DIFFERENT PEDAGOGICAL AGENT’S INSTRUCTIONAL ROLES IN E-LEARNING COURSEWARE AND ITS RELATION TO LEARNING

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ABSTRACT

This paper discusses different pedagogical agent’s instructional roles in e-learning and its relation to learning. In particular, this paper elaborates on the Social Development Theory (Vygotsky, 1978) and the Principles of e-Learning Design (Clark & Mayer, 2003). This paper also elaborates on past related research on the pedagogical agent’s instructional roles and a proposed research methodology to investigate the impact of different pedagogical agent’s instructional roles on learners with different ability levels in e-learning towards motivational and learning outcomes.

INTRODUCTION

Pedagogical Agents are animated life-like characters designed to facilitate and support human learning by interacting with learners in an interactive computer-mediated learning environments (Craig, Gholson, & Driscoll, 2002). Animated pedagogical agents can promote student motivation and engagement, and engender affective as well as cognitive responses (Baylor, 2005). Thus, animated pedagogical agents offer great promise for broadening the bandwidth of tutorial communication and increasing learning environments’ ability to engage and motivate learners (Johnson & Rickel, 2000).

Pedagogical agent research and development has made significant strides over the past few years, incorporating animated computer characters that are increasingly more realistic and human-like with respect to their dialogue, appearance, animation and the instructional outcomes they produce (Baylor, Cole, Graesser, & Johnson, 2005). Numbers of computer scientists developing animated pedagogical agents and a correspondingly large amount of investigation regarding system development principles (Ghalib, 2006; Lester, Voerman, Towns, & Callaway, 1997; Nunes et al., 2002; Zakaria, Ahdon, Siraj, & Husin, 2002). However, there is still significant lack of research on the instructional roles of pedagogical agents for supporting learning-related outcomes.

Several researchers suggested that computers in education or multimedia learning may provide their greatest potential for disadvantaged learners, those of low-ability and concrete operational students (Cavin & Lagowski, 1978; Huppert, Lomask, & lazarowitz, 2002). In other hand, some researchers stated that computer-based instruction was observed to be more effective for high-ability learners (Ardac & Sezen, 2002).

However, it is vital to design and develop a multimedia instruction that will benefit both low-ability and high-ability learners. In undertaking this study, the following research questions were put forward:

a. Is there any significant difference in the learning outcomes (achievement score) between the low-ability and high-ability learners with guidance from different pedagogical agent’s instructional roles (expert, motivator and mentor)?

b. Is there any significant difference in the motivational outcomes (IMMS score) between the low-ability and high-ability learners with guidance from different pedagogical agent’s instructional roles (expert, motivator and mentor)?

c. Is there an instructional role of pedagogical agent that can benefit both low-ability and high-ability learners?
PEDAGOGICAL AGENT’S INSTRUCTIONAL ROLES
Over the years, researchers have suggested various roles of pedagogical agents, such as agent as cognitive tool (Baylor, 1999), mentor (Baylor, 2000), and learning companion (Kim, 2005). The important aspect of designing PA is to carefully design their role within the learning environment to serve the intended educational purposes (Baylor & Kim, 2003). In their studies, they effectively simulated pedagogical agents as an expert, a motivator, and a mentor who served distinct instructional purposes.

<table>
<thead>
<tr>
<th></th>
<th>Expert</th>
<th>Motivator</th>
<th>Mentor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Image</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Animation</td>
<td>Limited gestures</td>
<td>Highly expressive</td>
<td>Highly expressive</td>
</tr>
<tr>
<td>Voice</td>
<td>Limited intonations</td>
<td>Enthusiastic, higher speed</td>
<td>Calm, engaging</td>
</tr>
<tr>
<td>Script</td>
<td>Information</td>
<td>Encouragement</td>
<td>Information &amp; Encouragement</td>
</tr>
<tr>
<td>Affect</td>
<td>Low</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>

An expert agent exhibits mastery or extensive knowledge and perform better than average within a domain. Whereas a motivator agent not necessarily knowledgeable but rather suggested his own ideas and verbally encouraging the learner to sustain the task (Bandura, 1997). As for a mentor agent, it does not simply provide information but rather provides guidance for the learner to bridge the gap between the current and desired skill levels (Craig, Gholson, & Driscoll, 2002).

THEORIES AND PRINCIPLES
Social Development Theory
The theoretical base for this study originated from Social Development Theory (Vygotsky, 1978) and the Principles of e-Learning Design (Clark & Mayer, 2003).

According to Vygotsky, social interaction plays a fundamental role in the process of cognitive development. His theory of social interaction asserts that a person learns from his or her context of social development and culture. Vygotsky’s theory of social interaction leads him to the zone of proximal development. Zone of proximal development is the difference of problem solving ability that a person has acquired and the ability or potential that he or she can obtain from interacting with others, such as, friends, teachers and related peers.

Social development theory also promotes learning contexts in which students play an active role in learning. Roles of the teacher and student are therefore shifted, as a teacher should collaborate with his or her students in order to help facilitate meaning construction in students.

Social Development Theory concludes that social interaction precedes development; consciousness and cognition is the end product of socialization and social behavior.
Therefore, the pedagogical agents should be designed with instructional roles to create an effective social interaction with the learners to enhance motivational and learning outcomes.

**Principles of e-Learning Design**
The principles stated in table 2 by Clark and Mayer (2003) is referred as the guideline for the instructional design of the e-learning system.

**Table 2: Principles of e-Learning Design (Clark & Mayer, 2003)**

<table>
<thead>
<tr>
<th>Principle</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multimedia Principle</td>
<td>People learn more deeply from words and graphics than from words alone.</td>
</tr>
<tr>
<td>Contiguity Principle</td>
<td>People learn more deeply when corresponding printed words and graphics are placed close to one another on the screen or when spoken words and graphics are presented at the same time.</td>
</tr>
<tr>
<td>Modality Principle</td>
<td>People learn more deeply from multimedia lessons when graphics are explained by audio narration rather than onscreen text.</td>
</tr>
<tr>
<td>Redundancy Principle</td>
<td>People learn more deeply from a multimedia lesson when graphics are explained by audio narration alone rather than audio narration and onscreen text.</td>
</tr>
<tr>
<td>Coherence Principle</td>
<td>People learn more deeply from multimedia lessons when distracting stories, graphics, and sounds are eliminated.</td>
</tr>
<tr>
<td>Personalization Principle</td>
<td>People learn more deeply from multimedia lessons when the speaker uses conversational style rather than formal style.</td>
</tr>
</tbody>
</table>

The personalization principle is relevant to the present study of pedagogical agent. The principle of personalization entails two important rules to be accounted to internalize the learning and knowledge acquiring process. The first rule states the use of conversational style rather than formal style in the printed or spoken text. The conversational style of communication creates the sense of social presence which in turn encourages the learner to actively use his or her cognitive capacity to the optimum. Meanwhile, the second rule affirms the employment of onscreen coaches or pedagogical agents. Several studies have validated the positive effects of the employment of pedagogical agents on increasing learners' level of interest which in turn promoting learning engagement and performance (Monero, Mayer, Spires, & Lester, 2001).

**PROPOSED RESEARCH METHODOLOGY**
This research methodology is proposed to investigate the impact of different pedagogical agent's instructional roles on learners with different ability levels in e-learning towards motivational and learning outcomes. The proposed research design is based on the quasi-experimental 3x2 factorial design with pedagogical agent's instructional roles (expert, motivator, and mentor) as independent variables, motivation outcomes and learning outcomes as dependent variables, and learner's ability levels (high-ability and low-ability) as moderator variables.
An e-learning courseware is developed based on Gagne Nine Events of Instruction (Gagne, Briggs, & Wager, 1992) and ARCS Model of Motivational Design (Keller, 1987). Three versions of courseware with different pedagogical agents and instructional roles are developed. A pilot test will be conducted before the actual commencement of the study involving 30 students who did not participate in the final study. Diagram 2 shows the example of the e-learning courseware with pedagogical agent.

Diagram 1: Research Framework

Diagram 2: The Chemistry e-Learning Courseware with Pedagogical Agent
the Form Four Chemistry syllabus designed by the Ministry of Education for secondary schools in Malaysia. The e-learning courseware is developed based on the chapter, “Periodic Table of Elements”. The students involved have not yet been exposed to this topic.

**Proposed Research Procedure**
Diagram 3 shows the flow chart of the proposed research procedure. The research procedure is divided into four main phrases. In first phrase (streaming), samples will be given the pre-test and the Cattell Culture Fair Intelligence Test (Cattell & Cattell, 1973) to be streamed into two groups according to their ability levels.

In second phrase (treatment), samples will be randomly assigned to one of the pedagogical agents. Samples will participate in the courseware with the guidance of the assigned pedagogical agent.

Later in third phrase (data collection), samples will be given the post-test and the Instructional Material Motivational Scale (IMMS) (Keller, 1987) to collect data on learning outcomes and motivational outcomes. The achievement scores will be obtained by taking the difference of the pre-test and the post-test scores.

In the final phrase (data analysis), the data collected through the experimental design for the achievement score and motivation score will be analyzed using an analysis of variance (ANOVA) to observe the interaction effect between the variables.

**Diagram 3: Research Procedure**

![Diagram](image)

**EXPECTED RESULT**
1. Learners who are using the expert agent will show a significant difference compared to the learners who are using the motivator agent in learning outcomes.
2. Learners who are using the motivator agent will show a significant difference compared to the learners who are using the expert agent in motivational outcomes.
3. Learners who are using the mentor agent will show a significant difference compared to the learners who are using the expert agent in both motivational outcomes and learning outcomes.
4. Learners who are using the mentor agent will show a significant difference compared to the learners who are using the motivator agent in both motivational outcomes and learning outcomes.

5. The high-ability learners will show a significant difference compared to low-ability learners in the e-learning system with expert agent in their motivational and learning outcomes.

6. The low-ability learners will show a significant difference compared to high-ability learners in the e-learning system with motivator agent in their motivational and learning outcomes.

7. The pedagogical agent's instructional role as mentor can benefit both low-ability and high-ability learners.

CONCLUSION
This paper has presented a review of literatures, theoretical framework, and the research design to study the value of pedagogical agent's instructional roles. This systematic research of pedagogical agent's features proposes a new e-learning system that is able to provide automated facilitation to the learning process via pedagogical agents and help to ease the burden of teacher in providing on-line coaching. Through this study, we hope to design and develop a multimedia instruction that will benefit both low-ability and high-ability learners.

REFERENCES


