Automating Instructional Design with Automated Pedagogical Agent Systems:

Will there always be a need for Instructional Designers?

by David Lewis
University of South Florida

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Merrill et al. (1996) described the Instructional Design process as a technology. If it is a technology, then it is likely that it will evolve and over time like many technologies become automated. In the early 1990s several authors including Merrill wrote about automating portions of the instructional design process for beginning instructional designers (Spector, Polson, & Muraida 1993, Tennyson, 1994). This paper will not be about automating portions of the instructional design process. But rather go beyond that stage and discuss automating instructional design in its entirety. One where the learner requests instruction and "voilà" -- it is delivered. The author suggests that this may be possible given an "automated pedagogical agent system." After making a case for this type of instructional design the paper will ponder the role of instructional designers given that automated pedagogical agent system.

Refinement and automation have been a recurring theme throughout the history of technology. Is it blasphemy then to believe that the craft of today's instructional designers could eventually be automated? Will we be looked upon as historical figures, who in their day toiled at their craft, only to be replaced by automation?

Instructional Design models are constantly being refined. New and better methods of designing, developing and implementing instruction are evolving constantly. Perhaps this day of instant instruction is closer that one might imagine. If one knows where to look there are several lines of research already available today that could be put together like pieces of a puzzle to build an automated pedagogical agent system. If they could be put together correctly, they would form the basis of an "automated instructional design system." There are three of these puzzle pieces: learning objects, pedagogical agents, and the sequence of instruction.

Learning Objects

The first of these puzzle pieces has been an important line of research in the past few years. But learning objects have been somewhat elusive. A lot of time and effort has been invested in just describing or defining learning objects (Wiley, 2000). For the purposes of this paper the definition provided by Wiley & Edwards will suffice: "Any digital resource that can be reused to mediate learning (Wiley & Edwards 2002)."

Researchers are still pondering what exactly a "learning object" is, but in 2002 the IEEE Learning Technology Standards Committee (LTSC, 2003) drafted a set of standards for learning objects. This is but one draft to be put forth in a series, but it is certainly one step closer to the development of learning objects. This of course will be important to the development of automated instructional design systems.

Pedagogical Agents

The second puzzle piece, although somewhat not as well known as learning objects, will serve as a key component of an automated pedagogical agent system. The third piece is that of pedagogical software agents. Pedagogical agents are actually a special case of learning objects. Therefore all the arguments that apply to learning objects also apply to pedagogical software agents.

Software Agents

Agents are an A.I. (Artificial Intelligence) concept from the 1950s. Pattie Maes (1994) gives us our modern definition of software agents: "…computer programs that employ A.I. techniques to provide active assistance to a user with computer-based tasks." Maes also describes what software agents do. They observe the user's actions to provide "active assistance." Finally they can also communicate with the user. This can be accomplished via text, beeps or spoken language.

Pedagogical agents are a special case of software agents. As one might imagine their role is to provide assistance in instructional scenarios. Instructional designers have employed them in a variety of roles from being an instructivist "Virtual Instructor," to being a facilitator of constructivist learning environments (Baylor, 2000).

The Sequence of Instruction

The third puzzle piece mentioned at the beginning of this paper is "the sequence of instruction." This line of research has been important since the 1960's. Progress in this area was made by Gagne and his associates over several decades (Gagne, 1985). Many have studied this topic and it has guided the development of learning objects (Wiley, 2000). This third piece of the puzzle "the sequence of instruction" is "how" instructional designers ply their trade. Different model suggest different routes. Constructivists suggest facilitating the construction of knowledge. Instructivists are more inclined to models like that of Gagne. Both again are possible with automated pedagogical agent systems.

Pedagogical Agent Systems

The combination of these puzzle pieces produce what the author has termed "automated pedagogical agent systems." These systems are automated; they provide instruction; and they include pedagogical agents.

Embodiment

Many agents have the characteristic of embodiment (Dix et al, 1998). That is the agent may have a physical or virtual representation. A distinction should be made at this point. Avatars are a virtual representation of a person within a virtual environment (Çapin et al., 1999). An Avatar is under the control of a person. This is as opposed to an agent, which

is autonomous or semiautonomous. That is it is under control of its programming. A virtual representation then, does not imply agency. But agents may be embodied.

A production line robot is an example of an agent that has a physical body. Clippit®, the Microsoft Office® Assistant on the other hand has a virtual body. That is there is a digital representation of Clippit® within Windows®. This is as opposed to a disembodied agent that has no representation at all, but is an integrated portion of a program or environment that work's on your behalf (Dix et al, 1998). Web crawler programs, that travel the Internet to retrieve information for search engines, are examples of common disembodied agents (Dix et al, 1998).

It was this point in reviewing the literature that the author had one of those rare moments of insight, an epiphany. A search engine which makes use of agent programs is an automated instructional design system! It was right there all the time. Search engines are certainly used for instructional purposes. Learners by the million use these systems to gather information into a nice list of sites that in total represent an instructional lesson.

This instructional lesson is poorly organized from our perspective. Instructional designers "the connoisseurs of instruction" for the most part may not even regard this as instruction. We are so used to good design that we haven't even stopped to consider this form of instruction as instruction at all. But it is. It is just a poorly organized lesson.

Google for instance, provides a nice list of web sites. This list is like a shuffled set of overheads. Learners must "surf" through them to find what they are looking for. What if it was not just a list of the most often used websites but a concisely organized lesson. Would it be automated instruction produced by an automated pedagogical agent system?

Will there always be a need for Instructional Designers?

The author's realization then led to another more disturbing realization. What if this system were to come to be? Wouldn't this do away with the need for instructional designers? Two courses of action came to mind – keep it quiet, or open up and share it with the world. After dwelling on it for some time the decision was made to open up and share this discovery. The advantages would far out weigh the disadvantages. Learners everywhere getting exactly what they need, and they would learn. But would this lead to the end of instructional designers? The decision was made to do what every good researcher would do -- consult the literature.

Well-known author, educator and computer scientist, Donald Norman believes that our main difficulty with software agents is not a technical problem, but a social one (Norman, 1997). He mentions this is because these systems have two important characteristics, "autonomy" and "the ability to interact with humans." Because of these characteristics he describes them as having "potential for social mischief."

For “a smooth introduction of this technology into our society,” Norman believes we need to consider how people feel about agents; and their comfort with, or acceptance of their automatic, autonomous actions (Norman, 1997).

Autonomy

People are often frightened by automated systems. Norman suggests that this is because people feel out of control, when dealing with automated systems. There is even evidence of this in instructional design community. Wiley (2002) described those who build automated systems as “trying to take humans out of the loop.” These feelings are understandable. But are they truly justified?

The above question: “Will there always be a need for Instructional Designers?” will be answered with the discussion of another question… Is anything truly automated? No matter what is automated. Isn’t there someone in control? People always monitor and alter the system. Therefore is there any such thing as “true” automation. This is what Christofferson & Woods (2002) refer to as the “substitution myth” People are always in control. What we develop we can always redesign.

Take a simple automated system like a thermostat for instance. It’s designed to automatically monitor and alter the temperature given environmental conditions. But is it truly automated!? What if someone wants to make it warmer or cooler? Isn’t there is an interface to change the current conditions. So isn’t its true purpose to monitor the temperature until someone decides to change it?

Perhaps the “automated pedagogical agent system” described above is just another medium for instructional designers. It is automated from the learner’s perspective. But people do interact with it and learn from the instruction provided. Therefore will there ever be a “truly automated” pedagogical agent system? Instructional designers design the learning objects provided by the system; they also will design and redesign the system itself.

Parasocial interactions

Norman also mentioned an agent’s ability to interact with humans. This could cause what he described as “social mischief (Norman, 1997).” Clifford Nass studies this “social mischief,” but has described it as “parasocial interaction (Fogg & Nass, 1996).” Nass, a social psychologist from Stanford University, has led a group of researchers, in a series of studies, to observe that ordinary computer-literate individuals “can be induced to use social rules toward computers and thus behave as if computers were human (Nass et al 1993; Nass & Steuer, 1994; Nass et al., 1995; Nass et al., 1997).” Each of these studies showed that people tend to apply social rules to computers. In a number of studies these researchers found that humans react differently depending on:

- the gender of the computer's "voices" (Nass et al., 1997);
- the ethnicity of the agent (Lee & Nass, 1998);

- the amount of praise offered (Fogg & Nass, 1996);
- and even if humor was involved in the interaction (Morkes, Kernal & Nass, 2000).

Nass describes this as a new paradigm in Human-Computer Interaction known as the "Computers are Social Actors" (CAS) paradigm (Nass et al., 1995). There is a reason for concern; humans bring all of their social rules to bear when interacting with agents. Perhaps instructional designers should consider these social rules when designing any instruction. These social rules were even evident with just text as an interface.

Summary

There are a number of problems associated with agents, but there is also great promise. Imagine a search engine that not only delivered what you were asking for but also provided it in a way that was instructionally sound! Again there are advantages and disadvantages associated with automated pedagogical agent systems. But as Norman (1997) stated, “once developed, technologies are here to stay.” Instructional designers should then try to make these systems as instructionally sound as possible.

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