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Authoring with Retudisauth adaptive dialogues for text comprehension

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Abstract

In this work is presented the process of authoring adaptive dialogues for informatics text comprehension using the authoring tool of ReTuDiS (Reflective Tutorial Dialogue System), which is based on text comprehension theories. Previous study resulted in student's profiles depending on their prior knowledge and students were given the appropriate text with text activities according to their profiles. Students organized text representations with different structure: relational, transformational and teleological. The purpose of this study is to design and test educational material of personalized dialogue activities for text comprehension appropriate for each student, depending on student's text representation. Dialogues are tested by groups of participating students before the authoring tool is used to incorporate the material in ReTuDiS. Feedback provided by the system, in the form of personalized dialogues, promotes reflection and is expected to help students improve their text comprehension skills. The system is accessible throughout the web and can be tested in real classroom conditions.

Keywords: Authoring tools; Adaptive dialogues; Text comprehension; Reflection

1. Introduction

The cognitive psychological approach in text comprehension suggests that the internal variables of the reader hold a primary role in text comprehension, such as his personal goals, interests and pre-existing knowledge. However, cognitive science does not ignore the influence of the text form, in which factors such as text cohesion and logical coherence of facts presented have been proved to be significant elements that facilitate its comprehension [1]. Recent discussions, directions and research results on text comprehension concern the structural analysis of science texts and cognitive aspects of text elements, such as causal relationships between text elements. Many studies on text comprehension have focused their interest on the sentence structure presented by the text [2]. Sentence structure of a text could be organized on the basis of hierarchy in order to allow the importance of sentences in the text to be revealed. In approaching text comprehension, researchers examine issues that focus on assisting comprehension through text summarization [3] by improving text coherence [4, 5] or assisting the design of the text form and text activities [6].

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In order to make the information in such activities available to target users (students, researchers, authors, educators) new efforts have emerged to bring together novel methodologies and technologies. Authoring such activities demands an authoring system which involves knowledge acquisition, design process and managing a large amount of complex information. Authoring tools offer the appropriate structure and guide authors (non programmers) to import and elaborate educational material such as text, questions, dialogues etc. [7, 8]. Recent discussions, directions and research results on text comprehension concern the structural analysis of science texts and cognitive aspects of text elements, such as causal relationships between text elements [4].

2. ReTuDiS and Text Comprehension Theories

ReTuDiS (Reflective Tutorial Dialogue System) is a web-based diagnosis and dialogue learner modelling system for text comprehension, which infers learners' cognitive profile in order to construct and revise the learner model with the learners' participation [9, 10]. In the diagnosis part the system, based on Text comprehension Theory [6], engages learners in a diagnostic activity which includes question answering. The purpose of this activity is to infer learner's initial profile. Learners compose a cognitive representation of the text, which contains the cognitive categories: entity, state, event and action, hierarchy of part to whole relations between entities, causal relations etc. Furthermore, the organization and structure of cognitive representation involve three system types: relational system, transformational system and teleological system. The organization and structure of cognitive representation is also examined on micro and macro-levels. On a micro-level scale, in order a person, to be able to explain the operation of a technical system, has to construct a representation, where every new event should be causally explained by the conditions of events which have already occurred. On macro-level, the development of the macrostructure by readers is achieved through the reconstruction of the microstructure and the establishment of a hierarchical structure with goals and sub-goals. The underlying theory beyond the dialogue part of ReTuDiS is the Theory of Inquiry Teaching [11]. ReTuDiS approaches dialogue activities based on theories of dialogue management, strategies, tactics and plans which promote reflection in learning. The dialogue part is based on the learners' cognitive profile, inferred by the diagnosis part, the learners' answers to text activities and the selected dialogue strategy offered by the system. The dialogue part of ReTuDiS engages the learner in personalized reflective dialogues in order to revise the learner model with participation of the learner.

3. Authoring with ReTuDiSAuth

In the framework of designing, organising and setting up the appropriate educational settings for supporting learning through text comprehension, we have developed the authoring tool ReTuDiSAuth (http://hermes.di.uoa.gr/retudis3/). The tool provides the necessary guidance to support authors in designing courseware for ReTuDiS through the different steps of this process [12, 13].

- Authoring Text structure. School and university text-books usually include texts not structured according to any theory of text comprehension. Authors of such texts usually ignore micro and macro structure. The underlying educational model concerning the formulation of a text depends mainly on the theory of Baudet and Denhiere for text comprehension [6]. In the environment of an educational system for text comprehension the author selects a text from a text-book and considers that the text describes a system (for example a technical system) and structures versions of the text in respect of relational, transformational and teleological system:
  - Relational text, according to the relational system, refers to: (a) a description of units that constitute the system, (b) a description of part /all relations connecting system units and (c) a description of static states of the units on micro-level.
  - Transformational text, according to the transformational system, includes: (a) a description of events and events' sequence taking place in these units and provoke changes to the state of the system, (b) a description of causal and temporal relations among events and the changes they bring to the state of the system.
  - Teleological text, according to the teleological system, includes descriptions throughout a "tree" of goals and sub-goals and how the technical system changes from an initial to a final state due to events in order to achieve the goals and sub-goals on macro-level.
- Authoring Text activities. The underlying model behind authoring text activities such as questions, dialogues and the dialogue management is the Theory of Inquiry Teaching [11]. Questions provide the focus and direction for the instruction through reflective tutorial dialogue. The design of the reflective dialogue help students become aware of their reasoning and construct more coherent arguments while leading them towards more

scientific thought. For each of the above version of the text the author can construct one or more text activities of the following types:

- Question-pairs with alternative answers. The author formulates the appropriate questions with alternative answers in a text, by using possible students' answers, using answers based on his educational experience or on bibliography. The first question in the question-pair is related to the causal importance of a specific factor in the text and a student's answer concerning this question is called position. The second question is related to a student's justification concerning the selected position and is called justification. For every question-pair the combination of a student's position and the corresponding justification constitute the student's argument.
- Categorizing entities. To structure the text activity the author identifies entities described in the text, which have part/ all relations among them and makes the appropriate connections among entities so as to declare their part/ all relations. The aim of this activity is student to be able to identify entities, to recognize part/ all relations among them and to categorize entities.
- Classifying events or operations. To structure the text activity the author inserts in the appropriate fields one by one the events belonging to a sequence so as one or more of them appear in a wrong causal and temporal order. The aim of this activity is student to be able to identify events and sequences of events, to identify the initial and the final state of the system provoked by the events, to recognize causal and temporal relations among events, and put them in the right order the system to be able to achieve a goal or a sub-goal.
- Completion of event or operations missing in a sequence. To structure the text activity the author abstracts one or more of the events in a sequence of events, which sequence constitutes an operation. The aim of this activity is to make student able to complete events missing in a sequence, which show temporal, causal and part/ all relations.

- Specifying the appropriate dialogue tactics and strategies. Dialogue tactics, inspired by the general teaching strategies [5, 11] are hints or Socratic-style dialogues. Tactics correspond to different levels of dialogue concerning the specific subject matter and involve students in activities which promote reflection. The author defines the dialogue tactics which have the following forms: (a) picks positive or negative examples, (b) picks counterexamples, (c) generates hypothesis, (d) makes student to form hypothesis, (e) makes student to test hypothesis, (f) entraps the student, (g) traces consequences to a contradiction or faulty knowledge of a student and (h) promotes questioning authority.
- Dialogue stages. The author constructs dialogue in stages: 1) the system makes student aware of the general framework of the assessment results, that is whether he is correct or not, and encourages him to take his first decision to participate in the discussion. In that case, the system explains the differences between his answers and the system's arguments. 2) The system indicates the points where there are contradictions between students' answers and encourages the student to return to stage 1 and continue with the next argument. 3) The student recognizes his contradiction and changes his reasoning or he insists on his answer. 4) The system discusses, justifies itself and argues with student over his contradictions. The actions of the system have to be driven towards eliminating the contradiction. The elimination will only be possible when students themselves remove the contradiction and are thus able to construct a more coherent argument. At the end, the system encourages student to try again to read the text and answer the questions, so that it can have a second opportunity to reassess students. In this way, students are involved in the diagnosis process and are expected to change their profiles.

4. Research

4.1. Previous research

Previous research was conducted the academic year 2009-2010, with participation of university students studying Informatics in the Department of Informatics & Telecommunications, University of Athens [14]. The participants were 1st semester students whose prior knowledge was emanating primarily from secondary degree education or from their personal experience. The educational material was taken from the university text-book [15] and included: a prior knowledge test, three versions of text: relational, transformational and teleological text with text activities. Application of the prior knowledge test resulted in the assessment of the student initial profile as: low, medium and high. Based on their profile, students were given the appropriate text R, M and T respectively come along with text activities. Students' answers were taken into account for the assessment of the final profiles which, as expected, were different from the initial ones.

4.2. Present research objectives

The purpose of this study is to apply educational material for text comprehension with feedback dialogues (texts and text activities with feedback dialogues) to students studying Informatics in Vocational Lyceum. Another purpose is to explore the changes in student's learning profile before and after the application of dialogues. The construction of dialogue activities was based on the results of the previous proportionate research, conducted with participation of university students studying Informatics [14]. Analysis of students' answers to text activities in the previous study resulted, as expected, in the conclusion that some students' answers are conflicting between each other. In this study the educational material is complemented with personalized dialogue activities concerning students' conflicting answers, contradicting answers and errors.

4.3 Participants

Our research is conducted the academic year 2010-2011 with the participation of forty-one students following Informatics course in Marousi 2nd Vocational Lyceum. Nineteen of them had been taught in the previous year the lesson "Network Communication Technologies".

4.4 Educational material and process

The experimental texts were based mainly on a chapter from the school text-book concerning "Local Network Operations: Transportation Techniques". The educational material included: a) a prior knowledge test, b) three versions of text: relational (R), transformational (M) and teleological (T) with activities on: answering questions with alternative answers, categorizing entities, classifying events or operations, completion of event or operations missing in a sequence and c) personalized dialogue activities concerning conflicting answers or errors in the form of: positive or negative examples, counterexamples, generating hypothesis and making student to test hypothesis, or tracing consequences to a contradiction or faulty knowledge of a student.

After the prior knowledge test, ReTuDiS estimated students' initial profiles and students were given the appropriate text with activities: R, M or T. After the activity the system presented the students their new profiles. In that point students were invited by the experts to form groups and participate in dialogue. The students formed groups of three students. The grouping was accidental and the assignment of roles was affected by the results of the prior knowledge test. The results indicated 26 students with R-activity (R-students), 12 with M-activity (M-students) and 3 with T-activity (T-students). Each group consisted of two R-students and one M-student or T-student. The groups were supplied with dialogue activities on paper and encouraged to discuss for reflection between each other their conflicting or non scientific answers, which were included in their detailed profiles.

For example in an M-activity, in a "classifying events or operations" question during message transmission in a local network, students were asked to classify the given mixed steps so as to make the right sequence of events or states. Steps given in the right sequence: 1) splitting up the message into packets, 2) attachment of control information on the packet (target address, number of packet etc.), 3) make an attempt to use the communication channel, 4) packet transmission into the channel 5) release of the channel and 6) inactivity of the channel.

A usual sequence given by the students is: 1, 3, 2, 4, 5 and 6. A dialogue tactic in this case in the form of "positive or negative example" is the following: "You write down on the letter the address of the receiver before you put it into the mail-box. A packet is like a letter so before transmission what you need to know about it?"

After the discussion students were encouraged to make again their text activities in ReTuDiS and the system estimated their final profiles.

4.5 Research results

To measure the profit of dialogue process in groups we made comparisons between the student's profiles before and after the application of the individualized reflective dialogue. All students participated and collaborated. Most of them changed their profiles. Detailed analysis of final profiles pointed out that R-students benefited more than M-students and T-students from this process. This can be explained by the fact that R-students were redundant compared with M-students and T-students and received help by the more experienced students. The results are encouraging for our team to experiment with greater number of students with the expectation to have more M and T-students.

6. Conclusion

This work contributes towards improvement of ReTuDiS system concerning structuring dialogue activities for personalization and promoting reflection. ReTuDiS' environment offer students with different learning profiles access to technical texts and dialogue activities adapted to their level of knowledge. ReTuDiSAuth offers authors an authoring tool and guidance to restructure texts and create dialogue activities for students in respect of the relational, the transformational and the teleological system. Currently, we use ReTuDiS for research in the framework of the course of Didactics of Informatics in the Department of Informatics and Telecommunications, University of Athens. Moreover, the system can be tested in real classroom conditions for personalized learning and group formation. Formative evaluation, concerning the effectiveness of educational material and the use of ReTuDiSAuth as authoring tool for personalized dialogue activities is designed.

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