FUDAOWANG: A Web-Based Intelligent Tutoring System Implementing Advanced Education Concepts

Wei Xu, Xidian University, China
Ke Zhao, Xidian University, China
Yatao Li, Xidian University, China
Zhenzhen Yi, Xidian University, China

ABSTRACT

Determining how to provide good tutoring functions is an important research direction of intelligent tutoring systems. In this study, the authors develop an intelligent tutoring system with good tutoring functions, called “FUDAOWANG.” The research domain that FUDAOWANG treats is junior middle school mathematics, which belongs to the objective mature domain. Its characteristic is that the knowledge employed is the mature knowledge accepted by most people. FUDAOWANG uses automatic reasoning technology about objective mature problems to realize its intelligence. Based on the results of the automatic reasoning, FUDAOWANG synthetically applies the problem-based tutoring and advanced education concepts to achieve the tutoring functions of stepwise prompt, detailed answers, rethinking after solution, consolidated exercise, etc. The evaluation of FUDAOWANG shows that it is helpful to students in improving learning achievements and cultivating good learning habits.

Keywords: Automatic Reasoning, Education, Education Concepts, Intelligent Tutoring System, Objective Mature Problem, Tutoring Functions Design

INTRODUCTION

With the increasing of science and technology, more and more technologies are applied in the field of education. A lot of education software that claimed to be able to help children study has appeared on the market. Does the education software can help students? What functions of good education software that teachers and students need should have? Students in general need the software to solve difficult problems in their study or work with them to explore problems, rather than the software only providing some fixed contents of problem sets. Students who learn better wish the software could provide the environment of training their innovation abilities, instead of simply imparting knowledge. Teachers hope
the software could also be powerful teaching assistants to help them answer the general questions raised by students, so that they have time and energy to do more creative work.

So far, many scholars and research institutions have made a big effort, and have developed many actual intelligent tutoring systems. In 1970s, the research of intelligent tutoring systems focused on the problem generation, particularly at the microcosmic level. The typical intelligent tutoring systems include Scholair (Carbonell, 1970), WHY (Stevens & Collins, 1977), SOPHE (Brown & Burton, 1975), WEST (Brown & Burton, 1976), BUGGY (Brown & Burton, 1978), GUIDON (Clancey, 1979), etc. In 1980s, the research was emphasized particularly on the learners and the learning process. The research of intelligent tutoring systems emphasized model tracing. The typical intelligent tutoring systems of this period included LISP Tutor (Anderson, Boyle, & Reiser, 1985), Geometry Tutor (Anderson, Boyle, & Yost, 1985), PROUST (Johnson, 1986), PIXIE (Sleeman, 1982), etc. In 1990s, the research focused on learner control. The typical intelligent tutoring systems of this period included Smithtown (Shute & Glaser, 1990), Bridge (Shute, 1991), Stat Lady (Shute & Gawlick-Grendell, 1996), SQL-Tutor (Mitrovic, 2003), Auto-Tutor (Graesser, 2004), etc. In the 21st century, the research emphasis turned to be the adaptive learning support, focusing on the results of cognitive science research (especially on learning mechanism research) and the design of learning process and learning environment. VC Prolog Tutor (Peylo, Thelen, Rollinger, & Gust, 2000), SCoT-DC (Clark, Fry, Ginnton, Peters, Pon-Barry, & Thomosen-Gray, 2001), Slide Tutor (Crowley & Medvedeva, 2006), AHP-Tutor (Ishizaka & Lust, 2004), MATH-EMA (Alexandros, Maria, & Georgios, 2009), Mathtutor (Aleven, McLaren, & Sewall, 2009) are the typical intelligent tutoring systems of this period.

The successful development of these systems provided the tutoring of various fields, and promoted the progress of education technology. On one hand, an intelligent tutoring system serving as an intelligent system is the result of the comprehensive application of artificial intelligence technologies. It reflects the development level of artificial intelligent technologies. It is unimaginable that a tutoring system can tutor students without intelligence. On the other hand, an intelligent tutoring system acting as a tutoring system must be able to tutor. It must have good tutoring functions, so it can serve students better. Consequently, how to improve the intelligence and how to provide good tutoring functions both are the important research directions for establishing intelligent tutoring systems.

For intelligent tutoring systems, intelligence and good tutoring function complement each other. The intelligence of an intelligent tutoring system is the foundation of realizing its tutoring functions. However, an intelligent system is not always a good tutoring system, and it must provide good tutoring functions. Just as the case that a person who can solve problems accurately and quickly may be unserviceable as a teacher or tutor. Therefore, it is very important for an intelligent tutoring system to be endowed with good tutoring functions.

Mathematics is an important research field of intelligent tutoring systems, in which many classic systems have been developed. Nevertheless, most of the mathematics intelligent tutoring systems focus on how to enhance the intelligence of these systems, which can be clearly seen from the published literatures. However, there are some systems that strive to make intelligent tutoring systems provide good tutoring functions based on ensuring the intelligence of the systems. As for mathematics learning, prompts play an important role in guiding students to solve problems independently, so there are intelligent tutoring systems, which can provide prompt functions, such as Andes (VanLehn et al., 2005), SIETTE (Guzma & Conejo, 2005), PACT (Aleven, Koedinger, & Cross, 1999), AgentX (Martin & Arroyo, 2004), XTutor (Muñoz-Merino & Kloos, 2009), MATH-EMA (Alexandros, Maria, & Georgios, 2009), MathTutor (Aleven, McLaren, & Sewall, 2009). For instance, SIETTE is used for instruc-
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