activity creates a more active, interactive, and students-centered learning environment.



Figure 3. Implementation of RAKHMATTRIX Learning Media

Students become more accustomed to visualizing the shape of objects based on given dimensions and characteristics without having to rely entirely on design examples or video tutorial. [16]. In addition, discussions among students and group-based problem-solving activities help enhance students' creativity, communication skills, and problem-solving abilities during CAD lessons.

3.5. Student Response Results

After the learning activity is completed, students are asked to fill out a response questionnaire to find out their responses to the use of RAKHMATTRIX learning media. The assessment includes aspects of interest, learning motivation, ease of use, and student activeness during learning. The results of the students' responses are presented in Table 5.

Table 5. Student Response Results to RAKHMATTRIX Learning Media

Assessment Aspects	Scores Obtained	Score Maximum	Percentage (%)	Category
Ketertarikan	15	15	100%	Excellent
Learning Motivation	14	15	93,33 %	Excellent
Ease of Use	14	15	93,33 %	Excellent
Student Loyalty	14	15	93,33 %	Excellent
Average	14,25	15	94,99 %	Excellent

The positive response of the students shows that the media is easy to use and well received during the learning process. The high assessment of the attractiveness and ease of use aspects indicates that the interface design and game mechanics on RAKHMATTRIX are in accordance with the characteristics of the user. However, this study has not evaluated whether these positive responses have an impact on improving students' learning outcomes and spatial visualization skills.

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3.6. Discussion

The results of the study show that the RAKHMATTRIX learning media obtained the Very deserved Based on the results of validation by media experts and material experts. In addition, students' responses to media use also showed the Excellent**,** which indicates that the media is easy to use and the media is easy to use and elicit a positive response from students to the aspect of interest during CAD learning. This condition is supported by the systematic presentation of material, attractive media displays, and the application of gamification concepts through Mystery Object Challenge which provides a more interactive learning experience.

4. CONCLUSION

This study developed a RAKHMATTRIX gamification learning media based on *the Mystery Object Challenge* in *Computer Aided Design* (CAD) subjects using the ADDIE development model. Based on the results of the validation of media experts, the media obtained a feasibility level of 91.67%, while the total percentage obtained from the table of material experts was 88.89%, both of which are classified as very feasible. In addition, 95% of the results of the student questionnaire showed the category of excellent. These findings show that RAKHMATRIX learning media is feasible to be used as an alternative learning media for CAD subjects.

This study is limited to the stage of media development, product validation and student response measurement, so it has not evaluated the effectiveness of media in improving learning outcomes and spatial visualization skills. Therefore, further research is recommended to use experimental or quasi-experimental designs involving a larger number of respondents and coming from several schools so that the effectiveness of the media can be tested more comprehensively. In addition, the next development can examine the influence of the use of RAKHMATTRIX media on learning outcomes, spatial visualization skills, creativity, learning motivation, and students' problem-solving abilities. Media development can also be directed to become a more interactive digital platform that can be accessed online.

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