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Using Intelligent Tutoring Systems Through Cognitive Tutor Authoring Tools to Solve Filling Slot Problems

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Abstract

Intelligent Tutoring Systems (ITS) is a computer system that provides instructions and is adapted to students who apply learning by doing theory. Cognitive Tutor Authoring Tools (CTAT) is one of ITS that supports the creation of flexible tutors for simple problems and complex solutions, able to support several strategies so that they can describe what students do when solving problems. In working on the problem of filling the place, students will solve the problem according to the students' logic of thinking. This is because the logic of thinking of each student is different depending on the information he receives. For this reason, in this study, the use of CTAT will be tried in working on filling slot questions using media, namely Intelligent Tutoring Systems (ITS) which uses Cognitive Tutor Authoring Tools (CTAT) tools. In this study, students have obtained the filling slot material first. Only then is the media used which will later be used to work on filling slot questions with different problems. From this research, it was found that the results of the study were increasing students' understanding in working on filling slot questions using Cognitive Tutor Authoring Tools (CTAT) media. So that the Cognitive Tutor Authoring Tools (CTAT) media can be used as an alternative learning media to develop students' understanding of filling slot material.

Keywords: Cognitive Tutor Authoring Tools; Filling Slot; Intelligent Tutoring Systems; Mathematics

Abstrak

Intelligent Tutoring Systems (ITS) adalah sistem komputer yang memberikan instruksi dan disesuaikan dengan siswa yang menerapkan learning by doing theory. Cognitive Tutor Authoring Tools (CTAT) merupakan salah satu ITS yang mendukung terciptanya tutor yang fleksibel untuk masalah sederhana dan solusi kompleks, mampu mendukung beberapa strategi sehingga dapat menggambarkan apa yang dilakukan siswa saat menyelesaikan masalah. Dalam mengerjakan soal aturan pengisian tempat, siswa akan menyelesaikan soal tersebut sesuai dengan logika berpikir siswa. Hal ini dikarenakan logika berpikir setiap siswa berbeda-beda tergantung dari informasi yang diterimanya. Untuk itu pada penelitian ini akan

dicoba penggunaan CTAT dalam mengerjakan soal aturan pengisian tempat menggunakan media yaitu Intelligent Tutoring Systems (ITS) yang menggunakan tools Cognitive Tutor Authoring Tools (CTAT). Pada penelitian ini siswa telah memperoleh materi aturan pengisian tempat terlebih dahulu. Baru kemudian digunakan media yang nantinya akan digunakan untuk mengerjakan soal aturan pengisian tempat dengan soal yang berbeda. Dari penelitian ini diketahui bahwa hasil penelitian adalah peningkatan pemahaman siswa dalam mengerjakan soal aturan pengisian tempat menggunakan media Cognitive Tutor Authoring Tools (CTAT). Sehingga media Cognitive Tutor Authoring Tools (CTAT) dapat digunakan sebagai media pembelajaran alternatif untuk mengembangkan pemahaman siswa terhadap materi aturan pengisian tempat.

Kata Kunci: Aturan Pengisian Tempat; Cognitive Tutor Authoring Tools; Intelligent Tutoring Systems; Matematika

Introduction

Indonesian education includes lessons on mathematics (Noor, 2019; Wahyuni, Arthamevia, & Kurniawan, 2020; Ardiansyah, 2020; Richardo, 2020; Afifaturrohmaniyyah & Malasari, 2021; Taskiyah & Widyastuti, 2021; Riayah & Fakhriyana, 2021). As a mathematics teacher, one of the basic goals of a mathematics teacher is to help all students learn and to enjoy mathematics to the fullest extent possible (Berki, & Valtanen, 2007). To find out whether students have learned mathematics, the teacher must assess the achievements of students in class (Carraher, Schliemann, Brizuela, & Earnest, 2006). One of the reasons why teachers should assess student achievement in class is to find out the extent to which content and skills are mastered so that they can diagnose strengths and weaknesses for each student (Brumbaugh, & Rock, 2012). The counting rule is the rule of counting to find out the number of certain events or objects that appear. It is called enumeration because the result is a whole number. There are three rules in counting, namely, the rules for filling the available places, the rules for permutations and the rules for combinations. Filling Slot is one of the materials that must be studied by class XII students in the 2013 Curriculum (Marsigit, 2008). This material is part of the Enumeration Rules.

Each person will retain all the information he receives and will use the information to perform tasks relevant to the information. Everyone will have a different logic of thinking, depending on the information they receive and the working memory of that person (Shaffer & Kipp, 2013). Conway, Kane, Bunting, Hambrick, Wilhelm, and Engle (2005) stated that Working Memory depends on several factors such as exercise, storage facilities, cognitive control abilities, and attention. In doing everything, everyone will use the memory he has acquired to complete his work. Intelligent Tutoring System (ITS) is a computer system that

provides direct customized instructions/commands or feedback to students (Lane, 2006). ITS applies learning by doing theory. ITS uses a variety of different technologies. Usually, these systems are also called Artificial Intelligence systems or expert systems created to simulate aspects of teachers and students.

Cognitive Tutor Authoring Tools, or CTAT is a suite of tools that allows for augmented learning by doing (i.e., active learning) (Baker, Corbett, & Koedinger, 2004). CTAT supports the creation of flexible tutors for simple problems and complex solutions, able to support several strategies so that they can describe what students do when solving teacher problems. CTAT tutors track students as they work through problems.

Method

This research is experimental research. Determination of the research problem is to use a case study on solving the Filling Slot problem. Computing approach in this study was chosen based on a literature study about the pattern of working on Filling Slot questions. Application of a computational approach Solving the Filling Slot problem by using CTAT (Byrne, 1996). Software development that applies a computing approach. For software development using methods in accordance with the principles of software development. In the development of this software, the approach used is an object-oriented method with stages, requirements (needs), analysis (analysis), design (design), construction (construction), and testing (testing), the stages are carried out overlapping and cycle. Tools used to develop software is CTAT (Cognitive Tutor Authoring Tools) and the user interface is made using the HTML model (Wagner, 2006).

Intelligent Tutoring System (ITS)

Intelligent Tutoring System (ITS) has been around since the late 1970s and was popular in the 1990s. ITS is an artificial intelligence in the form of a computer program that acts as if it could be an expert, teacher, student (Abd El-Sattar, 2008). Making ITS often requires collaboration between experts from various fields such as education, psychology and computer science engineering to design it. The goal of ITS is to provide the benefits of automated and cost-effective instructions.

According to Polson and Richardson (2013), the *Intelligent Tutoring System* consists of four subsystems or modules, namely:

Interface module. The interface module provides a means for students to interact with the *Intelligent Tutoring System*, usually via a graphical user interface

and sometimes using a simulation of the student's main task of learning (e.g., solving a Filling Slot problem).

Expert module. The expert module or domain module contains a description of the knowledge or behavior that represents the skills that are the main material in the *Intelligent Tutoring System. Artificial Intelligent (AI)* techniques are used to capture how the problem can be solved. This component of ITS models being an expert who sometimes learns in the environment and communicates face-to-face with other *ITS components* on the cases at hand.

Student module. Contains an overview of student knowledge, including misunderstandings in understanding certain knowledge. Discrepancies in student behavior or knowledge prompt the expert module to take corrective action such as providing feedback or correcting instructions.

Tutor module. Contains information about what the teacher does if there is a misunderstanding in mastering certain knowledge. If a student is deemed to have made a fundamental error, the tutor module will show a step-by-step demonstration before the student commits it himself. John Anderson said the main lesson of the *Intelligent Tutoring collection* refers to all research in expert systems where the expert module must have a lot of specific and detailed knowledge that comes from people who have experience in a particular field. The following is Figure 1 which describes the module on intelligent tutoring system.

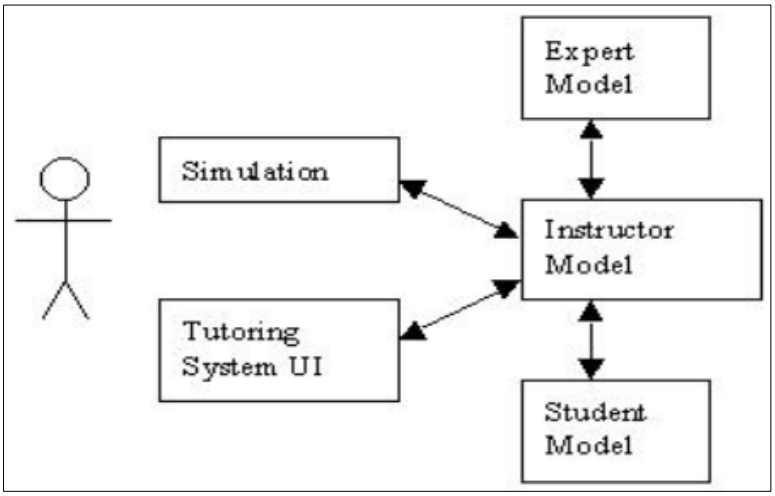

Figure 1. Module on Intelligent Tutoring System

Requirements

The development of information systems begins with conducting research on the elements of the system requirements concerned and defining these

requirements and elaborating them into guidelines for system development at the next stage. The related aspects are elements related to the system, both human resources, laws and regulations, hardware, organizational work procedures and various other aspects, both directly and indirectly related to the computerized system that will be implemented. built. This phase is a very important phase (essential) to get a complete picture of the system for the development of the system concerned into the form of implementing a computer-based system.

Analysis

The most important task in this stage is the process of finding problems and generating alternative problem solvers. And it is expected to understand the existing system and determine user needs and constraints on a new system.

Design

The stage after the analysis of the system development cycle is system design. System design describes how a system is formed which can be in the form of drawing, planning and sketching. The purpose of this system design is to meet the needs of system users and provide a clear and complete picture to computer programming and other technical experts involved (Wakerly, 2008).

Construction

The system construction stage is the stage of placing the system so that it is ready for operation. This stage includes the activity of writing program code using a computer programming language that has been determined in the previous stage (Matsuda, Cohen, & Koedinger, 2005).

Testing

After the process of writing programming code, the next step is in the form of a testing process or system test (Aleven, Ogan, Popescu, Torrey, & Koedinger, 2004). System testing includes comprehensive program testing. Testing this system is to ensure that the elements or components of the system are functioning as expected. Testing is carried out to look for errors or weaknesses that may still occur

Application of Software on the Object of Research

The objects of this research are students of class XII MIPA 1 and XII MIPA 2 at SMAN 2 Kudus in the academic year 2021/2022.

Evaluation and Validation of Research Results

Evaluation and Validation of Research Results using empirical testing methods in the classroom (Sugiyono, 2006). Statistical testing was carried out to test the significance of the approach used.

Results

Software Implementation Analysis

In this study, all the steps in doing the Filling Slot questions performed by students will be recorded in the CTAT behavior record which is described in the graph. The following are Figure 2 user interface of the CTAT application and Figure 3 steps to work that are recorded in the behavior record.

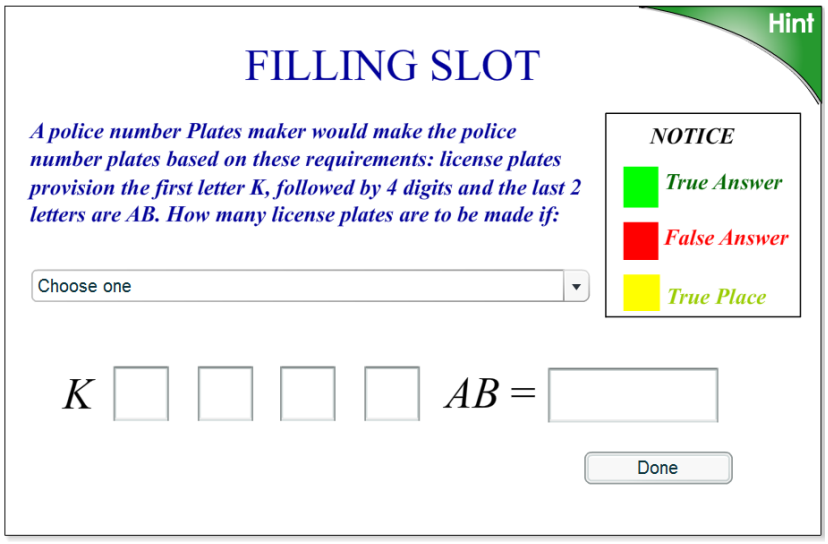

Figure 2. User Interface of the CTAT Application

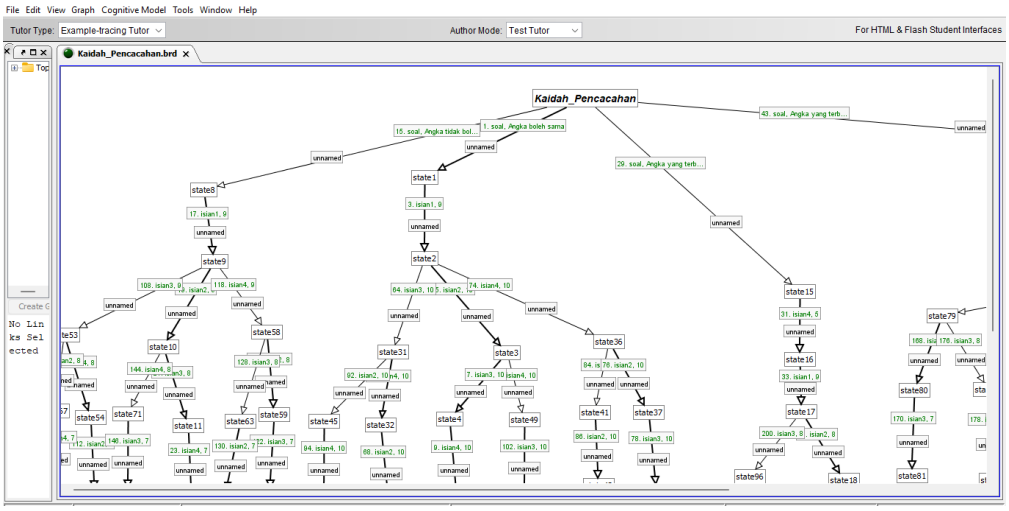

Figure 3. Steps to Work that are Recorded in the Behavior Record

From the graph on the behavior record (see Figure 3), all student behavior in working on the questions will be recorded, this can be seen in the graph whose writing is enlarged, so that the steps used by students in working on the Filling Slot questions can be identified quickly.

The results of the study using the Intelligents Tutoring System with the CTAT model in two experimental groups, namely the group using ITS and the group not using ITS, obtained data that students who use ITS in solving the Filling problem Slots have a high average score compared to the group that does not use ITS.

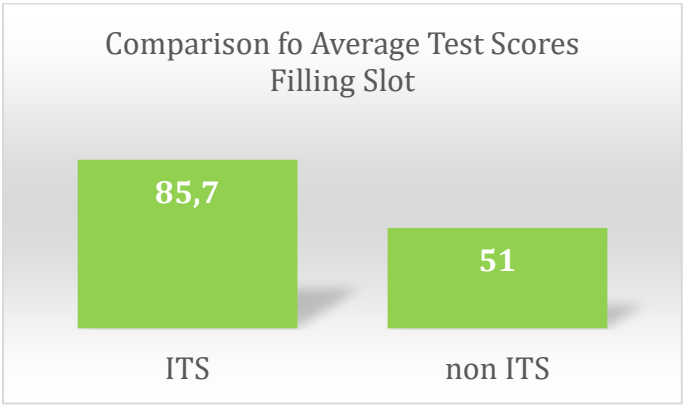

Figure 4. Research Results

Based on Figure 4, it can be seen that students who learn mathematics with the Intelligents Tutoring System with the CTAT model have better achievement than students who learn mathematics without using the Intelligents Tutoring System with the CTAT model.

Discussion

Integrated Tutoring Systems (ITS) are a tool for knowledge transfer that can assist educators in delivering content, particularly mathematics disciplines, which have a reputation for being a pain, intimidating, and challenging to learn (Amanda, 2021). The research findings reveal that students who study mathematics with the Intelligent Tutoring System with the CTAT model achieve better understanding than students who learn mathematics without using the Intelligent Tutoring System with the CTAT model. This finding is supported by research results Dewi (2017), Sherlyana (2019), Widodo (2019), Setiawan (2021), Yusuf, Thania, Harahap, and Ritonga (2022).

Conclusion

From the results of the research, it can be concluded that intelligent tutoring systems with Cognitive Tutor Authoring Tools (CTAT) in working on Filling Slot questions can improve students' understanding in studying filling slot material. So that the Cognitive Tutor Authoring Tools (CTAT) media can be used as an alternative learning media to develop students' understanding of filling slot material. Based on the researcher's direct experience in the research process, there are limitations experienced and can be a factor so that future researchers can pay more attention to further refine their research because this research itself certainly has shortcomings that need to be improved. The limitation of this research is that the seriousness of student learning when the research is carried out is something that is beyond the reach of the researcher to control.

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