EDUCATIONAL OBJECTIVES IN INTELLIGENT TUTORS FOR COMMUNICATION SKILLS

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ABSTRACT: *Intelligent Tutoring Systems have been successfully used to simulate human tutoring in various fields such as mathematics, physics or computer programming. The current paper discusses some of the particularities of designing such systems for the education of communication skills, specifically in a business setting (customer relations, employee communications etc). Since communication is an ill-defined domain (i.e. does not provide a systematic method to obtain a solution), various challenges arise. One of these challenges is the design of educational objectives – the module built on top of the system that would check the users' actions against predefined patterns and would provide the users with feed-back accordingly.*

KEY WORDS: *intelligent tutoring, computer systems, learning.*

JEL CLASSIFICATION: *D83, L86*

1. INTRODUCTION

The current paper will refer to communication skills in the context of business management, building upon existing research that considers communication as "the ability to make oneself understood, accepted and even followed" (Daly & Vangelisti, 2003) and shows that they are relevant in the human resources area and are as important to organizations as technical abilities (Green, 2000).

Intelligent Tutoring Systems (ITS) are complex applications that combine artificial intelligence techniques with pedagogical theories in order to provide training in a way that emulates human cognitive processes (Anderson et al, 1995), with the purpose of reaching the educational efficiency of one-on-one tutoring with a human expert professor Bloom (1984).

ITS have been successfully used in several domains, such as physics (Shelby et al., 2001), mathematics (Heffernan & Koedinger, 2002), programming (Corbett & Anderson, 1993; Quinson & Oster, 2015.) etc. Since ITS are based on various types of

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knowledge representation and are capable of monitoring users' interactions to provided adaptive feedback (Murray, 1999) they provide good opportunities to be used in the social skills domain.

To develop a ITS for communication skills, some pre-assumptions are considered:

First, the system should work as a Virtual Environment – scenario-based applications that allow virtual role playing, through a simulated environment. (Kerr et al., 2002).

Second, communication is dependent on the context, ie on other related communication acts or physical actions. The context gives meaning to a specific communication act – each such act may have different (even opposing meanings) due to the context, as shown in figure 1.
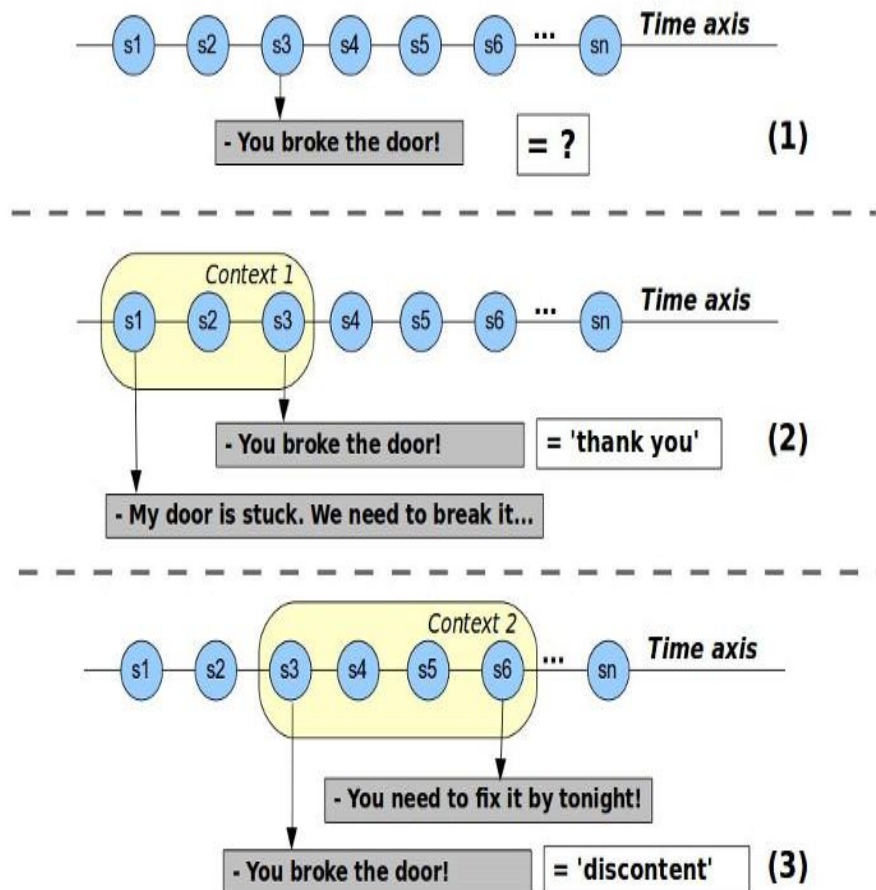

Figure 1. Context and meaning in communication

Third, since an ITS tries to emulate human tutoring, the educational objectives have to act as a scaffolding to instruction, as a guide for the user that provides feedback ment to give the user insight on the various aspects of communication that are relevant to the specific situation (scenario) at hand.

2. SYSTEM ARCHITECTURE AND MODELING

2.1. Architecture overview

Though several architectures for ITS have been proposed in literature (Murray, 1999), the current paper focuses on systems that work with an expert system as an interaction engine. The expert system contains a model of knowledge in the domain and should allow capturing of users' behavior by differentiating between "positive" and "negative" actions.

Thus, an ITS for communication should be constructed of three main components:

- *User interface:* allows the user to interact with the system, ie run the scenario and also provides the user with feedback according to his actions.
- *Expert module:* contains a rule-based representation of the domain knowledge, gives meaning to acts of communication between the user and the system and ensures the appropriate system response.
- *Student/tutor module:* contains a set of objectives related to possible user actions and some relations between these objectives; based on decisions of the expert module, the student/tutor module decides if the users' actions are aproppriate and provides specific feedback.

Figure 2 provides an overview of a proposed architecture for an ITS for communication skills, that is constructed around a rule-based expert system that records all system events in a *History* to allow constructing of a *context* for each communication action (as previously described).

The rule engine checks the rules in its knowledge base according to the history, decides the appropriate system response and sends a notification to the student/tutor module that is in charge of providing feed-back to the users on his choices. The rule engine is outside the scope of the current paper, which focuses on the student/tutor module.

The expert module and the student/tutor module are connected yet independent, making them two separate layers, with the tutor module on top.
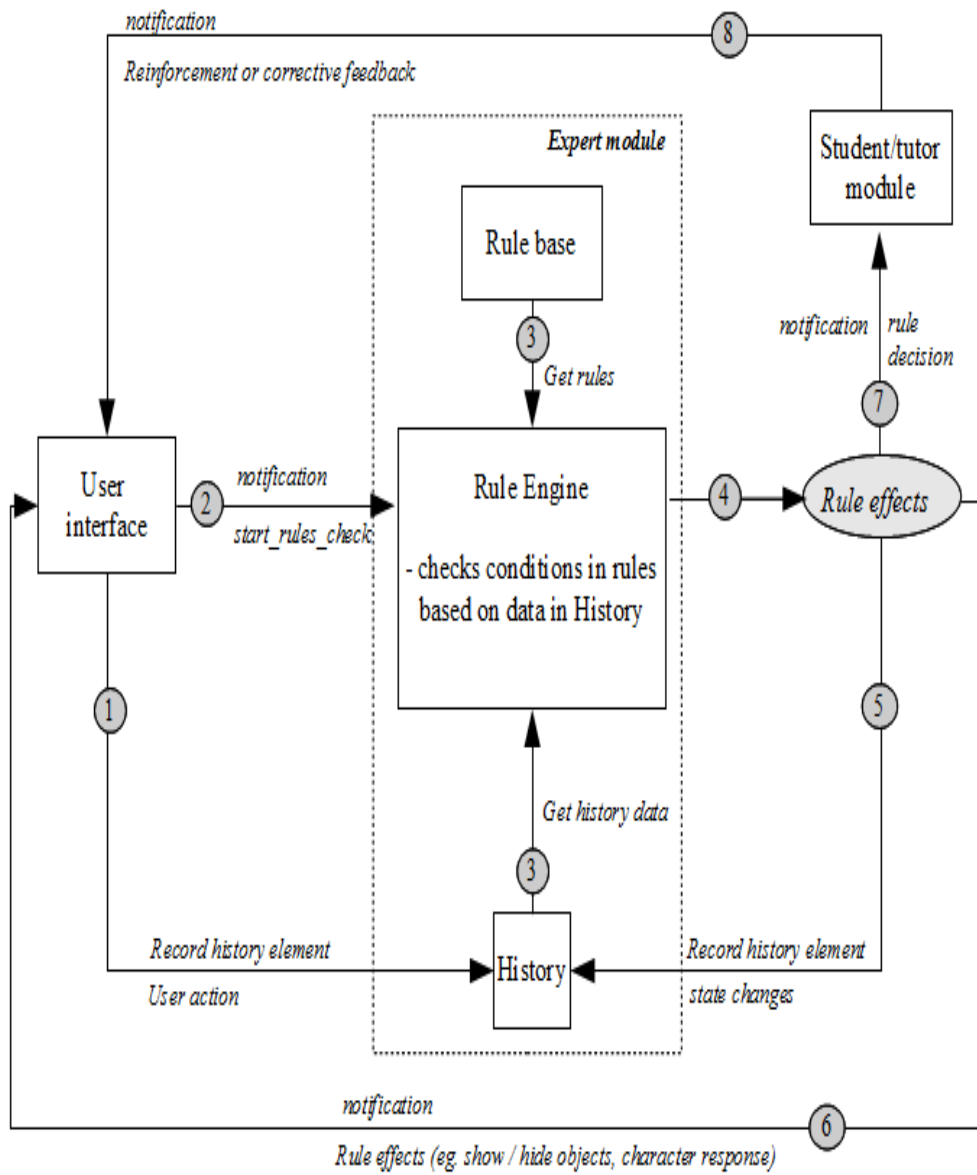
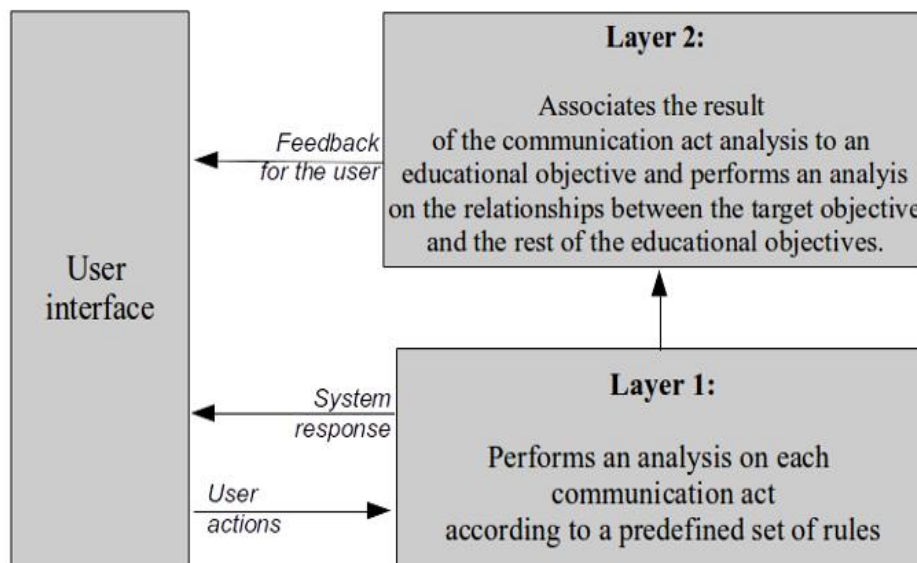**Figure 2. System architecture: overview**

Figure 3. Layer system: rules and educational objectives

2.2. The student/tutor module

This module should allow the definition of educational objective (ie – recommended behavior patterns). In defining these objectives and their place in the system, some considerations are in order:

Multiple solutions. In an ITS, a solution is seen as a sequence of actions of the user that validated a series of milestones in a specific order, and each action is seen as "positive" or "negative" according to the knowledge base (Anderson, 1995) . However, communication is considered an ill-defined domain which implies that more correct solutions are possible in any scenario (Lynch et al., 2006; Fournier-Viger, Nkambou, & Mephu, 2010).

For example, let's assume a scenario in which the user must conduct a meeting with a potential client. In such a conversation, several milestones may be considered "positive" such as greeting the client, asking the client about his requirements, giving the client various information or making a summary of the discussion at the end. Good communications may start either with asking the client about his requirements (Figure 4) or with giving the client information if he requests it first.

Relations between objectives. In tradition ITS, the order of reaching milestones is usually liniar and straightforward - solving an equation requires specific steps in a specific order. In communication, some milestones can be independent and some may follow relations such as order (some steps have to follow others).

However, the order can allow for greater degree of freedom if needed: two communication acts may be required to have an order, but not necessarily one

following the other – objective x may be valid, depending on the scenario, if for example it follows after an objective y, in no more than k actions.
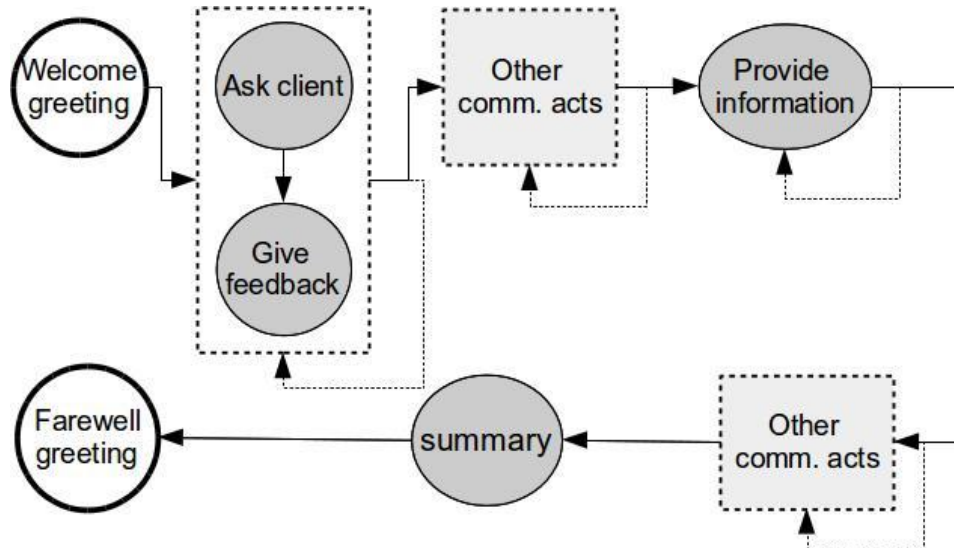
Figure 4. Possible solution: communication objectives, relations, iterations

In figure 4, objective "give feed-back" is only valid if it follows "ask client" directly, but objective "summary" is valid if "provide information" has been met at some point before (not necessarily in the previous action).

This can be solved by grouping objectives in sets, in such a way that the objectives in a set are independent from each other, but the sets allow setting relations among them.

Good, bad and irrelevant communication acts. Following the traditional ITS paradigm, a communication act may be "good" if the triggered rule (layer 1 in figure 3) is associated with a specific educational objective and in an acceptable position. However, in some cases, a communication act can be bad in itself, regardless of its position. This can be solved with "buggy rules" associated to "error objectives".

When a buggy rule gets triggered it will always prompt an remedial feed-back message. These are meant to capture frequent errors, between the triggering of regular goals. In other cases, communication acts may be irrelevant – they do not trigger any objective and should not influence the outcome.

Iterations and limitation of iterations. A particularity of communication is that some communication acts may be repeated (eg. You may need to ask your client more questions), yet some may be necesarry only once (figure 4). This has to be thought of on a case-by-case basis.

Reinforcement and corrective feedback. A communication tutor should provide both reinforcement (positive) feedback to ensure motivation as well as corrective feed-back to suggest ways of improvement.

Authoring tools. An essential part of the system should be the tools used to define the communication objectives for each scenario. Some objectives can be general (eg. "You should always start by greeting your counterpart") but since scenarios can be very different, they may need different objectives and / or different relations between objectives.

4. CONCLUSIONS

The current paper presents some considerations related to building Intelligent Tutoring Systems for communication skills. Since communication is an ill-defined domain, some particularities arise when designing the architecture of the system.

An important part of these particularities relate to the module that provides users with feed-back on their usage. This module should be designed in such a way that it is notified by the expert system that manages the systems' response to the users' actions and provide some important characteristics such as allowing multiple solutions, allowing both related and independent objectives and account for communication acts that may be irrelevant.

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