Towards an Explicit Instructor Model

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Abstract. Our long term aim is to reach an easily available, flexible and complete instructor model of an Intelligent Tutoring System. In order to get our objective, we propose a new instructor model where intentions of actual instructors are shaped into adaptive tutoring strategies. The key idea involves an instructor acting as she if was a knowledge engineer, proposing goals and softgoals, and choosing resources and tasks in order to reach them through an ITS. We present a preliminary conceptual approach to an explicit instructor model. When an author/instructor delivers to system her personal experience, ITS captures these individual features. Each instance of the model would be an instructor with a clear profile acting according to specific behavior. So, a student would choose a personal instructor that matches better her learning style.

Keywords: Artificial Intelligence in Education (AIED), Intelligent Tutoring System (ITS), Instructor model.

1 Introduction

A main problem of ITSs spreading appears when a real instructor wishes to use it and the system is not prepared to the instructor´s personal teaching style. If the teacher does not accept the ITS, she will not use it properly in a real class. A possible motive of this problem could be a wrong translation of actual tutoring strategies into a computational system.

Unfortunately, we have no scientific encyclopedia to consult the best tutorials heuristics. Instead, different teaching methods are adopted, because different students use different learning styles. Learning theories, instructional principles, teaching experiences, among other sources, have been used for developing teaching expertise. After tutoree knowledge is modeled, ITS pedagogic activity has usually been translated into rules collections that work relatively well in practice.

A recent approach proposes that a real instructor knowledge should be taken as one of the most important sources to extract the main lines of an ITS pedagogic knowledge [1],[2].

In everyday activity, a teacher plans her tasks according to the topic she is going to teach and the characteristics of the students group she will interact with, such as knowledge level and motivation level. However planning suffers modifications during the class as a result of the changes in the state of the students knowledge. That change, precisely, is difficult to anticipate because it depends on the individuality of each student. An experienced teacher can dynamically modify the planning , i.e., she provides a remedial action at the right time.

To model the teacher behavior, an ITS should include an explicit instructor model where to represent the goals the instructor wish to reach, the “secure” ones (e.g., teaching the topic X to a group of students) as well as the ones “I want to accomplish”(e.g., meaningful learning to all the group). These aspirations can be represented as a dynamic group of intentions. We follow John R. Searle´s intention concept[3], which he describes as an Intentional mental state. Such state is directed to something, e.g., ‘I want to teach how subtract’. According to Searle, intention encompasses the two basic Intentional states: belief and desire. The manipulation process of these intentions includes their acquisition by a computing system, their explicit representation, and finally, their translation into tutorial activities leading to intentions fulfillment. This work is part of our ITS ongoing development [4],[5] and in this case, we focus on the instructor intentions acquisition at conceptual level. To model instructor behavior we use concepts and models of a novel agent-oriented software development methodology named Tropos [6] which was inspired in the framework *i** [7].

2 An Intelligent Teaching/Learning Environment Approach

The usual objective of Intelligent Tutoring Systems is to model student behavior in order to deliver individualized instruction to each one of them. However, an ITS behavior can be improved by emphasizing tutoring expertise based on real teacher/professor activity, too. A tutoring system architecture has to be developed with components that support tutor and student activities. Therefore, students and instructors are the main actors, as well as the ITS itself. Following Tropos methodology, actors ‘ desires and objectives turn into ITS goals. For example, in figure 1, early hardgoals, i.e, “I have to” (shown as round-square-shaped icon) and softgoals , “I wish ..” (represented as cloudy shapes) are presented.

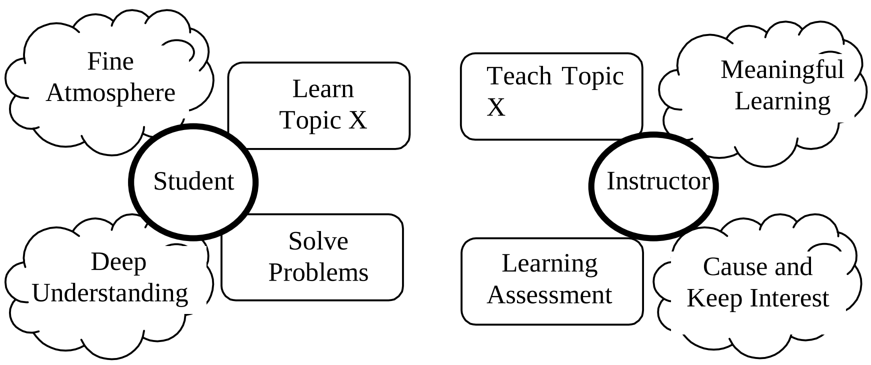

Fig. 1. early goals and softgoals of student and instructor

Definition of late requirements in i* introduces ITS as another actor and indicates what the relevant functions and qualities are. In this case, to model students, domain and instructor are the most relevant objectives, as usually are in any ITS. Moreover, a friendly and nice interface is desired. Currently, new and hard challenges appear in intelligent teaching environment research, namely, collaborative learning, dialogue processing and adaptive learning. All these ITS features would be included in useful systems.

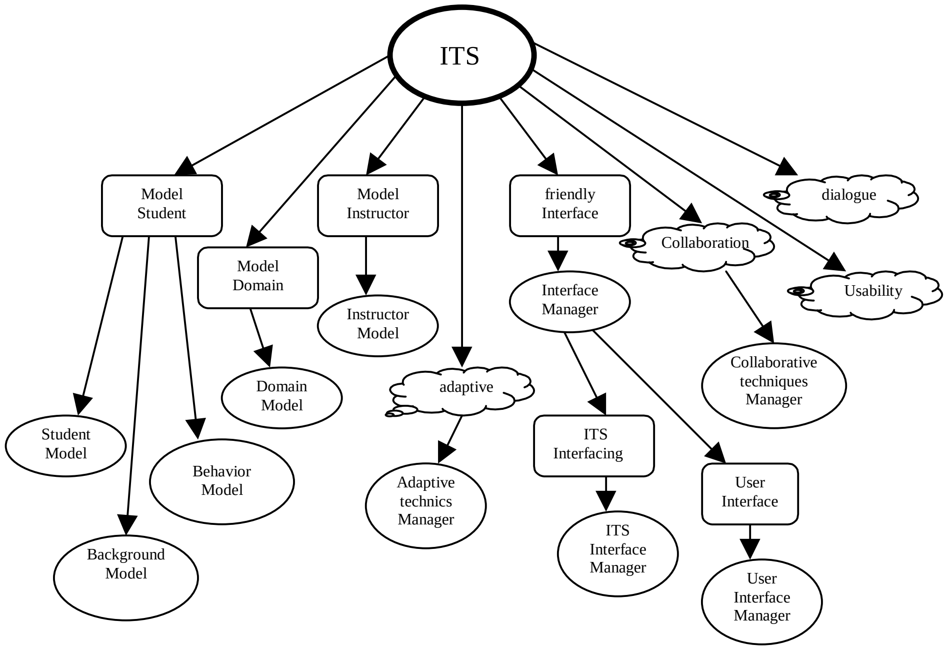

Fig. 2. Actor diagram of the architectural organization for ITS

Figure 2 illustrates a Strategic Dependency Model (early requirements) of ITS. It captures the relevant actors, their respective goals and their relationships. Actors decomposition in sub-actors that fulfil their objectives is presented too.

3 Instructor Model

In many ITSs, the *instructor model* is implicitly included and it has recently been developed explicitly [8]. We strongly sustain that instructors activity observation is a valuable source for teaching knowledge. Yet, teaching and learning theories influence the teaching practice as well. Nevertheless, the wealth of tactics and strategies employed by human expert teachers is still a main inspiration for ITS developers. In particular, we propose an explicit instructor model based on noticeable educational interactions. We focus on the following instructor model issues:

1. Tutorial strategies realism and adaptation improvement.
2. Intelligent individualized help provision for author/instructor.
3. Encourage to novice instructors to get involved in tutorial systems design .
4. Coordination and cooperation among several instructors during the ITS authoring.
5. Record each instructor activity.
6. Domain model improvement.
7. Default behavior

The first point focuses on Ohlsson criticism [9] about the restricted repertoire of teaching actions. The author bears that machine teachers concentrate on modeling and diagnosis at the expense of remedial actions and teaching. Our instructor model intends an iterative improvement cycle for tutoring strategies.

The second point pursues that a lot of experienced and “ordinary” teachers adopt ITS in their daily activity. All of them can be an “author” using intelligent help. This model feature would extend ITS spreading.

The third one attempts to involve novice instructors in ITS development. We suppose that young teachers accept new technologies in a natural way. The help system considers novice instructors too.

Point number four involves instructors with different level of experience. Cooperation among them would enrich instructor model, especially tutoring strategies building.

The fifth one points out that activity records of each human instructor supports the help system for others instructors, i.e., each author will be assisted by her colleagues through the accumulated register of her activity and the tool itself. The help system could also be supported by instructional design theories (e.g., Gagné or Merril theories).

Point number six follows two objectives: accordance in domain structure (diverse human instructors contribute to domain improvement) as well as domain acceptance by the users. It is a critical issue in ITS spreading that the instructor model pays attention to the domain model.

Finally, point seven points out that the instructor model will present a default teaching behavior running in background when an error occurs.

In order to reach the model function above-mentioned, the system could capture information on the instructor dynamic intentions (or objectives). At the very beginning, the initial intentions author emerge. For example we find instructor intentions related to their interests and usual activities (e. g. , preferred teaching style). Later, in student-tutoring system interaction phase, student interests appear (at this point, the coordination between student and instructor model is a very important issue). Among the first ones, we find instructor intentions referred to their interests and usual activities (e.g., preferred teaching style), and among the second ones, instructional plan alteration provoked by the actual students activity is encountered.

According to our instructor model outline, we present a Strategic Rational Model of it (we determine, through a means-end analysis, how the goals can be fulfilled through the contribution of other actors), in figure 3. We present two root tasks Initial intentions acquisition and Model evolution. The first one supports the hardgoal Instructional Planning and it is refined into several subtasks, namely, Tutoring Strategies Analysis, Student Hypothesis Analysis, Domain Hypothesis

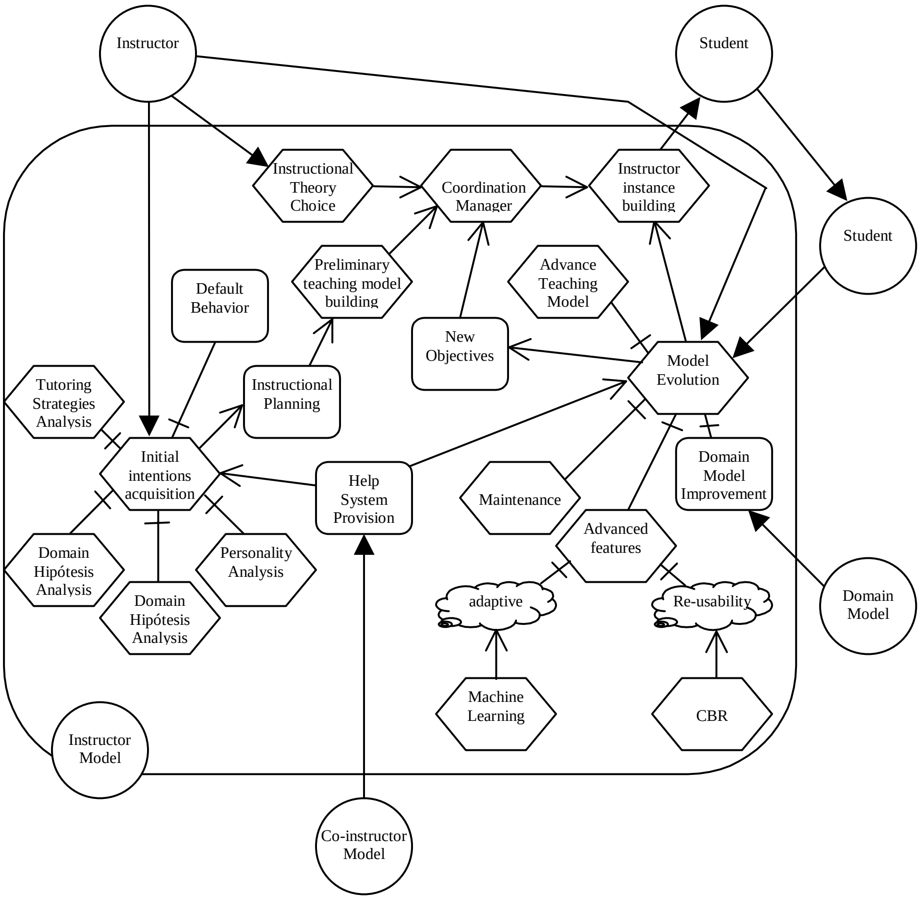

Fig. 3. Strategic rational model for instructor Model actor

Analysis and Personality Analysis, as well a goal Default Behavior. Especially, Tutoring Strategies Analysis translates initial teaching style proposed by instructors into formal tutoring strategies; Personality Analysis builds instructor profiles according to teachers choices and Default Behavior sets a teaching mode when the ITS does not reach a suitable instructor instance. The second one is refined into three subtasks (Maintenance, Advance Teaching Model and Advance Features). Because the task Advance Features becomes a relevant software responsibility, it is decomposed into two softgoals Adaptive and Re-usability. Machine learning techniques will support adaptive tutoring strategies modeling and Case Based Reasoning sustain re-usability feature. Advance Teaching Model is a teaching style improvement.

An outstanding objective is the Help System activity. This goal presents a strong dependency with the co-instructor model. Finally, the task Instructor Instance Building creates a virtual instructor that works with real students.

3.1 An Instructor Model with Personality

During initial intentions acquisition, personal features capture from human instructors are stood out. Our aim is to design and develop computational instructors with clear personalities. In this way, every real student can choose a teacher among several instructors. So, students could select a kindly or gracious teacher, among others. Along ITS execution, these instructors will acquire a precise profile.

3.2 Acquisition of Instructor Intentions at Conceptual Level

During the ITS authoring phase, there are two kinds of initial intentions: *delimited* (i.e., the instructor knows its definition well and the necessary means to achieve them) and *fuzzy* (i.e., instructor does not know them or how to achieve them, but she would like to). We represent the well delimited intentions with circles and the fuzzy ones with cloudy shape. The means to achieve these intentions (tasks and resources) are represented with an hexagon and rectangle respectively (based on i*, again):

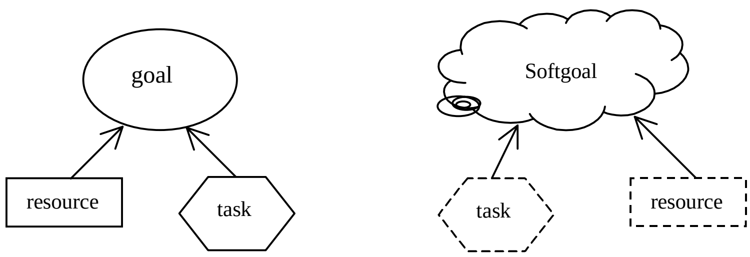

Fig. 4. hardgoals and softgoals representation

The dot lines indicate planned tasks in the early phase of instructional design and they can be modified during the execution. This phase is considered very important, because the instructor designs an ITS at a purely conceptual level. In figure 5, we present a simplified example of the intentions acquisition.

The success of the actual instructor intentions depends on different factors such as the students knowledge level, the emotional states, the team integration (they can have great individuality), age, experience, etc. As a result, to adjust the ITS design in

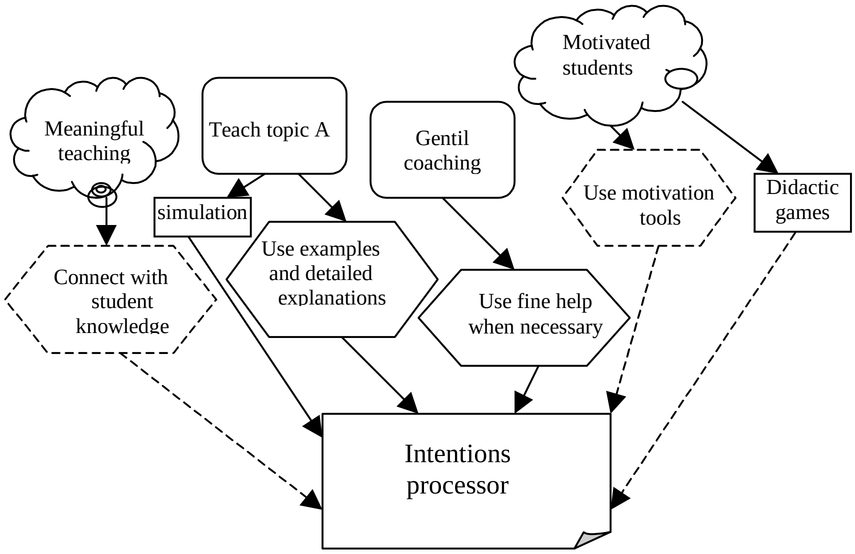

Fig. 5. example of human instructor intentions acquisition

its execution phase, you can modify the tasks and resources to achieve the new goal (or softgoal) if necessary.

The instructors may posses different levels of expertise, in consequence, the intentions may be different. If she possesses the level of an expert teacher, she could improve the course design. On the contrary, if the level is lower, she could learn about intelligent tutorial courses development. I.e., the ITS design and implementation become an *iterative refinement* process, its result will be to achieve better quality tutorial systems, encouraging the cooperation of authors.

3.3 Instructor Model Implementation

The key issue of how the capture of intentions would work in practice becomes a serious obstacle in our research work. To approach a solution, we propose, first, to assign a fulfillment coefficient to each goal and softgoal. For example, it could be an integer number between two limits. For goals the boundaries are 5 and 10. If the human instructor decides to rate a goal with 10, the system will have to carry it out with all the available resources. On the other hand, a five means that the goal could be left out. Softgoals have a lesser score. For example, it could be 0 to 5. Second, the tasks and resources of the system dedicated to the fulfillment of objectives adjust the success of the work system. Consequently, we need a trade-off between objectives and resources.

We will use multi-agent development methodology to implement our system. In particular, Protos would be our development platform.

4 Conclusion

The actual instructors intentions capture contributes to improve the ITS´s spreading, specially its utilization in classrooms by actual instructors. The possibility of intentions dynamic acquisition (propose, modify, divide or erase goals), in the design as well as in the tutor system execution, transmits security to the instructor because it does not need to create a “perfect” ITS before using it. This acquisition could be done with the intentions editor.

Even though the proposed conceptual design improves the relationship with instructors, there is still a problem with taking those intentions to a flexible tutorial strategies group in order to introduce changes made by the actual instructors.

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