

Investigating Multiple Pedagogical Perspectives through MIMIC (Multiple Intelligent Mentors Instructing Collaboratively)

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Abstract. In this exploratory experimental study, 135 pre-service teachers developed an instructional plan for a case study within a computer-based environment. Three-dimensional, animated pedagogical computer agents, representing constructivist and instructivist perspectives of instructional design, operationalized instructional theory within the environment. The research design was a two-factor ANOVA with the instructivist agent (present, not present) and constructivist agent (present, not present) serving as the two factors, leading to four combinations of agent conditions. Agents (if present) were available to provide suggestions. It was hypothesized that the agents would influence pre-service teachers' perspective of instructional planning, performance, reflections, and dispositions regarding instructional planning. A main effect for the constructivist agent indicated that when the constructivist agent was present participants reported a change in their perspective of instructional planning, developed more constructivist-oriented lesson plans, and reflected less on their thinking. A main effect for the instructivist agent indicated that when the instructivist agent was *not* present, participants reported more positive attitudes regarding instructional planning. There were no significant effects of agents on performance. For those participants receiving both agents ($N=43$), qualitative results indicated that students were metacognitively aware of the difference between two agents, yet there were no significant differences in their ratings of agent usefulness or tendency to provoke thought.

1. Introduction

In the field of instructional design, there are diverse theories and approaches to instruction (e.g., [1]). For teaching professionals, the importance of seeing how these theories relate to real instructional problems is critical. Having several experts describing the instructional content matter from different points of view can be very rewarding for the learner [2] and can help the learner to establish the best personalized approach to understanding the content. A promising possibility in terms of regulating pedagogical interventions is the instantiation of multiple pedagogical agents in a learning environment. Importantly, it is beneficial for our future teachers, our pre-service teachers, to see their role in the classroom from multiple perspectives [3]. [4] 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. However, there is limited controlled research systematically investigating learning with multiple pedagogical agents; thus, the importance of this investigation.

2. Research questions and design

If a pre-service teacher (PST) could confront multiple instructional theories simultaneously via pedagogical agents, how would this affect her performance in applying instructional design principles to an authentic problem, and her corresponding beliefs and attitudes about the theories? What characteristics of such an environment (e.g., presence of a particular pedagogical approach, number of pedagogical agents, or combination of agents) best promote learning and motivation? The research is a (2x2) ANOVA design with four randomly-assigned system conditions: a) Control (no agents); b) *Instructivist* agent present; c) *Constructivist* agent present; d) both *Instructivist* and *Constructivist* agents present. The two between-subject factors include 1) the presence of instructivist agent (present, not present), and 2) the presence of constructivist agent (present, not present). One within-subject factor is the character of the agent (counterbalanced for conditions b, c, d).

3. MIMIC agent-based learning environment

The MIMIC (Multiple Intelligent Mentors Instructing Collaboratively) system consists of pedagogical agents that represent two contrasting approaches to designing instruction (e.g., see [5]): 1) The *Instructivist* reflects a teacher-driven approach, including the problem-solving aspects of Instructional Systems Design (ISD) as characterized by [6]. 2) The *Constructivist* reflects learner-centered approaches, focusing on the importance of the context of learning, stressing that learning involves active interaction, and emphasizing the process rather than the product of learning [1]. The purpose of the agents was to serve as mentors who were available to provide suggestions. Every instructivist and constructivist intervention that is presented through the agents is documented and theoretically supported.

The content basis of the MIMIC environment is a multimedia-enhanced case study of a imaginary student Anna who is having difficulties learning the economic concept of “supply and demand”. Within the environment, the task for the pre-service teacher is to design instruction (consisting of three components: goals/blueprints, instructional plan, and assessment) within the agent-based environment to address this problem.

The current prototype system is implemented with Microsoft Agent which simplifies the creation of animated agents that are three-dimensional, animated and expressive. The MIMIC prototype system consists of a series of HTML forms with which the user interacts. VBScript was used to program the actions of Microsoft Agent characters and to script most DHTML sequences. JavaScript was used to provide client-side form validation, when necessary, and to control minor DHTML enhancements such as image rollovers. The core of the application’s processing is done with server-side scripting, implemented with ColdFusion.

4. Methods

The sample consisted of 135 pre-service teachers in an introductory educational technology course. As part of this required course, the participants had already been taught a systematic model and a constructivist approach to instructional planning. However, they were still relative novices in instructional planning.

Participants were randomly assigned to an agent condition. Upon logging into the computer environment, all participants answered questions regarding their attitudes toward instructional planning. Next, the introduction briefly described the case study situation with Anna (a student needing help with supply and demand) and her teacher, Mr. Lange. Depending on the experimental condition, zero, one or two Microsoft Agent characters were implemented as Advisors: Peedy the Parrot and Merlin the Wizard. The Advisors were referred to by gender-neutral names – Jan and Chris—where Jan was always the Instructivist advisor and Chris was always the Constructivist advisor. Agent character was counterbalanced in order to control for possible differences in agent character. After developing a complete instructional plan within the

environment, participants were queried regarding the amount of reflection that they engaged in while working in the system, their perceived change in perspective and attitudes of instructional design, and their enjoyment and value of the agent(s). For those participants receiving both agents, they were also asked to compare and contrast the agents. The entire procedure took approximately 90 minutes.

5. Results

A main effect for the Constructivist agent in the 2-factor ANOVA indicated that the system changed the pre-service teachers' perspective of instructional design the most when the Constructivist agent was present ($M=.80$ vs. $M=.47$, where 0=no change in perspective and 1=change in perspective; $F(2.58)=3.735$, $p=.01$). Further, main effects for the Constructivist agent also indicated that participants developed more constructivist lesson plans ($M= 6.17$ with the agent versus $M=4.47$ without the agent; $F(1) =11.28$, $p=.001$) and reflected *less* on their thinking ($M= 2.43$ versus $M=2.24$; $F(1)=4.727$, $p<.05$). A main effect for the Instructivist agent indicated that the presence of the instructivist agent *negatively* influenced their attitude toward instructional planning ($M=.75$ without the agent versus $M=.54$ with the agent; $F(1)=4.54$, $p<.05$). There were no significant effects of agents on performance.

When considering those who indicated that the program changed their perspective of instructional planning ($N=79$), they more enjoyed using the agents ($M=2.82$ vs. $M=2.34$; $t(101)=-3.76$, $p <.001$), paid more attention to the agent(s) ($M=2.75$ vs. $M=3.22$ $t(41) =-2.28$, $p<.05$), marginally believed the agents were more useful ($M=2.81$ vs. $M=3.15$; $t(41) = -1.71$, $p=.09$), and marginally believed that writing a lesson plan was more important ($M=4.02$ vs. $M=4.29$; $t(133)=-1.67$, $p=.09$) than those who did not change perspective.

For those participants receiving both agents ($N=43$), qualitative results indicated that students were metacognitively aware of the difference between two agents, yet there were no significant differences in their ratings of agent usefulness or tendency to provoke thought.

6. Conclusion

While the presence of the agents did not impact participants' performance, it did impact affective measures, such as change in perspective and attitudes regarding instructional design. Perhaps the constructivist agent was a key factor relating to the most change in perspective given that it is a relatively less-common approach to instructional planning for novices. The finding that its presence led to less reflection could be attributed to the novel ideas it presented, leading the participants to focus more attention to the agent's ideas rather than reflecting on their own thought. The negative effect of the instructivist agent on attitude toward instructional planning indicates that it may have emphasized the qualities of instructional design (e.g., systematic planning, break down of task components) that are generally perceived as less appealing to novice instructional planners. Future research should consider the impact of the system on more experienced instructional planners.

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