# THE EFFECTS OF ANIMATED AGENTS ON STUDENTS' ACHIEVEMENT AND ATTITUDES

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## ABSTRACT

**Animated agents are electronic agents that interact with learners through voice, visuals or text and that carry human-like characteristics such as gestures and facial expressions with the purpose of creating a social learning environment, and provide information and guidance and when required feedback and motivation to students during their learning experience. The aim of this study is to analyze the effect of the use of pedagogical agents in learning materials designed in multimedia on the achievement and attitudes of students. A general evaluation of the research findings indicate that the use of multimedia software developed by using pedagogical agents positively affects student achievement and attitude. The achievement of the students who worked with the software significantly increased, but no significant difference in terms of different pedagogical agents was observed. The comparison of the student's attitudes revealed no significant difference in terms of different pedagogical agents, yet the attitudes regarding "bearing human features" showed positively significant difference for the software with body shot of a real person. As it is seen in the unstructured interviews with the participants conducted during and after the experimental process, it should be stated that the students had positive attitudes towards the software and the use of pedagogical agent and expressed their liking.**

**Keywords:** **Animated pedagogical agent, distance learning, animated interface agent, Turkey.**

## INTRODUCTION

**With the widespread use of computers as teaching and learning tools, issues of how to meet learners' needs and what features learning software need to have arose, and the concept of multimedia came to be used frequently in education. In most general terms, multimedia refers to a user interface in a computer based application that is supported by tools like regular text, audio, visuals, graphics, video and animation. Multimedia is important in that it facilitates learning by using different communication and information channels.**

**One of the tools used in facilitating student-computer and student-content interaction in multimedia applications is animated pedagogical agents. According to Mayer's Cognitive Theory of Multimedia Learning, animated pedagogical agents improve learning by facilitating the social interaction between the computer and the human, and by transmitting non-verbal implicit information.**

**Animated pedagogical agents function to draw the attention of the student to a specific aspect, to transmit non-verbal implicit information via gestures, facial expressions and voice tone, to engage the learner for longer durations by creating a fun learning environment, and to provide guidance and motivation.**

**Therefore, in the future it is expected that we will frequently come across with animated pedagogical agents which have various kinds of forms, interaction and communication types.**

## ANIMATED AGENTS

**Animated agents are electronic agents that interact with learners through voice, visuals or text and that carry human-like characteristics such as gestures and facial expressions with the purpose of creating a social learning environment, and provide information and guidance and when required feedback and motivation to students during their learning experience. A review of the literature shows that animated pedagogical/animated agents play various roles in the learning process including instructor, learning companion, specialist, guidance teacher, and teaching assistant. With all these roles that they assume, animated pedagogical agents improve learning by facilitating the social interaction between the computer and the human, and by transmitting non-verbal information. At the most basic level, animated pedagogical agents can be classified into two as interactive and non-interactive. Non-interactive animated pedagogical agents function to draw the attention of the student to a specific aspect, to transmit non-verbal implicit knowledge via gestures, facial expressions and voice tone, to engage the learner for longer durations by creating a fun learning environment, and to provide guidance and motivation. Interactive animated pedagogical agents, on the other hand, combine some or all of the functions of providing guidance and feedback, encouraging and supporting the learner, and cooperating with the learner if supported by artificial intelligence applications.**

**In the literature, animated pedagogical characters are referred to variously as animated pedagogical characters, animated pedagogical agents, human digital assistants, and lifelike virtual agents, among others. The Turkish literature on the subject prefers the terms pedagogical interface agent and virtual character. Throughout this study, we will use "animated pedagogical agents". With distance learning being an increasing trend, it is widely accepted that e-learning and multimedia applications will gain momentum and become even more widespread with the advancements in technology. In this context, it is expected that use of animated pedagogical agents will also increase and become more varied and more widespread to meet learners' social learning needs.**

## ENHANCING DISTANCE LEARNING ENVIRONMENTS WITH ANIMATED PEDAGOGICAL AGENTS

**Animated pedagogical agents are one of the emerging concepts in the distance education field (Heller & Procter, 2010). Animated pedagogical agents have a number of potential benefits that are especially relevant to distance education, including improved communication and increased student motivation/engagement (Heller & Procter, 2010). There are several proposed advantages and Gulz (2004) lists and discusses six kinds of benefits that can be seen as central for enhancement with agents (Haake, 2009):**

- ***Increased motivation:*** **Character enhancement may prompt students to stay on and involve themselves in a learning environment by means of motivation. (e.g. Lester et al., 1997; Moreno 2004; Moundridou & Virvou, 2002).**
- ***Increased sense of ease and comfort:*** **The addition of social characters may have a positive relaxing effect on the student, making her or him feel more comfortable and more at ease with the learning tasks and the learning environment (e.g. Moundridou & Virvou, 2002; van Mulken et al., 1998).**

- ***Stimulation of essential learning behaviors:*** **Learning can be described as the employment of different basic strategies and the presence of a social actor may have a positive stimulating effect as to exploration, cooperation and reflection (e.g. Blair et al., 2006; Johnson et al., 2003).**
- ***Enhanced flow of information and communication*****: A central aspect of this approach is the importance of facial expressions and body language to reinforce, clarify, and consolidate the spoken dialogue as well as to provide feedback (e.g. Cassell & Thorisson, 1999; Massaro et al., 2000; Oviatt & Adams, 2000).**
- ***Gains in terms of memory, problem solving and understanding*****: Positive effects in terms of improved memory, problem solving, knowledge transfer, and understanding may follow from character enhancement (e.g. Blairet al., 2006; Johnson et al., 2003; Moreno et al., 2001).**
- ***Fulfilling the need for deeper personal relationships in learning*****: it is possible to establish and even maintain long-term qualitative personal relationships between a student and a social learning system (e.g. Bickmore & Picard, 2003; Moreno et al., 2001; Veletsianos & Miller, 2008).**

**Bloom (1984) suggests that one-on-one tutoring can significantly improve learner performance. It isn't feasible to provide a human tutor for every learner on the planet; the true promise of interactive animated pedagogical agents, then, is the potential of providing individualized instruction and tutors for a massive number of learners through computers (Slater, 2012). Thus, creating lifelike pedagogical agents potentially provides four important educational benefits (Lester, et al., 1997) Slater (2012):**

- **A pedagogical agent that appears to care about a learner's progress may convey to the learner that it and she are "in things together" and may encourage the learner to care more about her own progress.**
- **An emotive animated pedagogical agent that is in some way sensitive to the learner's progress may intervene when she becomes frustrated and before she begins to lose interest.**
- **An emotive animated pedagogical agent may convey enthusiasm for the subject matter at hand and may foster similar levels of enthusiasm in the learner. (4) A animated pedagogical agent with a rich and interesting personality may simply make learning more fun.**

**According to Slater (2012) interactive animated pedagogical agents can: *Adapt* - A animated pedagogical agent evaluates the learner's understanding throughout the interaction. *Motivate* - Animated pedagogical agents can prompt students to interact by asking questions, offering encouragement and giving feedback. They present relevant information, offer memorable examples, interpret student responses, and even tell a clever joke or two.**

***Engage*** **- Animated pedagogical agents have colorful personalities, interesting life histories, and specific areas of expertise. They can be designed to be the coolest teachers in school.**

***Evolve*** **- Animated pedagogical agents can be revised and updated as frequently as necessary to keep learners current in a rapidly accelerating culture. They can search out the best or most current content available on the web to enrich the lessons that someone else has previously designed.**

**Strengths of animated pedagogical agents in distance learning environment (Slater, 2012; Jaques, Adja , Jung, Bordini, & Vicari, 2002):**

- **Ability to tutor a massive number of people**
- **Individualized instruction: adaptive to user needs**
- **Provide collaboration when a student has difficulty in learning something or accomplishing some task.**
- **Correct wrong ideas and provide new information**
- **Removal of some barriers to learning (i.e. fear of asking the same question twice)**
- **Uses a conversational style interface**
- **May increase feelings of self-efficacy**
- **Could provide wide source of information (i.e. web databases)**
- **Facilitates what researchers Nass and Reeves have established: people treat computers like other people**
- **May increase learner engagement**
- **Fantasy element of interacting with another is motivating for many**
- **Makes use of body gestures: a component missing from traditional Computer Based Training (CBT)**

**Weaknesses Animated pedagogical Agents in Distance Learning Environment (Slater, 2012; Shaw, Johnson, & Ganeshan, 2010; Haake, 2009):**

- **Animated pedagogical Agents are currently complex to create**
- **Speech recognition, Understanding Daily Language and Artificial Intelligence technology is not strong enough for widespread use.**
- **The domain animated pedagogical agents are intimately connected to computer science and artificial intelligence and, accordingly, the domain as a whole is computationally oriented.**
- **People could treat the computer too much like another person: negative effects**
- **Relying on persona can be distracting if the user does not like the persona**
- **Can be distracting for younger users**
- **Massive undertaking to get**
- **Presentation details such as body posture, facial expression, and tone of voice have a big impact on students' impressions of these agents. So, users can react to agents in unexpected ways**

## PURPOSE of the STUDY

**The purpose of this study is to analyze the effect of the use of animated pedagogical agents in learning materials designed in multimedia on the achievement and attitudes of students. To do so, the study seeks to answer the following questions:**

- **How does the multimedia educational content aided by animated pedagogical agents affect student achievement?**
- **Does student achievement vary according to the types of animated pedagogical agents (headshot of a real person, body shot of a real person, body shot of an animated character) used in multimedia educational content?**
- **Do student's attitudes vary according to the types of animated pedagogical agents (head shot of a real person, body shot of a real person, body shot of an animated character) used in multimedia educational content?**

## METHODOLOGY

**This section reviews the research model, study group, data gathering tools, process and analysis, and all applications conducted in the research.**

## Research Model

**The research model was experimental design with pretest-posttest control group. The experimental design is used to determine the cause and effect relationships through producing data to be observed in the research under the control of the researcher. In the pretest-posttest control group design, the participants are measured according to the independent variable before and after the experimental procedure.**

**This research investigated the effect of the use of multimedia pedagogical agents on student achievement and attitude. In order to put forth the effect of three different animated pedagogical agents, three experiment groups and one control group were used in the study. Different agent types are the independent variable, while the achievement and attitudes constitute the dependent variables.**

## Participants

**The sample of the research consists of 90 undergraduate students from Anadolu University, Faculty of Communication Sciences, enrolled in the program for the academic year 2010-2011 and currently in their freshmen year. The participants were assigned to in total four groups, that is, three experiment groups and one control group. 22 students were assigned to the animated pedagogical agent headshot software group, 21 students to the animated pedagogical agent body shot software group, 25 students to the animated pedagogical agent software group, and 22 students to the software group with only the voice element.**

**The participants were 52 males and 38 females. The age range was between 19 and 24. All of them had computer skills and 82% of them had their own personal computer. More than 80% of the participants stated that they learnt how to use the computer through their own efforts in time, rather than through lectures or courses.**

**In terms of the purposes to use the computer, 68% of the participants stated that they used it for writing, 78% for sending and receiving e-mails, 16% for joining discussion groups, 41% for education, 80% for obtaining information; 78% for using CDs/DVDs, 82% for preparing homework and presentations,and 86% for playing games or chatting.91% of the participants rated 5 and above with regards to the extent to which they feel comfortable using the computer.**

**In terms of self-sufficiency, 76% of them rated 5 and above. Moreover, 82% of the participants stated that using the computer increased their efficiency with the rate of 5 and above. These rates suggest that the participants' computer using skills and purposes are quite similar.**

## Data Gathering

**This section summarizes the data gathering tools and experimental application process. In order to determine the effect of animated pedagogical agent and animated pedagogical agent types on student achievement and attitudes, the topic "Stem Cells" was chosen, as the students were unfamiliar to the subject, and teaching materials were designed with animated lectures and three different animated pedagogical agents.**

**A total of four groups participated in the study: one control group in which no animated pedagogical agent was included and only voice was used, and three experiment groups (headshot of a real person, body shot of a real person, body shot of animation character). Figures: 1, 2 and 3 below present sample screenshots with each animated pedagogical agent.**

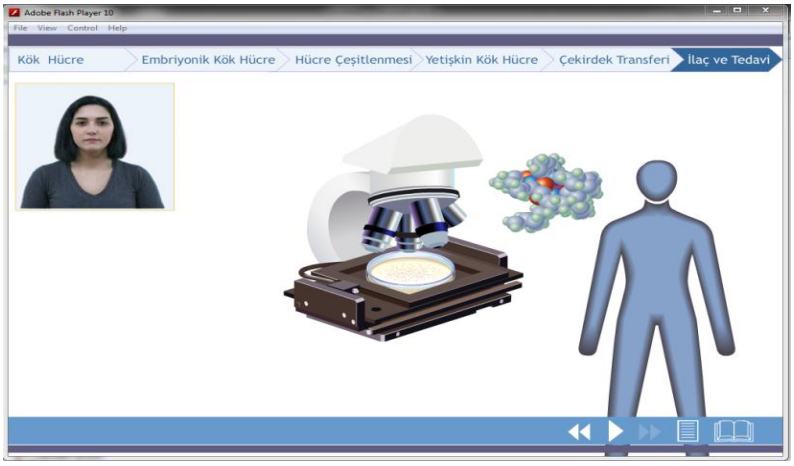


**Figure: 1**
**Headshot of a Real Person**

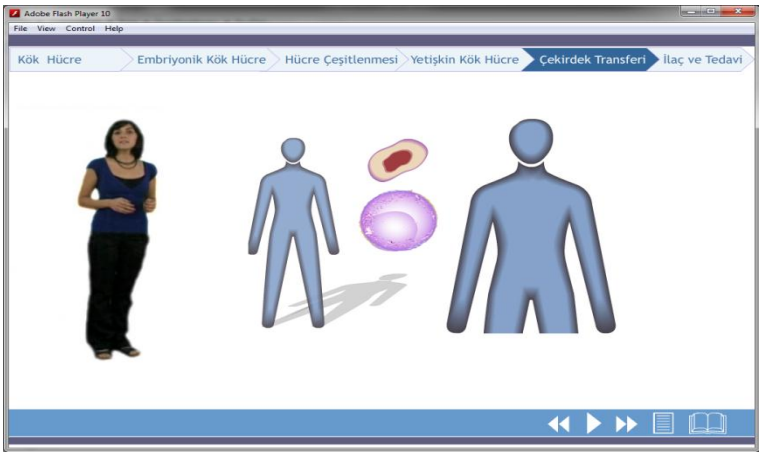


**Figure: 2**
**Body Shot of a Real Person**

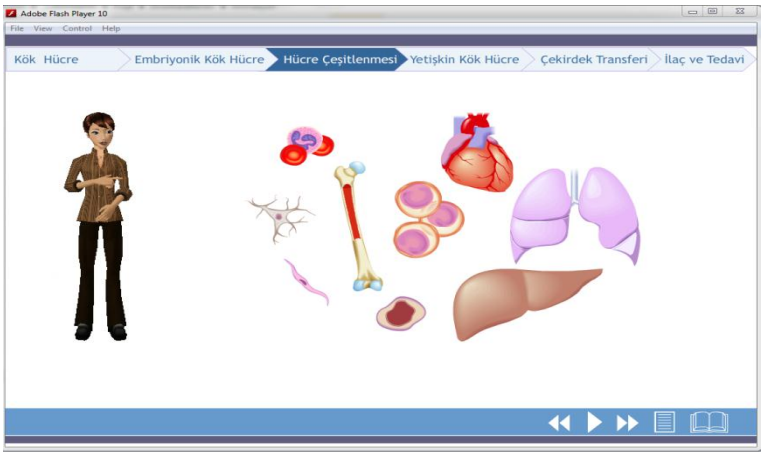


**Figure: 3**
**Body Shot of Animation Character**

**Developing teaching materials was a tiring process during which several problems emerged. The development process and the problems experienced are listed below.**

**Content Development**

**First, various resources were scanned and the content on "Stem Cells" was developed to be used for the learning software. As it is a medical subject, expert views were taken and simplified as much as possible. The web-based lesson content is developed by the authors of this study based on the following studies.**

- **University of Michigan – Stem Cell Research Center**
  **http://www.umich.edu/news/stemcells/022706_TabA.html**
- **East of England Stem Cell Network**
  **http://www.eescn.org.uk/media/pedersen.html**
- **Films Euro Stem Cell**
  **http://www.eurostemcell.org/films**
- **NWABR- Education Materials**
  **http://www.nwabr.org/education/stemcellresources.htm#AN**
- **Riken Center for Developmental Biology**
  **http://www.cdb.riken.jp/jp/stemcells**

**The researchers worked on the interface and design of the software to be used in the learning process and developed a sample page. The animation visuals about stem cells to appear in each screen of the software were designed and placed in the pages. The content developed was scripted and placed next to the relevant animation visuals. After having obtained a standard design, different animated pedagogical agents were designed for each experiment group. At this stage, sound and video records were made in a studio. A real-person animated pedagogical agent headshot was made for the first experiment group, and a real-person animated pedagogical agent body shot was made for the second experiment group, and finally only sound was recorded for the fourth group. For the third experiment group, 3-D body shot of animation characters was developed.**

**To select the "animated pedagogical agents" for the software, the students working at Anadolu University Radio A were contacted by virtue of their good diction and familiarity with such studies. The shots were made with one student from the Faculty of Communication Sciences, selected among the Radio A employees. The shots were completed by working in four different units, namely, Studio of Faculty of Communication Sciences, ETV Sound Studio, Radio A Sound Studio and Studio of Open University Faculty.**

**Adobe Photoshop CS5 and Adobe Flash CS5 Pro were used for developing the learning material, while Audacity and Adobe Sound Booth were utilized for processing the sound files. In addition, for editing the body shots and headshots, Adobe Premiere Pro and Adobe After Effects CS3 Pro were used, while the software CodeBaby was chosen for developing the 3-D animated character. LimeSurvey is used for posttests. In the multimedia learning software, the lecture was given by the animated pedagogical agent to the experiment groups, while in the control group it was given by voice without any pedagogical agent, yet the students were able to see the text on the screen by clicking on the text button. The software also included a dictionary of the terms related to the subject of stem cells and their explanations. Along with the software, the Computer Test, the Computer Use and Personal Information Questionnaire and the Animated pedagogical Agent Attitude Scale were developed to be used for collecting the research data and prepared for pilot scheme.**

**Before the experiment, a pilot study was conducted in order to determine the problems in the software programs and to test the data gathering tools. 22 students enrolled in the course Communication Design participated in the pilot study conducted in Computer Classroom No. 208, at Anadolu University, Faculty of Communication Sciences. 7 students watched the software which has pedagogical agent as headshot of a real person, while three groups of five students each watched the other three types of software. At the end of the pilot study, the students were asked to fill in the "Personal Information and Computer Use Questionnaire", the "Stem Cells Knowledge Test" and the "Animated pedagogical Agent Attitude Scale". With the pilot study, it was aimed to determine the possible problems in the software programs and to try out the tests developed.**

**In the analysis, the Cronbach's Alpha reliability coefficient of the "Animated pedagogical Agent Attitude Scale" was found as .95. The achievement of the participants was determined by a test in this study. The achievement test was developed by the researchers, and then, was presented to the experts. The necessary revisions were made in line with the two reviews, one from a test development expert and the other from a biology expertin. The Cronbach's Alpha reliability coefficient of the test was found as .68.**

**In order to determine the participants' attitudes towards the teaching media, content and design styles, a Likert-type scale was developed. Each item was evaluated according to Strongly Agree (5), Agree (4), Neither Agree nor Disagree (3), Disagree (2) and Strongly Disagree (1). The Cronbach's Alpha reliability coefficient of the scale was found as .95. The experimental application was conducted at the computer labs of the Faculty of Communication Sciences. After the participant students' arrival to the computer labs, the following steps were conducted:**

**Step 1: The placement of the students to the appropriate computers,**
**Step 2: The explanation of the application processes and the program,**
**Step 3: The application of the tests before the multimedia lecture,**
**Step 4: The application of the multimedia lecture: the students' receiving the multimedia lecture on the computer according to their own learning speed, and their signing out from the application,**
**Step 5: The application of the tests after the multimedia lecture,**
**Step 6: Thanking the participants and handing their gifts after having received their signatures.**

**The participant group of 90 students of the study was randomly assigned to the developed programs by taking into consideration the proportional distribution of gender. Each participant took a test determining their pre-knowledge about the subject and filled in a questionnaire designed to determine their demographics and computer skills before the application of the teaching program. At the end of the program, the achievement test and the attitude scale were conducted. At the end of the study, a 2-GB USB memory stick was given to each participant as a present.**

## Data Analysis and Interpretation

**Descriptive and procedural statistics were used in the analysis of the data obtained. In order to determine the achievement and attitudes of each unit of participants, descriptive statistics such as average and standard deviation were utilized. In order to determine the difference between the participants' achievement levels, independent groups t-test and covariance analysis were used. Thus, the change in the students from pretest toposttest could be observed. In order to determine the effect of different animated pedagogical agents on achievement and attitudes and the difference between them, variance analysis (ANOVA) was conducted.**

**These operations were conducted by utilizing SPSS software. Significance level of .05 was used as the baseline in all statistical analyses.**

## FINDINGS

**This section presents the findings gathered through the statistical analysis of the collected data concerning the subquestions of the research.**

### Effects of the Animated Pedagogical Agent on Achievement

**The first subquestion of the research was "How does the multimedia educational content aided by the animated pedagogical agents affect the student's achievement?" With respect to this sub question, the difference between the pretest and posttest scores of the students who used the educational media supported by the animated pedagogical interface agent was examined. For this purpose, paired samples t-test were conducted. Table 1 and Table 2 present the results of the analysis.**

**Table: 1**
**t-Test Descriptive Results**

| | Mean | N | Std. Dev. | Std. Error Mean |
|---|---|---|---|---|
| Posttest | 15,18 | 67 | 3,030 | ,370 |
| Pretest | 9,42 | 67 | 2,818 | ,344 |

**As seen in Table: 1, the pretest average of the students was 9.42, while the posttest average was 15.18. It is striking the increase in the students' posttest scores.**

**Table: 2**
**Results of Paired Samples t-Test**

| | Paired Differences | | | | | t | df | Sig. |
|---|---|---|---|---|---|---|---|---|
| | Mean | Std. Dev. | Std. Error Mean | %95 Confidence Interval of the Difference | | | | |
| | | | | Lower | Upper | | | |
| Posttest - Pretest | 5,761 | 3,238 | ,396 | 4,971 | 6,551 | 14,562 | 66 | ,000 |

**According to the analysis results given in Table 2, there is a significant difference between the pretest and posttest scores of the students who worked with the multimedia educational content supported by the animated pedagogical agent (p<.01).**

### Effects of the Animated Pedagogical Agent on Achievement

**The second subquestion of the research was "2. Does student's achievement vary in accordance with according to the types of training animated pedagogical agents (head shot of a real person, body shot of a real person, body shot of an animation character) used in multimedia educational content?"**

**With respect to this sub question, the difference between the scores of the students who used the educational media supported by the pedagocical interface agent was analyzed by Covariance Analysis. Covariance Analysis (ANCOVA) is a technique which enables the control of the possible variables other than the factor tested which may affect the dependent variable.**

**In this research, ANCOVA was conducted in order to control the effect of the pretest scores of the students.**

**Thus, the statistical correction for the relationship between the independent variable and covariable was made.**

**With the decrease in the error variance, the differences between the data were inquired.**

**It was observed that the posttest scores of the participants changed after the controlled pretest scores were controlled. Table: 3 shows these changes.**

**Table: 3**
**Means and Corrected Means of Groups**

| Animated pedagogical Agent | N | Mean | Corrected Mean |
|---|---|---|---|
| Head shot of real person | 22 | 15,45 | 15,19 |
| Body shot of real person | 21 | 15,14 | 15,39 |
| Animation character | 25 | 14,96 | 14,98 |
| Just voice | 22 | 16,27 | 16,38 |

**The average number of correct answers in the last revised test was 15.19 for the first group (which worked with headshot animated pedagogical agent), 15.39 for the second group (which worked with body shot animated pedagogical agent).**

**14.98 for the third group (which worked with animation character) and 16.38 for the fourth group (which worked with voice only).**

**The ANCOVA results on the significance of these differences are shown in Table: 4.**

**Table: 4**
**Comparison of Group Differences**

| Source of Variance | Sum of Squares | Mean Squares | F | Sig. |
|---|---|---|---|---|
| Pretest | 98,126 | 98,126 | 14,146 | 0,000 |
| Experiment groups | 26,888 | 8,963 | 1,292 | 0,283 |

**According to the ANCOVA results, there is no significant difference (p>.05) in terms of student's achievement in multimedia education supported by animated pedagogical agent among the groups.**

## Effects of Animated Pedagogical Agent on Attitudes

**The third subquestion of the research was "Do the student's attitudes vary according to in accordance with the types of animated pedagogical agents (head shot of a real person, body shot of a real person, body shot of an animation animated character) used in multimedia educational content?" With respect to this subquestion, the difference in the attitude scores of the students who used educational media aided by animated pedagogical agents was analysed by variance analysis (ANOVA) through descriptive statistics.**

**The analysis results are presented in Table: 5 and Table: 6.**

**Table: 5**
**Analysis of Variance Descriptive Results**

| | | N | Mean | Std. Dev. |
|---|---|---|---|---|
| Content | Voice | 22 | 7,64 | 1,590 |
| | Head shot | 22 | 8,09 | 1,109 |
| | Body shot | 21 | 8,43 | ,926 |
| | Ani. charac. | 25 | 7,88 | 1,424 |
| | Total | 90 | 8,00 | 1,307 |
| Facilitating Learning | Voice | 11 | 7,36 | 1,286 |
| | Head shot | 22 | 7,09 | ,971 |
| | Body shot | 21 | 7,10 | 1,640 |
| | Ani. charac. | 25 | 6,96 | 1,620 |
| | Total | 79 | 7,09 | 1,407 |
| Credibility | Voice | 11 | 8,00 | 1,789 |
| | Head shot | 22 | 7,77 | 1,541 |
| | Body shot | 21 | 7,62 | 1,687 |
| | Ani. charac. | 25 | 7,76 | 1,562 |
| | Total | 79 | 7,76 | 1,595 |
| Being Human | Voice | 11 | 5,45 | 1,635 |
| | Head shot | 22 | 4,91 | 1,540 |
| | Body shot | 21 | 6,14 | 1,682 |
| | Ani. charac. | 25 | 4,84 | 1,675 |
| | Total | 79 | 5,29 | 1,696 |
| Encouragement | Voice | 11 | 6,82 | 1,168 |
| | Head shot | 22 | 6,18 | 1,220 |
| | Body shot | 21 | 6,67 | 1,390 |
| | Ani. charac. | 25 | 7,00 | 1,500 |
| | Total | 79 | 6,66 | 1,367 |
| Total | Voice | 11 | 68,91 | 11,300 |
| | Head shot | 22 | 69,00 | 7,940 |
| | Body shot | 21 | 71,67 | 9,367 |
| | Ani. charac. | 25 | 71,76 | 10,698 |
| | Total | 79 | 70,57 | 9,639 |

**The variance analysis was conducted in order to compare the answers to the groups formed within the scale items and the answers to the entire scale according to different animated pedagogical agents. The subgroups of the scale were attitudes toward the content, attitudes related to the facilitation of learning, the plausibility of the animated pedagogical agent, the animated pedagogical agent's bearing human features, and the encouragement by the animated pedagogical agent.**

**The attitudes towards each animated pedagogical agent group were compared in terms of these subgroups and the sum of the attitude scores. Table: 5 presents each subgroup's descriptive values and Table: 6 the variance analysis results.**

**Table: 6**
**Results of Analysis of Variance**

| | | Sum of | df | Mean | F | Sig. |
|---|---|---|---|---|---|---|
| Content | Between groups | 7,308 | 3 | 2,436 | 1,448 | ,235 |
| | Within groups | 144,692 | 86 | 1,682 | | |
| | Total | 152,000 | 89 | | | |
| Facilitating Learning | Between groups | 1,247 | 3 | ,416 | ,204 | ,894 |
| | Within groups | 153,133 | 75 | 2,042 | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Total | 154,380 | 78 | | | |
| Credibility | Between groups | 1,054 | 3 | ,351 | ,134 | ,940 |
| | Within groups | 197,376 | 75 | 2,632 | | |
| | Total | 198,430 | 78 | | | |
| Being Human | Between groups | 23,827 | 3 | 7,942 | 2,971 | ,037* |
| | Within groups | 200,477 | 75 | 2,673 | | |
| | Total | 224,304 | 78 | | | |
| Encouragement | Between groups | 8,196 | 3 | 2,732 | 1,489 | ,224 |
| | Within groups | 137,576 | 75 | 1,834 | | |
| | Total | 145,772 | 78 | | | |
| Total | Between groups | 145,231 | 3 | 48,410 | ,511 | ,676 |
| | Within groups | 7102,136 | 75 | 94,695 | | |
| | Total | 7247,367 | 78 | | | |

**Table: 6 shows that there was no significant difference in terms of animated pedagogical agents in the attitude scale subgroups except for one subgroup. The group with a statistical difference was "bearing human features" group.**

**There was a statistically significant difference between the attitudes concerning the animated pedagogical agent's bearing human features (p<.05).**

**In order to examine the direction of this difference, Fisher's LSD Significant Difference test was conducted. Table 7 shows the results of the test.**

**Table: 7**
**Fisher's LSD Test Results**

| Dependent Variable | (I) Ped. Agent | (J) Ped. Agent | Mean Diff. (I-J) | Std. Error | Sig. | 95% Interval of Confidence | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower | Upper |
| Being Human | Voice | Head shot | ,545 | ,604 | ,369 | -,66 | 1,75 |
| | | Body shot | -,688 | ,609 | ,262 | -1,90 | ,52 |
| | | Ani. Charac. | ,615 | ,592 | ,302 | -,56 | 1,79 |
| | Head shot | Voice | -,545 | ,604 | ,369 | -1,75 | ,66 |
| | | Body shot | -1,234* | ,499 | ,016* | -2,23 | -,24 |
| | | Ani. Charac. | ,069 | ,478 | ,885 | -,88 | 1,02 |
| | Body shot | Voice | ,688 | ,609 | ,262 | -,52 | 1,90 |
| | | Body shot | 1,234* | ,499 | ,016* | ,24 | 2,23 |
| | | Ani. Charac. | 1,303* | ,484 | ,009* | ,34 | 2,27 |
| | Animated Charac. | Voice | -,615 | ,592 | ,302 | -1,79 | ,56 |
| | | Head shot | -,069 | ,478 | ,885 | -1,02 | ,88 |
| | | Body shot | -1,303* | ,484 | ,009* | -2,27 | -,34 |

**Table: 7 shows that the body shot of a real person as pedagogical agent group attitudes were significantly different from headshot of a real as pedagogical and animation character as a pedagogical agent groups (p<.05). According to this, the students evaluated the body shot of a real person as pedagogical agent more positively than head shot of a real as pedagogical and animation character as a pedagogical agent in terms of bearing human features.**

## CONCLUSIONS

**A general evaluation of the research findings indicate that the use of multimedia software developed by using animated pedagogical agents positively affects student achievement and attitude. The achievement of the students who worked with the software significantly increased, but no significant difference in terms of different animated pedagogical agents was observed.**

**The comparison of the student's attitudes revealed no significant difference in terms of different animated pedagogical agents, yet the attitudes regarding "bearing human features" showed positively significant difference for the software with body shot of a real person. As it is seen in the unstructured interviews with the participants conducted during and after the experimental process, it should be stated that the students had positive attitudes towards the software and the use of animated pedagogical agent and expressed their liking.**

**Improving communication and increasing student motivation and engagement with animated pedagogical agents in distance learning environments is an emerging field. Educational researches mentioned earlier shows that animated pedagogical agents mostly do not have a direct effect to students' success scores but it has a considerable effect on students' motivation by providing individualized instruction, collaboration, guidance and increasing social presence sense. Animated pedagogical agents are promising in improving learner performance.**

**Therefore in near future it is expected that animated agents will be one of the important fields in distance education to increase sense of belonging and social presence of learners with the development of Intelligent Tutoring Systems, Artificial Intelligence, Gesture and Narrative Language, and Synthetic Lifelike Characters.**

## SUGGESTIONS TO RESEARCHERS

**Taking into consideration that the subject is quite new in the domestic literature and has not been sufficiently studied by the researchers in Turkey, different aspects of pedagogical agents should be examined by collecting experimental, descriptive or qualitative data. Primary aspects to be investigated might be the gender of the pedagogical agent, whether the pedagogical agent is visually appreciated by the learner, the personification of the agents in the software, the animation agent's being 2-D or 3-D; what the learner feels for different agents in terms of the sense of reality, and clothes, gestures, mimics, emotions, roles (narrator, motivator, peer, etc.), speech features, accents and cultural preferences of the pedagogical agents.**

**Despite the perspective through which the subject will be tackled and the type of data used, working on this subject is an intense process which necessitates a long span of time, expertise, and mastership over technology (both in terms of hardware and software technologies). It is suggested that the prospective researchers for this subject take into consideration all these issues.**

## FUTURE DIRECTIONS ON PEDAGOGIGAL AGENTS

**According to Slater (2012) future main areas of research, which are related with Pedagogical Agents, are Artificial Intelligence, Gesture and Narrative Language, Intelligent Tutoring Systems and Synthetic Lifelike Characters. *Artificial Intelligence* is the branch of computer science which is concerned with enabling computers to simulate such aspects of human intelligence as speech recognition, deduction, inference, creative response, the ability to learn from experience, and the ability to make inferences given incomplete information.**

***Gesture and Narrative Language* is this field studies how agents can be designed with psychosocial competencies, based on a deep understanding of human linguistic, cognitive, and social abilities.**

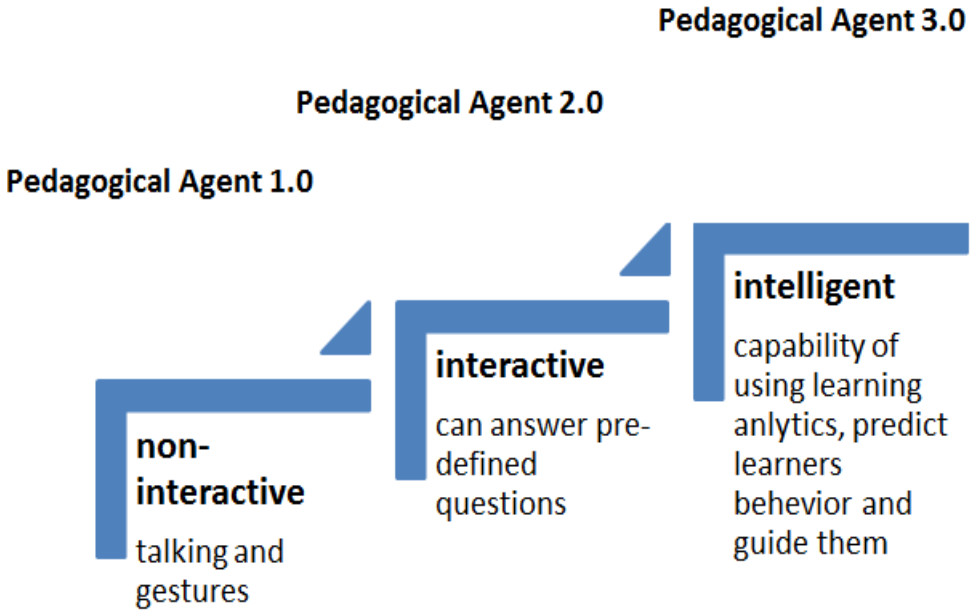


**Figure: 4**
**Expected Evolution of Pedagogical Agents (Unal Colak & Ozan, 2011)**

***Intelligent Tutoring Systems* are computer-based learning environments. In contrast to traditional educational software, these programs are not static preprogrammed systems; on the contrary, the computer's decisions about what problem or what information to present next to the learner.**

***Synthetic Lifelike Characters* is interested in understand how to build interactive characters that come alive in the eyes of the people who interact with them. Avatars or computer-generated characters such as Second life could be one aspect of this field.It is expected that the use of pedagogical agents will increase and become more varied and more widespread to meet learners' social learning needs (Unal Colak & Ozan, 2011).Creating flexible and customized systems will be possible with Intelligent Tutoring Systems, Artificial Intelligence, Gesture and Narrative Language, and Synthetic Lifelike Characters. Figure: 4 shows the Expected Evolution of Pedagogical Agents (Unal Colak & Ozan, 2011).**

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