Historical Text Comprehension Reflective Tutorial Dialogue System

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ABSTRACT

The Reflective Tutorial Dialogue System (ReTuDiS) is a system for learner modelling historical text comprehension through reflective dialogue. The system infers learners' cognitive profiles and constructs their learner models. Based on the learner model the system plans the appropriate --personalized for learners-- reflective tutorial dialogue in order to promote their reflection, a fact which leads them towards scientific thought. The system consists of two parts: (1) the Diagnosis part and (2) the Reflective Tutorial Dialogue part. In this paper we present the dialogue strategies, tactics and plans which are used by the dialogue part for the generation of the appropriate for learners' reflective learning dialogues according to their learner models. Moreover, in this paper we present the experts' comments concerning the tutorial dialogue during an experiment.

Keywords

Dialogue-based reflection, Interactive dialogue, Planning and Historical text comprehension

Introduction

Tutorial dialogue has many positive characteristics for promoting learning. It provides learners with a learning environment that is appropriate for the accomplishment of learning goals. It provides tutors with the opportunity of tailoring instruction to individual needs. Reflective tutorial dialogue between learner and the system about the learner's own beliefs can make a learner model open (Kay, 2001; Paiva & Self, 1995). Interactive open learner modelling involves human learners in learning dialogues to improve learning through promoting and facilitating reflection. Advanced computer learning environments require open learner models, which promote reflection, in order to help learners overcome their learning difficulties (Bull, 1997; Bull & Nghien, 2002). Open learner models encourage learners to reflect on the domain being studied, on their own strategies for learning and on their own understanding. Towards this direction, the dialogue management, the dialogue strategies and the dialogue tactics, which mainly formulate the dialogue framework, aim at the promotion of reflection in learning (Freedman, 2000; Schultz et al., 2003; Zinn et al., 2002). Through dialogue learners defend their views to the system by collaborating, discussing and arguing the assessment, which the system has made of their knowledge and beliefs. The recently growing interest in opening learner models to learners encourages the development of tutorial dialogue systems which give learners greater responsibility and control over their learning process (Kay, 2001).

There are systems in the literature supporting student models, which are related to text comprehension. SimStudents, an integrated student model for story and equation problem solving, uses an ACT-R based cognitive model (MacLaren & Koedinger 2002). Other systems are the Empirical Assessment of Comprehension (Mathan & Koedinger 2002) and the Engines for Education (Schank & Cleary, 1994). The model of literacy comprehension (Zwaan, 1996) takes into account the predication semantics model of text comprehension and recall (Turner, 1996) and is based on the Construction-Integration model (Kintsch, 1975). The model of narrative comprehension and recall (Fletcher, 1996) is based upon Trabasso & Van den Broek's model (Trabasso, 1985), which considers understanding of text as a process of finding (by the reader) the causal path which links text from the beginning to its end. Recently, various approaches have been proposed which involve learners in negotiating dialogues, as well as learner models which encourage learners towards inspection and modification

of the model (Dimitrova, 2002; Zapata-Riviera & Greer, 2002). Moreover, developments promoting collaborative student modeling such as SQL-Tutor (Bull, 1997), dialogue planning (Freedman, 2000; Watson, 1997), learner reflection through discussion such as StyLe-OLM (Dimitrova, 2002), mixed -initiative dialogue (McSherry, 2002), dialogue management (Freedman, 2000, Zinn et al., 2002) and tutorial dialogue (Schultz et al., 2003) have been explored. ATLAS-ANDES is a tutorial dialogue system, which uses a combination of knowledge construction dialogues and allows the generation of tutorial dialogues (Zinn et al., 2002). ScoT is a scalable, reusable, conversational tutorial dialogue system (Schultz et al., 2003).

In this paper we present ReTuDiS, a dialogue-based reflective learning system, which constructs dialogue based on the learner model for Historical Text Comprehension (Grigoriadou et al, 2003; Tsaganou et al., 2003b). First, we outline how the system bases learner's historical text comprehension on the recognition of general cognitive categories. Applying the hybrid technique of Fuzzy-Case-Based Reasoning, the system infers learners' cognitive profiles in the diagnosis part and constructs the learner models. In the next section we describe how the strategies of the Theory of Inquiry Teaching (Collins, 1987) are adopted in the dialogue part. We concentrate on how the appropriate tutorial dialogue is generated using the library of dialogue-parts. Moreover, in this section, we display the four- stages interactive dialogue between a learner and the system, as well as how the dialogue engages learners to reflect on their own strategies in each of these stages. Formative evaluation and results are discussed. Finally, we conclude and give our future perspectives.

ReTuDiS

ReTuDiS is a diagnosis and tutorial dialogue learner modelling system, which infers learners' cognitive profiles of historical text comprehension (Tsaganou, 2002). ReTuDiS, based on the Theory of Inquiry Teaching (Collins, 1987), exploits cognitive profiles to construct learner models and produce appropriate for each learner tutorial dialogues. ReTuDiS consists of two parts: The Diagnosis part and the Dialogue part.

The Diagnosis part of ReTuDiS

ReTuDiS is based on MOCOHN (Model of Comprehension of Historical Narration) a pencil-and-paper diagnosis model of learner's comprehension of historical text (Cavoura, 1994; Cavoura, 2000). Based upon the narrative approach of historical text (Ricoeur, 1983), the mental models of Johnson-Laird and Schank & Abelson's text comprehension theory (Schank & Abelson, 1977), MOCOHN adapts Baudet & Denhière's theory (Baudet & Denhiere, 1992) for historical text comprehension. It considers text comprehension as the attribution of meanings to causal connections between occurrences in a text. Learners compose a representation of the historical text, which contains the cognitive categories: *event*, *state* and *action* (Baudet & Denhiere, 1992). Learners' arguments are based on the three cognitive categories. For the interpretation of learners' cognitive processes learners' discourse is analysed, in order to trace the recognition (or not) of the three cognitive categories. MOCOHN gives an explanation of the way students represent the world of history and the way their cognitive processes lead to comprehension of a historical text.

ReTuDiS system is designed to be applicable not only to historical texts but to any texts with a causal structure. The diagnosis part of ReTuDiS engages learners in an activity which includes reading comprehension of a historical text and answering question-pairs by using given alternative answers (Tsaganou et al., 2002; Tsaganou et al., 2003a). The historical text includes factors, which represent the three cognitive categories *action*, *state* and *event*. For every factor at least one question-pair, is submitted to the learner. The first question in the question-pair is related to the causal importance of the specific factor and a learner's answer concerning this question is called *position*. The second question is related to a learner's justification concerning the selected position and is called *justification*. Learners have to study all the text to comprehend it, to compare each factor with the others and then select answers. The purpose of the activity is to train learners in procedural knowledge. The types of cognitive processes learners expected to activate correspond to Bloom's taxonomies: (1) remember, (2) understand: learners compare factors, explain them, draw logical conclusions using the presented material and (3) analyse: learners distinguish important from unimportant factors (Anderson et al., 2001). Learners' answers are used for diagnosing their historical text comprehension. The learner has to use the given alternative answers, in order to express his position for certain historical issues and support it by selecting a justification. Alternative answers concerning position and justification are classified as *valid*, *towards-valid* or *non-valid* as they are depicted in Tables 1 and 2. Figure 1 depicts a historical text concerning five different factors of the outbreak of the French Revolution. It also depicts question-pair number 1 and alternative answers with (non-visible by the learner) characterizations. In the historical text, one factor represents the cognitive category event, another one

the cognitive category state and three others the cognitive category action. For example, for question-pair 1 the alternative answers a1 and b3 are non-valid, a2, b1 and b4 are towards-valid, whereas a3 and b2 are valid.

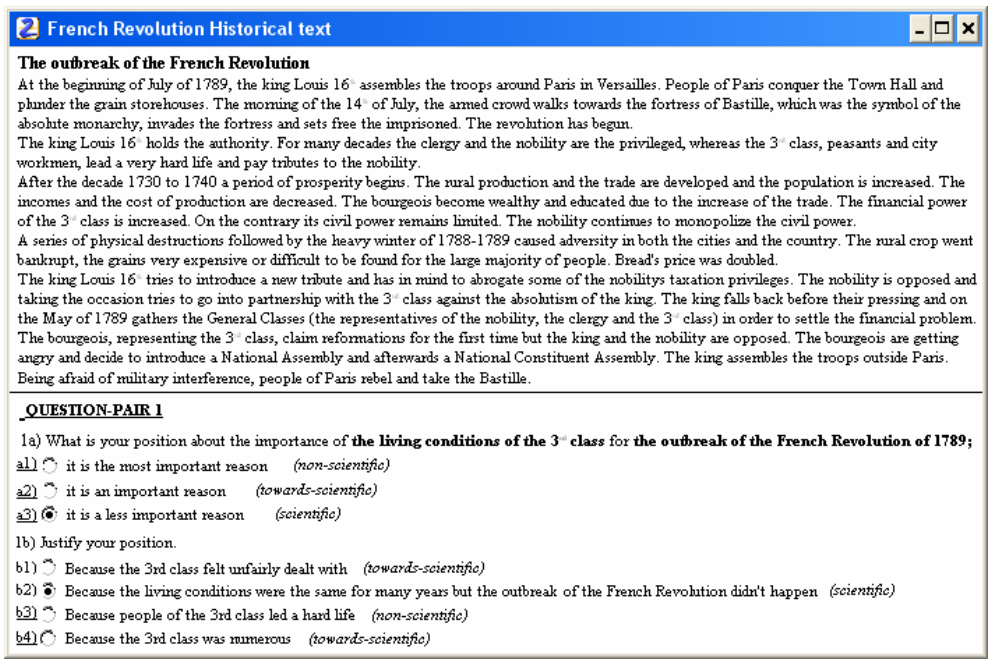

Figure 1: A screenshot of ReTuDiS

Table 1. Classification of answers concerning position

position	**answers**
valid	learners attribute minimum importance to an event and a state and maximum or medium importance to an action
towards-valid	learners attribute medium importance to events and states
non-valid	learners attribute maximum importance to an event or minimum importance to an action

Table 2. Classification of answers concerning justification

justification	**answers**	
valid	learners grounded their answers on scientific historical thought	
towards-valid	learners based their answers on the *common sense* schemas of experience, quantity, continuity and attitudes, which means learners are towards acquiring scientific thought	*experiential*: learners used their own experience or sentiment to strengthen their position
		quantity: learners used quantitative criteria to strengthen their position
		continuity: learners perceived the world as continuous
		attitudes: learners expressed positive or negative values (for example good, bad) towards the historical events
non-valid	learners gave cyclic answers based on the questions posed (non-scientific thought)	

For every question-pair the combination of a learner's *position* and the corresponding *justification* constitute the learner's *argument*. An *argument* is defined as *complete,* when both position and justification are *valid*. Otherwise the argument is *non-complete.* Possible values of argument completeness are: c*omplete, almost complete, intermediate, nearly incomplete* and *incomplete.* The expert defines the different degrees of argument completeness. Argument completeness --which is associated with the recognition (or not) of an instance of a cognitive category-- is used as a vehicle for revealing the degree of recognition (or not) of the corresponding cognitive category. In case an argument is *non-complete*, it means that there is a contradiction between *position* and *justification* for the corresponding question-pair.

The Diagnosis part of the system, using IF…THEN rules, which incorporate the description of expert knowledge concerning learner answers to question-pairs, infers the argument completeness of all the learner arguments. Learners' behaviour, represented by the characterisations of positions, justifications and arguments, constitute the problem description of the corresponding case. A case is viewed as a set of attributes where the characterisations are the problem description and the cognitive profile is the solution. Representative cases constitute a case-base. Using the technique of Fuzzy-Case-Based Reasoning the system handles case adaptation --by comparing the similarity values of argument completeness between cases—in order to infer learners' cognitive profiles (Tsaganou et al., 2003b). Based on the hypothesis that similar problems have similar solutions the system estimates the degree to which a case is similar to a case stored in the case-base, using a fuzzy k-nn algorithm. The system adopts the cognitive profile of the most similar case. This technique achieves the right balance between the hard to acquire expert knowledge and the more easily acquired knowledge in the form of cases (Watson, 1997).

Learners' cognitive profile is measured by the degree of argument completeness and reflects the degree of recognition of all the cognitive categories: event, state and action while expressing learners' difficulties, if any, in thinking scientifically. Cognitive profiles represent a learner classification scheme and correspond to the main levels of scientific (historical) thought. The main categories of cognitive profiles are: (1) *Low* profiles for learners who seem to encounter serious difficulties, (2) *Intermediate* for learners who seem to encounter some difficulties on which the reflective dialogue focuses in order to help learners overcome them and (3) *High* for learners who seem to have no learning difficulties. The target group the system focuses upon includes learners for whom the system diagnoses contradictions between a position and a justification for a given question-pair, a fact which means that they encounter difficulties in thinking scientifically.

The Dialogue part of ReTuDiS

ReTuDiS aims at constructing reflective dialogue concerning learners' contradictions in their answers. The learning outcomes are summarized as follows. Learners must be able:

1. to recognize the three cognitive categories *state event* and *action*
2. to appraise a factor in the historical text which corresponds to the cognitive category *action* as the most important cause rather than to a *state* or *event*.
3. to meet reflective dialogue and to construct coherent arguments, which means without contradictions between a *position* and its *justification*.

The underlying theory beyond the tutorial Dialogue part of ReTuDiS is the Theory of Inquiry Teaching (Collins, 1983). This theory is prescribed as a theory for the use of discovery and inquiry approach in learning. Many of its strategies are intended to develop higher thought processes rather than content-specific know1edge. Questions provide the focus and direction for the instruction through reflective tutorial dialogue. Learners formulate hypotheses based on observation of varied cases (examples), in order to force greater depth of processing of the new knowledge. In ReTuDiS the following tactics are adopted in dialogue part as instruction tools:

1. Selecting Positive and Negative Examples. When a learner considers an accidental event like "the heavy winter of 1989" as more important than an action, the system presents positive paradigm cases like "an earthquake".
2. Selecting Counterexamples. If a learner forms a hypothesis which is not completely true, the system will often select a case, which satisfies the learner's hypothesis but violates the hypothesized prediction. For example, the learner considers "living conditions of the 3rd class before 1789" as the most important cause. The system's counterexample can be: "whenever people's living conditions are bad, do we have a revolution?"
3. Generating Hypothetical Cases*:* generate hypothetical cases in order to force learner's reasoning about situations that are hard to reproduce naturally.
4. Forming Hypotheses*:* try to make the learner predict how a dependent variable varies with one or more independent variables or factors. The system generates the hypothesis that "if the heavy winter of 1789 had not happened, would the outbreak of the French Revolution have happened?" in order to make the learner reason about it.
5. Testing Hypotheses. Once learners have formulated a hypothesis, the system wants them to figure out how to test the hypothesis.
6. Tracing Consequences to a Contradiction. System often traces the implications of a learner's answer to a contradiction with some other belief the learner holds.

The dialogue part of ReTuDiS uses information included in a case: characterizations of the learner's positions, justifications and arguments, the learner's cognitive profile inferred by the diagnosis part and the dialogue strategy. In order to generate the appropriate dialogue in response to learners' feedback, the system assesses the contradictions within the learner's arguments in the corresponding case. Depending on the characterizations of positions and justifications the dialogue part activates the appropriate for each learner sequence of dialogue-parts, and by using the dialogue plan, dynamically constructs the individualized learning dialogue. Dialogues are appropriate to each learner's learning difficulties, as they appear according to his/her learner model.

Dialogue Strategies

Tutorial strategies are methods for constructing an initial plan for reflective dialogue. ReTuDiS is designed to allow for reflecting tutoring. In order to construct an initial overall tutoring plan, the system uses information from the annotated case of a learner's performance in a comprehension activity concerning a historical text. The initial tutoring plan can be dynamically revised during the tutorial dialogue. ReTuDiS presently has three main strategies for taking instructional decisions and constructing the initial tutorial plan. The system tries to find out if there is a contradiction between characterisations of a position and a justification. One of the following strategies can be applied:

1. *Strategy 1:* the system selects the factor, which the learner considers as the most important of all others. The Tutorial dialogue begins with a discussion about this factor.
2. *Strategy 2:* the system sorts learner's argument characterizations in a list according to decreasing degree of argument completeness. The reflective dialogue begins with a discussion about the factor for which the learner seems to face minor contradictions. The system generates the sequence of dialogue-parts for this factor (initial plan). Then the system prepares the next sequence of dialogue-parts, based on the results of the previous.
3. *Strategy 3:* the system examines every factor, in order to find out if there is a contradiction between characterisations of position and justification (for example, valid position and non-valid or close-to-valid justification and the contrary) and ignores the factors for which there is no contradiction, either because both position and justification are valid or because both position and justification are non-valid.

Dialogue-parts Library

The system has at its disposal the *dialogue-parts' library* (Tables 3, 4), which contains *general* dialogue-parts and *specific* dialogue-parts of different types. Each general dialogue-part is seen as a reusable component for the construction of the dialogue between a learner and the system and is independent of the historical text. Each specific dialogue-part is seen as a reusable component, which is dependent upon the specific historical text. Specific dialogue-parts which learners use in the dialogue are the alternative answers. Specific dialogue-parts, which the system uses in the dialogue, follow dialogue tactics and are designed to remedy a particular learning difficulty.

Table 3. Dialogue-parts library- General parts

types of dialogue-parts	*dialogue-parts*
comparisons	the most important cause, important cause, less important cause
position or justification descriptions	valid, towards-valid, non-valid
argument descriptions	complete, almost complete, intermediate, nearly incomplete, incomplete experience, quantity, continuity, views, cyclic
explanations	explain, don't explain
intentions	insist, don't insist
selections	happened, not happened, yes indeed, no I don't believe, yes I'd like, no I don't like
contradictions	contradictory to, not contradictory to

The dialogue part of ReTuDiS generates the appropriate to each learner tutorial dialogue using the library of general dialogue-parts (Table 3).

Table 4: Dialogue-parts library- Specific parts

types of dialogue-parts	*dialogue-parts*
factors	the living conditions of the 3rd class, the heavy winter of 1789, the financial development during the decade 1930, the convergence of the general classes by the King, bourgeois and 3rd class jointly claim for constitution
learner's argumentations expressing:	
scientific thought	the living conditions were the same for many years
experience	the 3rd class felt unfairly dealt with, despite the financial development 3rd class continued to be displeased, the delegates of the bourgeois are indignant towards the King and the nobility
quantity	the 3rd class was numerous, the more the people the more the possibilities for success, due to the heavy winter the life of a large number of people became harder, the financial development increased the number of bourgeois
continuity	the heavy winter made the poverty worse, bourgeois and 3rd class share the same goals
views	due to the heavy winter the rural crop was bad, people work and the nobility enjoy
cyclic thought	3rd class lead a hard life
system argumentations expressing:	
examples	the heavy winter or an earthquake are accidental events
counterexamples	whenever the living conditions of people are, bad do we have a revolution? whenever a social part is unfairly dealt with or is displeased, do we have a revolution? is a revolution always provoked by numerous social parts?
generation of hypothesis	form the hypothesis that the living conditions as a cause for the French Revolution didn't exist.

Dialogue Plan

Dialogue is generated in 4 stages (Figure 2). A sequence of dialogue-parts, each based on the results of the previous stage, constructs the dialogue plan (Table 5).

STAGE 1: The system makes learners aware of the general framework of the assessment results, that is whether learners are correct or not, and encourages them to take their first decision to participate in the discussion. Dialogue-part S1D1 is generated by the system, in case learners want the system to explain them the differences between their answers and the system concerning an argument. Dialogue-part S1D2 is generated in case learners do not want the system to explain them the dialogue concerning their argument. Dialogue is thus terminated.

STAGE 2: The system uses qualitative criteria to indicate the points where there are contradictions between learners' position and their justification. Dialogue-parts S2D1 to S2D5 are generated by the system according to the different combinations of learners' responses, which correspond to different degrees of argument completeness and are related to one of the five factors in the historical text. When dialogue-part S2D5 is generated, the system responds appreciatively as regards learners' abilities and encourages them to return to stage 1 and continue with the next argument.

STAGE 3: Each learner's decision triggers the system to use the appropriate individualized tactics. The Dialogue-part S3D1 is generated, in case learners insist on their answer and dialogue-part S3D2, in case they do not insist, which means that they recognize their contradiction and change their reasoning.

STAGE 4: The system discusses, justifies itself and argues with learners over their contradictions. The appropriate dialogue-parts S4D1, S4D2 and S4D3 are generated, in case learners insist on position, on justification or on both respectively. The actions of the system have to be driven towards eliminating the contradiction. The elimination will only be possible when learners themselves remove the contradiction and are thus able to construct a more coherent argument. At the end, the system encourages learner to try again to read

the historical text and answer the questions, so that it can have a second opportunity to reassess learners. In this way, learners are involved in the diagnosis process and are expected to change their model.

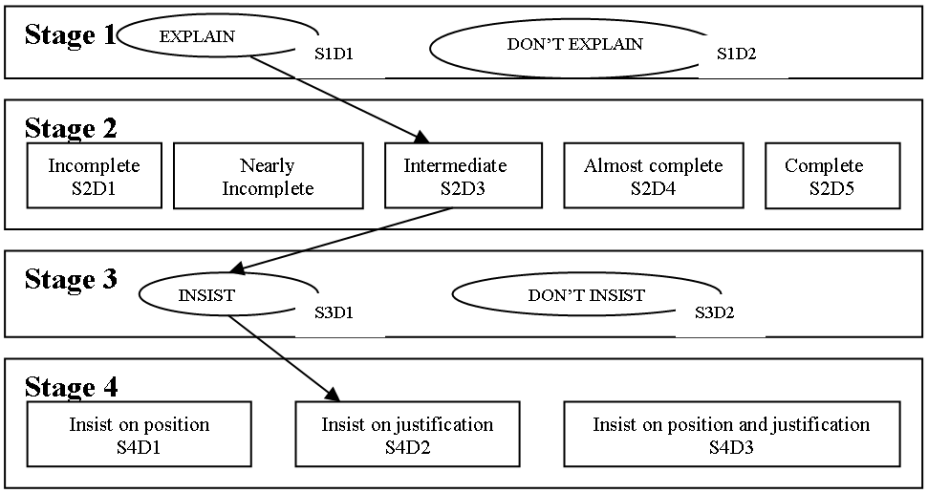

Figure 2: Dialogue stages

Table 5: Dialogue Plan

1 System: Your answers concerning the …(*factor*) indicate that you consider it as … (*comparison*) for the French Revolution. Your argument is characterized …(*description*). Do you want the system to… or to….? (*selection)*
Learner: I'd like to …(*explanation)*
2 System: You asked the system to explain. Your answers concerning the …(*factor*) consist of your position and your justification. Your position is that the …(*factor*) were… (*comparison)* for the French Revolution. This is a …(*description*) position. Your justification for that position is that the …(alternative answer). This is a …(*characterization)* justification.
Your position on the …(*factor*) is …(*contradiction)* your justification. That is why your argument is characterized …(*description*). What do you intent to do now?... or ….(*intention)*
Learner: I …(*selection*) on my position that the …(*factor*). … (*comparison).*
3 System: You …(*decision*) on your position. Let's consider that the …(*factor*) as a cause for the French Revolution didn't exist. Do you believe that the outbreak of the French revolution would have happened?
Learner: I believe that the outbreak of the French revolution would have …(*selection*).
System: But the outbreak of the French revolution has happened. So, what is your logical conclusion?
Learner: The …(*factor*)…(*comparison*)
4 System: Would you like to try to answer again?....(*selection*)

Dialogue Tactics

The following dialogue example (Table 6) illustrates the interaction concerning question-pair 1. The learner has given non-valid position and valid justification, which correspond to answers a1 and b2 of Figure 1 and result in an intermediate argument of the category state. ReTuDiS uses dialogue tactics to support tutorial interactions. For example, in turn 3, the tactics: selection of counterexamples and generation of hypothesis are used. The learner considers the "living conditions of the 3rd class before 1789" as the most important cause. The tutor's counterexample can be "whenever the living conditions of people are bad, do we have a revolution"? In order to make the learner reason about it the tutor generates the hypothesis that: "if the heavy winter of 1989 had not happened, would the outbreak of the French Revolution has happened"?

Table 6: Dialogue example in 4 turns concerning an argument

1 System: Your answers concerning the LIVING CONDITIONS indicate that you consider it as THE MOST IMPORTANT CAUSE for the French Revolution. Your argument is characterized INTERMEDIATE. Do you want the system to EXPLAIN or to CONTINUE?
Learner: EXPLAIN
2 System: You asked the system to explain. Your answers concerning the LIVING CONDITIONS consist of your position and your justification. Your position is that the LIVING CONDITIONS were THE MOST IMPORTANT CAUSE for the French Revolution. This is a NON-VALID position. Your justification for that position is that the LIVING CONDITIONS WERE THE SAME FOR MANY YEARS. This is a VALID justification.

Your position on the LIVING CONDITIONS is CONTRADICTORY TO your justification. That is why your argument is characterized INTERMEDIATE. What do you intent to do now? INSIST or NOT INSIST.
Learner: I INSIST on my position that the LIVING CONDITIONS ARE THE MOST IMPORTANT CAUSE.
3 System: You INSIST on your position. Let's consider that the LIVING CONDITIONS as a cause for the French Revolution didn't exist. Do you believe that the outbreak of the French revolution would have happened?
Learner: I believe that the outbreak of the French revolution would NOT have HAPPENED.
System: But the outbreak of the French revolution has happened. So, what is your logical conclusion?
Learner: The LIVING CONDITIONS ARE NOT THE MOST IMPORTANT CAUSE
4 System: Would **y**ou like to try to answer again?

Formative Evaluation

Formative evaluation was conducted as part of the development cycle of the system using the web-based version of ReTuDiS (http://m.1asphost.com/kostas74/History/first.asp) and with the participation of human experts. Their comments were recorded and an interview at the end clarified uncovered aspects. Evaluation aimed at further revisions, modifications and improvements (Mark & Greer, 1993; Mitrovic et al., 2002) and focused on indicating problems with dialogue coherence, suitability of dialogue tactics and strategies appropriate for planning effective diagnostic dialogues. The experts were given explanations about the aims of ReTuDiS and asked to explore a variety of potential situations envisaging learner's behaviour who would discuss his domain knowledge with the system.

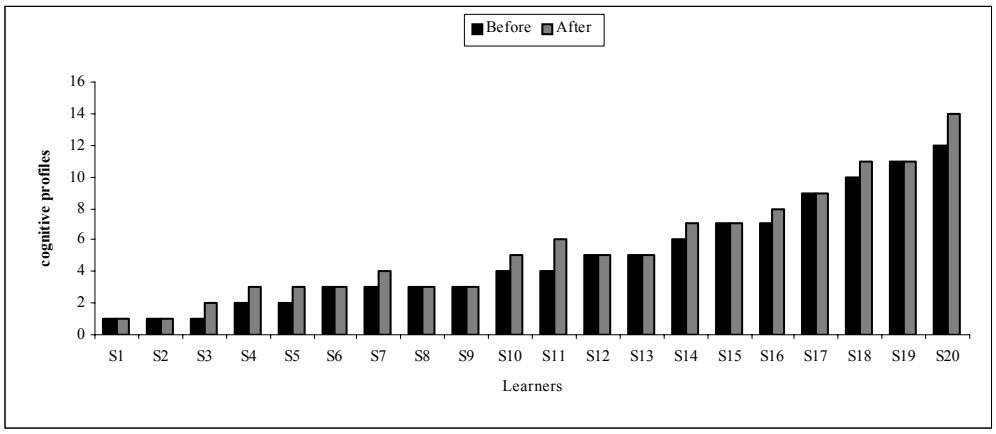

Figure 3. Changes in the cognitive profiles

ReTuDiS recorded learners' answers and inferred their cognitive profiles, taking into account their argument completeness for all stated arguments, before and after the application of the reflective dialogue. Figure 3 presents learners' cognitive profiles before and after the application of the reflective dialogue. The horizontal axis shows the 20 learners (S1 to S20) classified from lower to higher cognitive profiles. The vertical axis shows cognitive profiles {very low, very low+, low, low+, nearly low, nearly low+, below intermediate, below intermediate+, above intermediate, above intermediate+, nearly high, nearly high+, high, high+ and very high}, which correspond to {1,2,3,4,5,6,7,8,9,10,11,12,13,14}. It is worth noticing that most of the learners with a high degree of argument completeness indicated improvement in their learner models. For example, in the group of learners S6, S7, S8 and S9 with a low cognitive profile, only S7 improved his cognitive profile by one level, whereas in the group of S10 and S11, with low+ cognitive profile, S10 improved his cognitive profile by one level and S11 by two levels.

In general, dialogue planning appears suitable for organising dialogue which meets the requirements of dialogue-based interactive and reflective learning. The dialogue tactics in ReTuDiS have been considered adequate in respect to maintaining local focus of the dialogue. Few problems with the current implementation have been identified, e.g. occasional repetitions of statements and questions about already made claims have occurred. A richer domain knowledge base could lead to higher chances of obtaining adequate dialogue tactics.

Conclusions and Future Plans

In this work we have presented and evaluated ReTuDiS. Based on diagnostic results, the dialogue part engages learners in learning dialogues according to appropriate dialogue strategies and tactics. Dialogue indicates contradictions amidst learners' answers and discusses with learners, in order to help them eliminate their contradictions. Dialogue promotes learners' reflection and helps them become aware of their reasoning process and construct more coherent arguments while leading them towards scientific thought. The application perspectives of this dialogue-based interactive and reflective learning environment aim at individualized learning, by activating the appropriate to a learner interactive dialogue with the system. There are apparent educational benefits of the system in that it can help learners change their reasoning.

The research contribution of ReTuDiS, in contrast to related systems (Cavoura, 2000, Fletcher, 1996), consists in its computer-based nature for learner modeling comprehension of historical text basing comprehension on the recognition of general cognitive categories. Another innovation of ReTuDiS is the use of the hybrid technique of Fuzzy-Case-Based Reasoning in the diagnosis part for the educational purposes of diagnosis of historical text comprehension (case construction, definition of similarity measures). Moreover, innovation is the application of the Theory of Inquiry Teaching and the construction of the dialogue part (general dialogue-parts which are reusable for any new historical text, specific dialogue-parts, dialogue tactics, strategies and plans) for personalized reflective learning. The complexity of the application of a new text in ReTuDiS consists in the selection by the expert of a text with a causal structure, the definition of the factors in order to have them correspond to the cognitive categories, the construction of the appropriate question-pairs with alternative answers, the enrichment of the case base with new cases, the definition of the similarity values and the formulation of the specific reflective dialogue-parts, which are not reusable as the general are. The evaluation results are encouraging for the educational impact of the system on learners and for future work. In our future plans we foresee further research into the application of ReTuDiS to new historical texts and to technical text comprehension. Lastly, an authoring tool for the application of a new text in ReTuDiS is still under construction.

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