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Application of Computer Assisted Instruction Model in Physics Learning

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Abstract: The rapid advancement of technology has significantly transformed various sectors, including education, leading to the emergence of e-learning. This approach utilizes electronic media to facilitate faster and more efficient absorption of learning materials by students. One form of e-learning is the Computer Assisted Instruction (CAI) model, which integrates information technology components such as communication tools, audio, video, and images into a cohesive multimedia platform. The implementation of CAI in e-learning enables flexible learning delivery by allowing educators to present instructional content and engage learners interactively, whether in one-on-one sessions or in small groups. This model enhances the learning experience by incorporating tutorials and multimedia presentations. Physics, as a branch of natural science, plays a critical role in shaping human reasoning and intellectual development. It investigates the fundamental elements of the universe, the forces acting upon them, and the resulting interactions, ranging from subatomic particles to cosmic phenomena. Natural Science itself is more than just the accumulation of knowledge in the form of facts or theories—it also involves systematic inquiry and discovery processes. Applying the CAI model in high school physics education, particularly in the topic of straight-motion kinematics, is expected to improve students' comprehension and conceptual understanding. Based on evaluations from media and subject matter experts, as well as product testing, the instructional media developed has been rated highly feasible, receiving an 86% approval score from users.

Keywords: Computer assisted instruction; Learning; Learning model; Physical science; Straight motion kinematics

Introduction

Technological advancements have brought significant transformations across various fields, including education. One notable outcome is the emergence of e-learning, an electronic-based learning medium that enables students to absorb instructional content more efficiently (Vambudi et al., 2024). Computer Assisted Instruction (CAI) represents an innovation in integrated information technology, combining elements such as communication, audio, video, and visuals into a unified multimedia format (Prayogi, 2021; Abu-Shanab & Al-Tarawneh, 2015; Rosali, 2020). The integration of the Computer Assisted Instruction (CAI) model into e-learning facilitates diverse instructional methods, including delivering learning materials and engaging students through interactive tutorials, whether conducted individually or in small group settings (Ruliah et al., 2019; Camnalbur & Erdogan, 2008; Bayraktar, 2002; Kausar et al., 2008; Demir & Basol, 2014). Learning media designed through this computer-based program are anticipated to offer

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greater variety and innovation, thereby enhancing the effectiveness and efficiency of the teaching and learning process (Astriani et al., 2022; Sari & Tyas, 2024; Isnaini et al., 2022; Arya et al., 2024; Mulyani et al., 2024) Interaction between teachers and students is no longer limited to face-to-face meetings, but is also supported by computer-based learning tools, which are designed to be as engaging as possible to assist both educators and learners in the teaching process (Hermila et al., 2023; Hava, 2021; Nuroh et al., 2022; Moradi & Chen, 2019; Rahiem, 2021; Yang et al., 2022; Yansyah et al., 2023; Yigit, 2020).

Physics, as a branch of natural science, plays a vital role in developing human reasoning and intellectual capacity. It explores the fundamental components of the universe, the forces that influence them, and the resulting interactions—ranging from subatomic particles that constitute matter to the large-scale behavior of the cosmos (Firestein, 2016). Science, or Natural Science, involves a systematic approach to understanding nature. It is not merely the acquisition of knowledge in the form of facts, concepts, or principles, but also encompasses the investigative processes used to discover them (Anharuddin & Fatonah, 2023; Sutriyani & Desstya, 2022; Martin et al., 2015).

One of the obstacles students face in grasping the material is the difficulty they encounter when trying to comprehend and apply formulas in problem-solving (Evendi et al., 2024; Meliyanti et al., 2024; Wuryanie et al., 2020; Szabo et al., 2020; Adianto & Rusli, 2021). Therefore, science learning needs to be presented in an engaging and appealing manner to avoid monotony and boredom, making it easier for students to understand. Students in learning science, especially in the field of physics, are expected to be a vehicle for studying the environment scientifically (Nurhasnah et al., 2020; Saputra & Oktavia, 2024; Choirunnisya & Sudira, 2023) Science education becomes more engaging and meaningful when teachers present concepts and problems in ways that are relatable and easy for students to grasp, often by connecting them to everyday experiences. Consequently, it is essential for teachers to offer support and motivation to facilitate student comprehension (Zaki & Nulhakim, 2021).

Method

In research on the development of learning media by applying the Computer Assisted Instruction model (Hutahaean et al., 2022; Silitonga et al., 2024; Zulhelmi et al., 2023; Kara & Kahraman, 2008; Vernadakis et al., 2006), it is necessary to carry out a concept or research flow which can be seen in Figure 1.

Tutorial

This tutorial model consists of seven tutorials for each material, each including definitions and formulas relevant to topics within straight motion kinematics. The tutorials cover Motion, Distance and Displacement, Velocity and Speed, Acceleration, Uniform Linear Motion, Uniformly Accelerated Linear Motion, and Free Fall Motion.

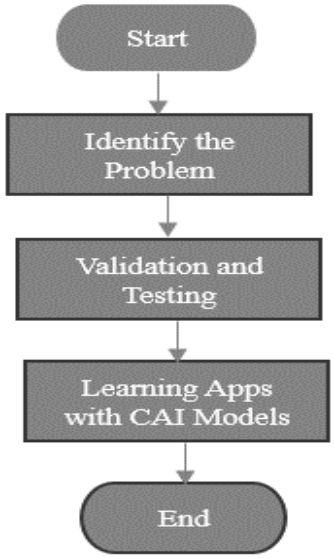

Figure 1. Research flowchart

Drill and Practice

This model includes six exercises and practice sessions, corresponding to each topic within the straight-motion kinematics material. In total, there are 12 practice questions, with two questions allocated for each topic.

A Use Case Diagram is a modeling tool used to illustrate the behavior of a system under development. It depicts the interactions between one or more actors and the system being designed. In the design of this application, use case diagrams describe system functionality as procedures or rules that the system agrees to run as desired. The following is a Use case diagram of a physics learning application, which can be seen in the following figure 2.

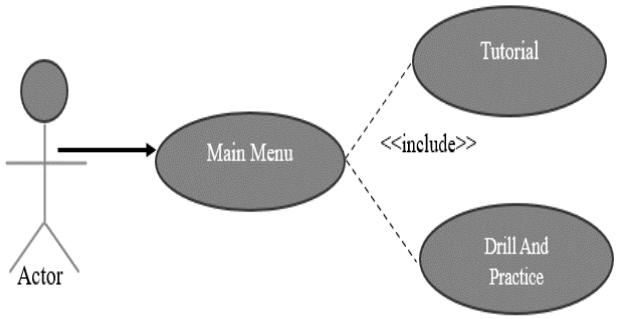

Figure 2. Use case diagram media

Result and Discussion

The application for learning physics subjects is implemented directly by users. The stages of using this learning application consist of several steps, namely: Step I: The application will bring up the main menu of the system containing an options menu that can be selected by the user. Step II: In this application, users must complete one by one each topic of discussion first such as completing the discussion of questions to be able to proceed to the next topic of discussion. Step III: This process will continue to be active as long as the user is still using this learning application. The following describes the display of the program used by teachers as follows:

Main Menu

It is a menu display that will be selected by users when they want to use the application, namely Students and Teachers and the About Me menu. If the user selects the student button, the topic of discussion will appear in the tutorial. If the user selects the teacher button, the teacher login menu will appear.

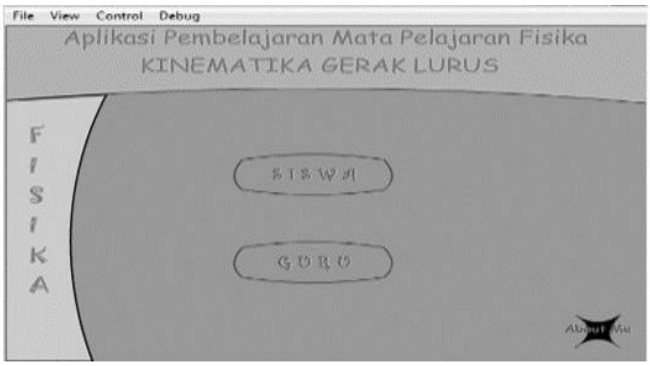

Figure 3. Main menu

Tutorial

This menu serves to display the entire material and some animations of the topic of discussion so that at any time the teacher can update each material.

Figure 4. Tutorial view

Drill and Practice

This display consists of several options, namely sample questions and practice questions and their completion.

Figure 5. Drill and Practice View

Validation

Product validation is the process of testing and evaluation to ensure that the product functions properly, safely, and meets established quality standards.

Table 1. Eligibility Criteria

Percentage	Criteria
85% - 100%	Very Decent
69% - 84%	Feasible
53% - 68 %	Decent Enough
37% - 52%	Less Feasible
20% - 36%	Not Feasible

The learning media developed is the application of computer assisted instruction model in physics learning. At this stage, the media will be validated by expert validators. The assessment aspects of media expert validation consist of two aspects, namely display aspects, coding aspects.

Table 2. Media Expert Assessment Results

Aspect	Value	Percentage	Criteria
Design	89	89%	Very Decent
Coding	41	79%	Feasible
Average		84%	Feasible

The next validation is to test the feasibility of the application of computer assisted instruction model in physics learning. The process carried out is to provide an evaluation questionnaire to two material experts.

Table 3. Material Expert Assessment Results

Aspect	Value	Percentage	Criteria
Contents	75	75%	Feasible
Presentation	80	80%	Feasible
Language	83	83%	Feasible
Average		79%	Feasible

The next stage of research is the testing of learning media products carried out on students in the scope of small group trials.

Table 4. Product Trial

Aspect	Value	Percentage	Criteria
Material	84	84%	Very Decent
Practicality	87	87%	Very Decent
Benefits	87	87%	Very Decent
Display	88	88%	Very Decent
Average		86%	Very Decent

Conclusion

Based on the above explanation regarding the implementation of physics learning at the high school level using the Computer Assisted Instruction (CAI) method, several conclusions can be drawn. This includes the presentation of a physics learning application focused on straight-motion kinematics. The CAI approach, which is computer-based, can be effectively applied in physics education for high school students. The application supports individual learning and features tutorials, drills and practice sessions, games, and simulations. The application consists of several interface components, including Home, Main Menu, Tutorial, Drill, and Practice forms. Validation results from media experts showed an approval rate of 85%, categorized as good and feasible, while material experts gave a 79% approval rating, indicating good quality and usability. Field trials also demonstrated the product's effectiveness, with an 86% user satisfaction rate, classifying it as highly feasible.

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Author Contributions
All authors contributed to this research. HDH participated in media development and script editing. MI conducted the compilation, participated in data analysis and helped draft the script. JH participated in the research in the form of data collection and script writing.

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Conflicts of Interest
All authors in this study stated that they did not have competing interests for all parties.

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