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ABSTRACT

This paper describes preliminary work on "Multiple Intelligent Mentors Instructing Collaboratively" (MIMIC), an intelligent Web-based agent environment for learning instructional design. The focus is on developing theoretical foundations of instructional design and instructional theory that form the foundation for systems development. In the proposed intelligent learning environment (ILE), intelligent agents will serve as mentors and learner companions in support of pre-service teachers (PSTs) in learning instructional design, a key aspect of their professional preparation. This environment also promises to promote higher-order thinking, stressing learning by reflection and metacognition. The paper discusses: the features of MIMIC; overall framework; motivational components; cognitive considerations for agent-based learning environments; and future theoretical development. An example is provided to illustrate the interactions that take place with the MIMIC system. (Contains 25 references.) (AEF)

MULTIPLE INTELLIGENT MENTORS INSTRUCTING COLLABORATIVELY (MIMIC): DEVELOPING A THEORETICAL FRAMEWORK

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INTRODUCTION

Imagine having a super-smart friend or colleague with whom you could study at any time of the day, who was always there to encourage and guide you. Or imagine having a job coach who could confidentially lead you through a complex work situation. Imagine now that the friend is not a human friend, but rather a computer program called an intelligent agent. People have always been fascinated with the idea of non-human computer assistants: androids, humanoids, robots, the mechanical maid "Rosie" in the cartoon "The Jetsons." But what about the possibility of intelligent agents serving as computer-based instructors, mentors, coaches, or learning companions?

Intelligent agents have been predicted to be the most important computing paradigm in the next 10 years. Janca (1995) claims that by the year 2000 every significant application will have some form of agent functionality. Agent-based computing is becoming a focal point for several research programs and enterprise involvement world-wide. Consequently, the use of intelligent agents for educational purposes is of great interest.

From an educational vantage point, an intelligent agent is a computer program that simulates a human relationship by doing something that another person could otherwise do for you (Seiker, 1994, p.92). Hietala & Niemirepo (1998) suggest that the same social factors that occur in learning communities with human beings are also influential in a learning community consisting of multiple artificial teaching and learning agents. Yet there are distinct advantages of this intelligent learning environment (ILE) approach over a human-based approach. Consider the following:

1. the learner can take as much time as needed
2. the learner can learn at her convenience
3. the learner can adjust the interactions according to her preferences
4. the learner is encouraged to reflect on her thinking processes
5. the learner has a willing collaborator if desired for the learning process, and
6. the learner has a selection of teachers at her disposal.

Thousands of Web-based courses and other educational applications have been made available on the Web within the last five years. However, the majority of sites consist of static hypertext pages, meeting above features #1 and #2. The challenge is to develop advanced Web-based educational applications that offer interactivity and adaptability (features #3 through #6), which a learning environment with intelligent agents would offer. Considering the large amount of resources and attention that has recently been given to web-based instruction, this project is significant in that it proposes the development of an ILE and corresponding agent technology that will benefit the multi-million dollar investment made by educational institutions to re-purpose courses, certificates, and degrees.

The purpose of this paper is to describe preliminary work on this project, "Multiple Intelligent Mentors Instructing Collaboratively" (MIMIC), an intelligent web-based agent environment for learning instructional design. The focus here is on the developing theoretical foundations of instructional design and instructional theory that form the foundation for system development. In the proposed ILE, intelligent agents will serve as mentors and learner companions in support of pre-service teachers (PST) in learning instructional design: a key aspect of their professional preparation. Further, this environment will promote higher-order thinking, stressing learning by reflection and metacognition.

FEATURES OF MIMIC

MULTIPLE MENTORS FOR THE LEARNER

In terms of the theoretical foundations of MIMIC, the learner will have access to multiple teaching agents. Having several experts describing the instructional content matter from different points of view can be very rewarding for the learner (Laurel, Oren & Don , 1990). Since the learner may learn more from a teacher using a different learning style, multiple teachers can help the learner to establish the best personalized approach to understanding the content. Hietala & Niemirepo (1998) refer to this aspect as the need for pedagogical multiplicity of teachers. They suggest that the many levels and complexities of the learning process might be alleviated by providing more alternatives to the learner via an "extended family of intelligent agents."

An example of such a system is the ETOILE system (Dillenbourg, Mendelsohm & Schneider, 1994). ETOILE includes five teaching agents, labeled after the teaching styles they implement. They are called by the names of Skinner, Bloom, Vygotsky, Piaget, and Papert. Each tutor is implemented as an independent rule base. The five teaching agents implement decreasing level of directiveness: Skinner works step by stop, Bloom makes larger steps but with close control of mastery, Vygotsky is based on participation, Piaget intervenes only to point out problems and Papert does not interrupt the learner. This ETOILE system also includes a "coach" agent that is in charge of which tutor is used; however, the learner may also select or remove a tutor. In ETOILE, however, the pedagogical roles of the agents are separated out from the content, whereas MIMIC will be domain-specific to instructional design case studies.

To represent different areas of expertise within instructional design, reflecting Kafai's (1991) characteristics of instructional design as problem finding, personal expression, and problem solving, MIMIC will have three pedagogical agents. As modern conceptions of intelligence include a diverse set of characteristics, such as emotional intelligence, and multiple intelligences (Gardner) this will be reflected by the pedagogical agents. Specifically, the teaching agents will represent different teaching styles specifically related to instructional design instruction. First, the *Artist Agent* will reflect more creative aspects and personal expressiveness (e.g., humanistic aspects, role of intuition (e.g., Baylor, 1997b), teaching as a craft, existentialism, idea generation, motivational issues) of instructional design. Second, the *ISD Agent* will reflect the problem-solving aspects of Instructional Systems Design (ISD) as characterized by Dick & Carey (1978,1985,1990,1996) and also incorporating information processing theory and Gagne & Driscoll's events of instruction. Third, the *Alternative Views Agent* will reflect constructivist and other alternative approaches such as the following: post-modern instructional and semiotic theories, cognitive flexibility theory, Vygotskian theory, and situated cognition.

By taking into account these three perspectives, MIMIC provides the learner with a dynamic learning experience and a holistic view of instructional design. All three pedagogical agents will be grounded in empirical research with strong theoretical support for pedagogical methods. Also, each agent will be created independently and with strict attention to the theoretical literature, so as to eliminate bias as to which method is "better" by those involved in development.

Of course there is overlap across the different three perspectives, which must be accounted for and will factor into the agents' interactions. A few examples of the types of agents' suggestions to the PST (pre-service teacher) follow:

ISD Agent

- To take a more reductionistic, deductive approach breaking the situation into components (e.g., task analysis).
- To consider learning characteristics and careful diagnosis of prior and prerequisite knowledge.
- To systematically include practice and feedback in design of instruction.

Artist Agent

- To sense relationships using intuition (e.g., Baylor, 1997b)
- To vicariously imagine the instruction from the learner's perspective in terms of interest and motivation.
- To generate ideas and manage the "flow" of the information (e.g., idea generation literature).

Alternative Views Agent

- To promote the learner's need to construct the information as part of the designed instruction (e.g., constructivist literature or learning-by-design literature)
- To implement a more hands off & learner centered approach, situated to the learner's experiences
- To provide complex learning environments that incorporate authentic activity for the learner.

OVERALL FRAMEWORK

Together with extensive support from empirical and theoretical studies, the framework will also build upon theoretical work of learning through instructional design (e.g., Baylor, 1997a, 1998a), conceptualizing intelligent agents as cognitive tools (Baylor, 1999a) and mentors (Baylor, in press), and modeling cognitive processes such as intuition (e.g., Baylor, 1997b). The three agent pedagogies (Artist, ISD, and Alternative Views) are delineated after examining instructional research together with commonsensical notions of good instruction.

Together, the three approaches consider both the tangible (i.e., systematic problem-solving) and more intangible factors (i.e., teaching as an art/craft) that are involved with instructional interactions.

However, much of the theoretical framework for MIMIC will come through the inductive process of *creating* the system where multi-disciplinary knowledge about the instructional design process will be acquired, contributing to the general knowledge base in several fields. Significantly, the project involves both the application and development of theory.

APPEAL TO DIVERSE LEARNERS

Rich, multimedia-based case studies will form the content basis of the instruction, and will incorporate students from a variety of socio-economic levels, ethnic backgrounds, ages, gender, and geographical locations. Further, these students will also present a variety of learning styles and aptitudes to the PST, thereby incorporating individual differences in learning and the student's particular strengths (e.g., Gardner's theory of multiple intelligences). Additionally, it is conceivable that the student characteristics will be used by the agents to give suggestions to the PST that are more focussed to the student's abilities. For example, that a visually oriented student is helped by a visual metaphor.

AVAILABILITY OF LEARNING COMPANION FOR COLLABORATION IN PROBLEM-SOLVING

The PST will have an intelligent agent as a learning companion. The learning companion agents will replicate behavior of novices, that the user can "collaborate" with. A less capable computer-based learning companion is preferable for the student because it encourages him/her to teach the companion (e.g., Uresti, 1998). Results from Bransford's recent (1998) NSF grant in the area of teachable agents, where learners actually teach agents to solve math and science problems, will also be investigated.

EMPHASIZES HIGHER ORDER THINKING SKILLS, METACOGNITION, AND REFLECTIVE THINKING

A key goal of this research is to promote metacognition in learning instructional design. Schoenfeld (1987) describes three categories of metacognition: 1) knowledge of one's thought processes; 2) control or self-regulation; 3) beliefs or intuitions. This research focuses on the first and second categories: that metacognition incorporates knowledge and monitoring of one's thought processes. Information processing models of cognition (e.g., Pressley & McCormick, 1995) suggest the primary importance of metacognitive skills, particularly as metacognitive ability is a feature of expert problem solvers (Glaser & Chi, 1988). Where novices tend to focus on surface features of a problem, experts tend to better organize and represent the information and use more metacognitive skills. Although a metacognitive state may hinder intuitive ability (Baylor, 1997b), it is beneficial for other reasoning processes.

This theoretical foundation of MIMIC allows for intelligent agents to support an individual's metacognitive processes with the agent serving as a technological "reciprocal teacher" (e.g., Palinscar & Brown, 1984), prompting the individual to engage in analysis of his/her own cognitive processes. This tool serves to encourage the individual to asses what cognitive strategies are being used, similar to Salomon's pedagogic computer program, the Writing Partner (Salomon, 1993a), which asks the learner intelligent questions through the writing process. In MIMIC, the teaching strategy differences among the mentoring agents will be made *explicit* to the learner (as opposed to being built-in to the system and invisible to the learner) in order to facilitate reflective thinking. For example, at the completion of a case study, the PST will be provided with a demonstration of how each agent "solved" the case and then encouraged to reflect as to how it compared to his/her approach.

MOTIVATIONAL DEVICE

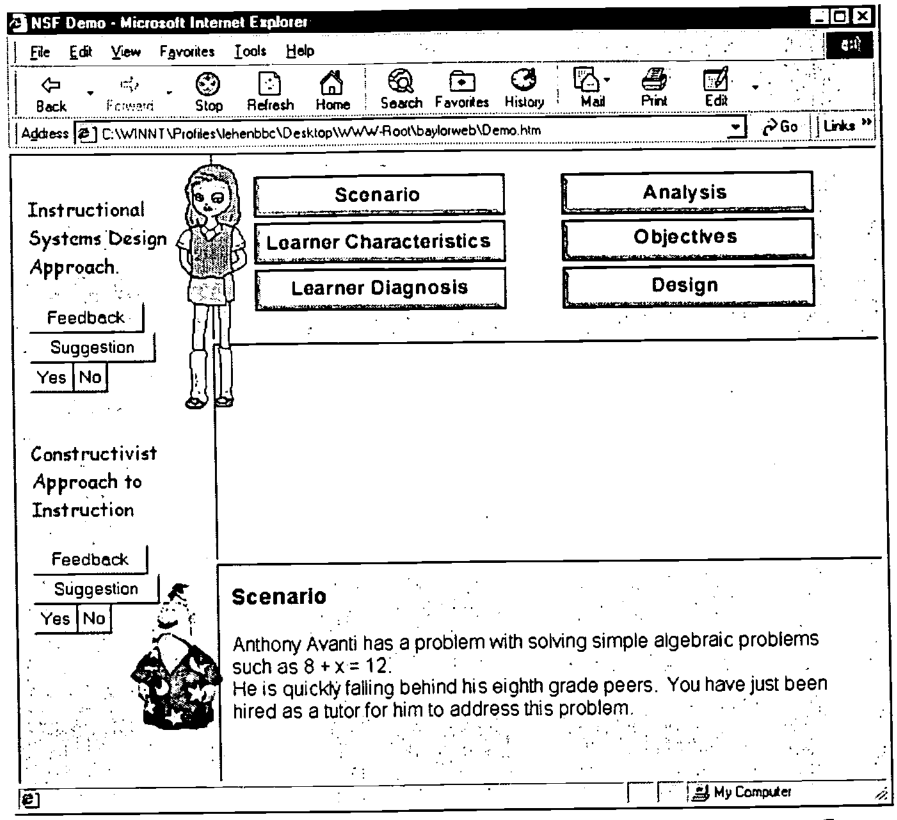
A critical factor regarding the person-agent relationship includes developing a social relationship of the agent with the learner. This relationship requires the intelligent agent to be perceived by the learner as trustworthy, honest, and cooperative while providing feedback. An important part of this feature is that the intelligent agent resembles a human mentor in terms of motivational qualities. As Lepper & Chabay (1987) propose, motivational components are as important as cognitive components for an intelligent tutor. Taking it one step further, they propose that bringing empathy to computer tutors is conducive to learning. Additionally, the intelligent agents will be conversational and invoke a human-like persona in their interactions with the learner. This area draws from Keller's ARCS theory of motivation, and work regarding agent persona (e.g., Laurel et. al., 1990).

EXAMPLE

The purpose of the following example is not to show what a complete product may look like, but to provide a sense of the interactions. For an even better illustration of the process, please see http://CyberLab.iupui.edu/baylor/MIMIC/ for a "live" demonstration of the following script. Note that this case study includes only two pedagogical agents plus a pre-service teacher in order to simplify the example. Also note that the *bases* for these interactions such as these will be founded on theoretical principles of instructional design.

Basically, the pedagogical agents "observe" the user and comment occasionally. At any time in the process, the user can request assistance from the pedagogical agents (e.g., to receive feedback or suggestions regarding what to do next). The system will occasionally make mistakes on purpose so that the user has to always be evaluating the results. And if the user does not detect the error, one of the agents would bring it to the user's attention that there is an error that needs to be detected. This facilitates metacognitive thought from the user throughout the entire process.

The MIMIC framework promotes non-linear instructional design, in that the PST would be able to occasionally "jump around" in the instructional process as the data may suggest, which is a characteristic of expert designers (Guindon, 1990). For example, in considering a procedural step such as to "apply toothpaste on brush," the PST may wish to record ideas with regards to implementation and development, such as to squeeze the tube from the end, or to use a rhyme to open/close cap, "righty-tighty, lefty-loosy". The complete system will have multiple levels (e.g., analysis, objectives, design, assessment) that are essentially linked microworlds for the user to work within.



For the purpose of this example, the following abbreviations will be used:

ISD Agent = traditional, instructional systems design approach

ALT Agent = alternative, constructivist approach to instruction

PST = pre-service teacher; the *user* of the system

<ALT AGENT> Click on the "Scenario" button to start..

<ISD AGENT> Click on the "Scenario" button to start..

<PST> selects "Scenario" button

DISPLAY (left panel): Anthony Avanti has a problem with solving simple algebraic problems such as 8+ x = 12. He is quickly falling behind his eighth grade peers. You have just been hired as a tutor for him to address this problem. (in final version would have video clip)

<PST> selects Learner Characteristics button

DISPLAY (left panel) in bulleted list: male, Hispanic, moderate SES level, good English, average aptitude in math; 13 years old

<PST> selects Analysis button

DISPLAY: Analysis workspace

<PST> selects Learner Diagnosis button

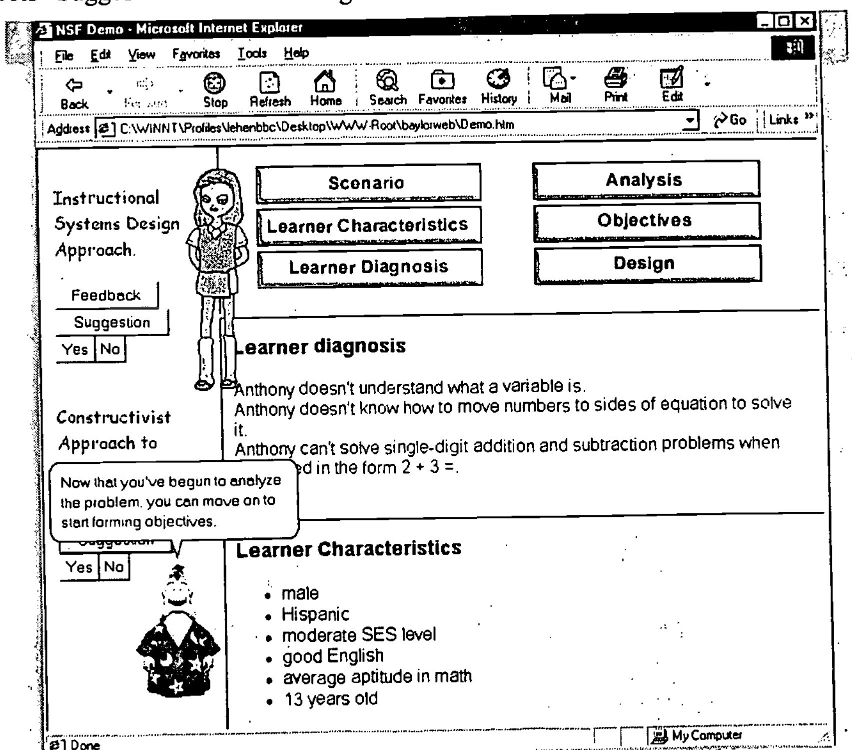
DISPLAY (left panel): (in final version would his handwritten responses to sample questions.. so that PST infers and types in the following:)

Anthony doesn't understand what a variable is.

Anthony doesn't know how to move numbers to sides of equation to solve it.

Anthony can solve single-digit addition and subtraction problems when presented in the form 2+3=

<PST> selects "Suggestion" under ALT Agent



<ALT> Now that you've begun to analyze the problem, you can move on to start forming objectives. You can always come back to this stage at any time.

<PST> selects Objectives button

DISPLAY: "Objectives" overlay appears in workspace, with analysis notes (from learner diagnosis) in top half:

<PST> types in the following under "Objectives" workspace (auto-numbered):

1) Anthony will know what a variable is in simple algebraic equations.

2) Anthony will be able to solve addition and subtraction mathematical equations by reducing the equation to a form where the left side of the equation equal one number on the right side of the equation.

<PST> selects "Feedback" under the ISD Agent

<ISD AGENT> You are following a good sequence of events and you have addressed what needs to be accomplished in this situation. Under Objective 1, try restating "will know" in terms of a measurable behavior. Go ahead and change it now, I will wait.

<PST> Changes "will know" to "will be able to explain the concept of a variable…"

<ISD AGENT> Great! Your objective #2 looks good as well.

<ALT AGENT> Can you think of any other objectives that you want Anthony to meet?

<PST> No.

<ALT AGENT> What about wanting him to be able to create simple algebraic sentences to represent a situation?? For example, if he has 3 apples, and his sister gives him X apples, he has a total of 5 apples. This would be represented as 3+X=5

<PST> (Adds Objective 3) Anthony will be able to represent simple real-world situations in terms of algebraic equations with one variable.

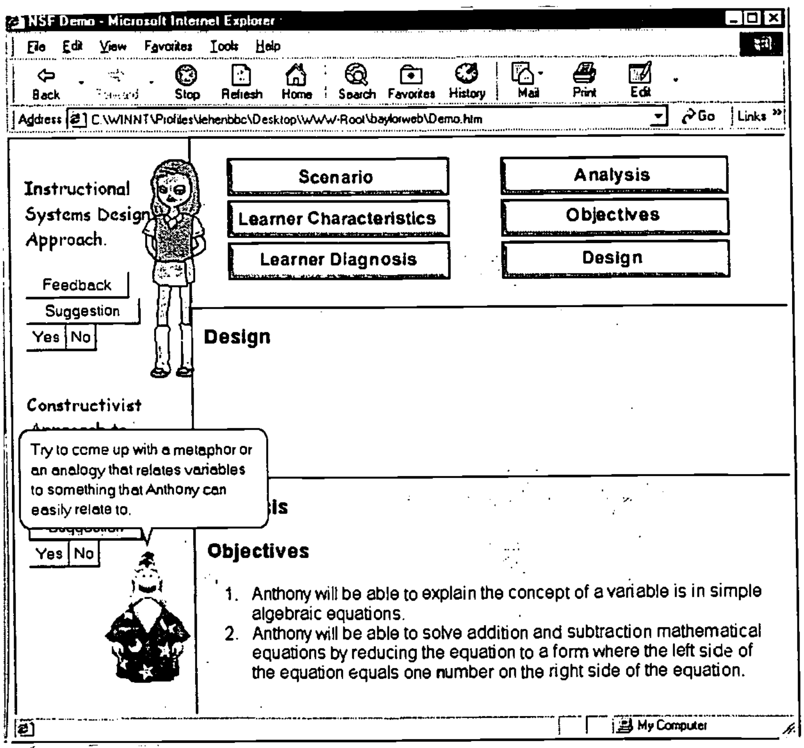
<ALT AGENT> Looks like you have got the idea!

<PST> selects "Suggestion" under ISD Agent

<ISD AGENT> Proceed to start designing the instruction.

<PST> selects "Design" button

<PST> selects "Suggestion" under the ALT Agent



<ALT AGENT> Think back and consider how you were first taught to use variables, if you remember. Try to come up with a metaphor or an analogy that relates variables to something that Anthony can easily relate to.

<PST> (Types in the "Design" area of screen) Variables are placeholders; variables represent initially unknown values

<PST> selects "Suggestion" under the ISD Agent

<ISD AGENT> Try starting with the definition of a variable.

****

At this point, the design of instruction for the first objective has barely begun, and this is a relatively simple case. The agents' role is to facilitate the instructional design process by the PST. Each agent independently analyzes the progress of the PST while taking into account the other agent(s) and cooperating where possible (with some shared goals). At the completion of the case study, each agent would demonstrate its solution of the case and then request for the PST to compare that to what s/he did. Note that the final version will not necessarily have natural language processing. Instead, for example, the PST could select what s/he believes to be appropriate objectives from a list of objectives rather than type them in.

COGNITIVE CONSIDERATIONS FOR AGENT-BASED LEARNING ENVIRONMENTS (BAYLOR, 1999B)

In terms of the guiding principles underlying development, there are three goals. First, to conceptualize the strategies that the pedagogical agents "learn" through interacting with each other and with the users of the system. Second, to develop a model of feedback that allows for the user to implement sufficient control over his/her use of the system. Third, to develop a method of managing agent-agent and agent-learner collaboration.

The framework is driven in part by Baylor's (1999b) three primary cognitive considerations for agent-based learning environments (confidence, collaboration, and control), each provides a different dimension on the learning situation. First, the learner must have confidence in the agent(s), including believability, motivational attachment to the agent, and perception that the agent is competent and trustworthy. The aspect of confidence relates to the learner's *perceptions and attributions* of the agent's ability and worthiness. Second, the learner and agent(s) must have adequate collaboration so that the learner is provided with sufficient feedback at an appropriate level of explicitness. Also, the agents should cooperate with each other accordingly to meet the instructional goals. The aspect of collaboration relates to the learner's *relationship* with the agent(s). Third, learner and agent control should be adjusted so that the learner is provided with the most appropriate learning experience. The aspect of control relates to the importance of careful *instructional planning* for the system design. Taken together, the learner's confidence in the agent(s), the successful collaboration of learner and agent, and appropriate delimiting of agent and learner control will contribute to a beneficial agent-based learning environment.

INSTRUCTIONAL DESIGN CASE STUDIES

Given that is difficult to find existing instructional design case studies that are appropriate (e.g., Ertmer & Russell, 1995), part of this area will involve reviewing the literature regarding guidelines for constructing ID case studies. Consequently, it is expected that much effort will go into creating realistic, rich, case studies that represent diverse learning environments, incorporating a variety of learner backgrounds (ethnic, gender, SES) and learning styles (e.g., Gardner's multiple intelligences). Developing a systematic way of categorizing and developing the case studies is a primary goal. While cases will be presented as realistically as possible to maintain the complexity of the ill-structured nature of ID, the first cases to be implemented will be more well-defined, such as involving the instruction of a procedure. Once cases are developed and/or located, the next step is to evaluate the key features of the case studies and categorize them systematically to determine the major components of a protoypical ID case study. Following that, experts will analyze them so that this information can be knowledge-engineered into the system one case at a time. Eventually, the intent is to develop a generic engine that runs independently from the case studies and can be readily customized for new cases.

EXPERT INTERACTION ANALYSES AND KNOWLEDGE ENGINEERING

In developing the framework and the rules underlying the pedagogical agent interactions, there will be interaction analyses of expert mentors' interactions from multiple pedagogical perspectives for given case studies. Part of this task involves applying knowledge engineering principles to encode the pedagogical information in a flexible format into the intelligent agent database. Additionally, there will be additional investigation into possible implications from other research (e.g., Chi & VanLen) regarding the instruction of metacognition and reflective thinking.

FUTURE THEORETICAL DEVELOPMENT

Following expert interaction analyses and substantiating the details for each pedagogical agent, the initial system will be developed. As mentioned previously, this is expected to be a recursive process, in that development of MIMIC will both require and create theoretical support. Overall, the future theoretical development of MIMIC involves six main objectives: 1) to describe the implementation of metacognitive and reflective thinking in the system; 2) to describe updated views of intelligence in education based on the artificial intelligence techniques used as part of the system together with learners' experience with the expert pedagogical agents; 3) to conceptualize the strategies that the pedagogical agents "learn" through interacting with each other and with the users of the system; 4) to investigate the resolution of conflict for the user as a result of working within a system that provides diverse and sometimes contradictory instructional strategies; 5) to examine how the use of MIMIC shapes current theories of instruction through analysis of learners' interactions with the system; and, 6) to examine how the development of MIMIC shapes current theories of instruction through analysis of the methods developed in creating the system.

REFERENCES

Baylor, A. L. (1997a). *The effects of designing instruction for text on learning.* Unpublished doctoral dissertation. University of South Carolina, Columbia, SC.

Baylor, A. L. (1997b). A three-component conception of intuition: Immediacy, sensing relationships, and reason. *New Ideas in Psychology*, 15 (2), 185-194.

Baylor, A. L. (1999). Learning through novice instructional design (NID) of text. Submitted for publication to *Journal of Learning Sciences.*

Baylor, A. L. (in press). Beyond Butlers: Intelligent agents as mentors. *Journal of Educational Computing and Research.*

Baylor, A. L. (1999a). Intelligent agents as cognitive tools. *Educational Technology, 39(2)*, 36-40.

Baylor, A. L. (1999b). Cognitive guidelines for agent-based learning environments: The three cognitive considerations of confidence, collaboration, and control. Unpublished manuscript.

Daloz, L. (1990). Mentorship. In Galbraith, M. (Ed.), *Adult Learning Methods* (pp. 205-224). Krieger.
Dick, W. & Carey, L. (1978,1985,1990,1996). *The systematic design of instruction*. Addison-Wesley Longman.
Dillenbourg, P., Mendelsohm, P. & Schneider, D. (1994). The distribution of pedagogical roles in a multiagent learning environment. In Lewis, R., & Mendelsohn, P. (Eds.), *Lessons from learning*. Elsevier, 199-216.
Ertmer, P., & Russell, J. (1995). Using case studies to enhance instructional design education. *Educational Technology*, July-August 1995, 23-31.
Gordon & Hall. Presented at Workshop "Current Trends and Applications of Artificial Intelligence in Education" at The Fourth World Congress on Expert Systems, Mexico City, Mexico.
Guindon, R. (1990). Designing the design process: Exploiting opportunistic thoughts, *Human-Computer Interaction, 5*, 305-344.
Hietala & Niemetiro. Presented at Workshop "Current Trends and Applications of Artificial Intelligence in Education" at The Fourth World Congress on Expert Systems, Mexico City, Mexico.
Janca, P. (1995). Pragmatic application of information agents: theory and practice. *BIS Strategic Decisions.*
Kafai, Y. (1991). Design for learning: An exploration of design theories and their implication for educational computing. Unpublished qualifying paper. Harvard University Graduate School of Education.
Khan, B.H. (1997). Editor of Web Based Instruction. Englewood Ciffs, New Jersey: Educational Technology Publications.
Laurel, B., Oren, T. & Don, A. (1990). Issues in multimedia interface design:Media integration and interface agents. In Proc. CHI'90 Human Factors in Computing Systems, ACM Press, 133-139.
Lepper, M.R. & Chabay, R.W. (1987). Socializing the intelligent tutor: bringing empathy to computer tutors. In H. Mandl and A. Lesgold (Eds.), Learning issues for intelligent tutoring systems. (pp. 242-257) New York: Springer-Verlag.
Palinscar, A., & Brown, A. (1984). Reciprocal teaching of comprehension-fostering and comprehension-monitoring activities. Cognition and Instruction, 1(2), 117-175.
Pressley, M., & McCormick, C. (1995). Advanced educational psychology for educators, researchers, and policymakers. New York, NY: HarperCollins College Publishers.
Salomon, G. (1993). On the nature of pedagogic computer tools: The case of the writing partner. Computers as cognitive tools. (pp. 179-196). Hillsdale: Lawrence Earlbaum Associates.
Schoenfeld, A. H. (1987). What's all the fuss about metacognition? In A. Schoenfeld (Ed.) Cognitive science and mathematics education (pp. 189-216). Hillsdale, NJ: Lawrence Erlbaum Associates.
Seiker, T. (1994). Coach: A teaching agent that learns. Communications of the ACM, 37(7), 92-99.
Uresti, J.A.R., (1998). Teaching a learning companion. Presented at Workshop "Current Trends and Applications of Artificial Intelligence in Education" at The Fourth World Congress on Expert Systems, Mexico City, Mexico.
Wilson, B. G. (1996). What is a constructivist learning environment? In Wilson, B.G (Ed.), *Constructivist learning environments: Case studies in instructional design*. Educational Technology Publ., 3-8.

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