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Students' attitudes towards animated demonstrations as computer learning tools

Theofanis C. Despotakis, George E. Palaigeorgiou and Ioannis A. Tsoukalas
Computer Science Department, Aristotle University of Thessaloniki, Greece
tdespota@csd.auth.gr // gpalegeo@csd.auth.gr // tsoukala@csd.auth.gr

ABSTRACT

Animated demonstrations are increasingly used for presenting the functionality of various computer applications. Nevertheless, our understanding of whether and how students integrate this technology into their learning strategies remains limited. Although, several studies have examined animated demonstrations' learning efficiency, this study aims at investigating users' initial attitudes towards animated demonstrations as computer learning tools. Attitudes about knowledge sources play a determinative role for their acceptance. Quantitative and qualitative information was collected from forty-six interviews with students who used animated demonstrations for the first time. Students appraised animated demonstrations with regard to their authentic representation of task sequences, arguing that comprehension of the demonstrations did not entail intensive metacognitive burdens. On the contrary, students claimed that animated demonstrations had browsing inefficiencies and sometimes failed to satisfy individual learning needs. Interview transcripts revealed that students' attitudes were influenced by several factors, such as the nature of the computer application to be learnt, students' prior knowledge of that application, their prior learning practices, narrator's characteristics, simulated practice options and the procedural segmentation of the presentation. Results of the study can be exploited to enhance the design of educational applications that incorporate animated demonstrations.

Keywords

Animated demonstrations, Computer learning, Students' attitudes, Exploratory study

Introduction

The ceaseless development and evolution of computer applications has dramatically increased the time and effort required for learning to use computers. Users of a growing number of everyday computer activities face labyrinths of features and services. They often familiarize themselves with only a small portion of the application's functionality and in most cases, fail to exploit the functionality efficiently and effectively (Leutner, 2000). Ironically, users' limited knowledge is likely to become insufficient or out of date in a very short period of time, as a result of the frequent software upgrades (Phelps, Hase & Elis, 2005).

The incidental nature of computer learning needs has forced users to use informal knowledge sources, such as hands-on experience and their social environment (Rieman, 1996; Phelps, Hase & Elis, 2005). Studies have revealed that users explore an application's interface and functionality immediately after installation (Carroll, 1990), making limited use of the help system or the accompanying documentation (Rieman, 1996). When challenged to overcome technical difficulties, they tend to seek for help from more experienced family members, friends or colleagues, because of their ability to provide immediate and concise support (Winter, Chudoba & Gutek, 1997). Even though the need for systematic support of users is widely accepted (Bannert & Reimann, 2000), there appears to be an absence of adequate knowledge sources that meet these learning needs.

Today, promising efforts to enhance computer learning are concentrated on educational applications that incorporate animated demonstrations. Animated demonstrations (ADs) reproduce a screen-captured usage scenario of a software application with verbal explanations. Benefits of using animations to present the functionality of software applications were documented as early as the 1980s (Shneiderman, 1983; Rieber, 1990). ADs' primary instructional value is the authentic and graphical representation of the mechanisms by which users can perform various tasks and achieve particular results (Palmiter, 1993). ADs can help users identify more easily the required actions and the corresponding interface objects associated with target activities, eliminating the "referential step" (Just & Carpenter, 1987) required for the comprehension of textual instructions (Palmiter & Elkerton, 1991). ADs promote the continuous development of a relationship between the user's actions and the system's responses, while textual representations require the user to imagine the described interactions (Palmiter & Elkerton, 1991; Harrison, 1995).

While many studies have noted the positive results of using ADs, other studies yielded contradictory results. For example, it has been asserted that ADs are not a panacea and often not used (Pane, Corbett & John, 1996; Tversky, Morrison & Betrancourt, 2002) and they also may lead to mimicry (Atlas, Cornett, Lane & Napier, 1997). Furthermore, researchers have claimed that ADs do not foster the long-term maintenance of knowledge and its transferability to new contexts (Palmiter & Elkerton, 1991), may distract users from concentrating on key issues (Weiss, Knowlton & Morrison, 2002) and have fundamental usability flaws (Carroll & Mazur, 1986).

Despite the controversial conclusions, most users appear to be very willing to use ADs (Payne, Chesworth & Hill, 1992; Harrison, 1995). This is also confirmed by the recent growth of ADs' use in help systems, educational applications, software presentations, and even gaming instructions (Shneiderman & Plaisant, 2005). Nevertheless, our understanding of ADs' advances in learning efficiency and the criteria for accepting or rejecting them remains limited. In this study we investigate users' attitudes towards ADs as computer learning tools.

Research goals

Contrary to prior studies that focused mainly on the examination of ADs' learning efficiency, we aimed at detecting users' attitudes towards ADs after encountering them for the first time. According to the Theory of Reasoned Action (Ajzen & Fishbein, 1980), attitudes towards objects and behaviors constitute an important determinant of subsequent actual behavior. Similarly, the Technology Acceptance Model (Davis, Bagozzi & Warshaw 1989) postulates that cognitive beliefs about using an object, such as perceived usefulness and perceived ease-of-use, affect attitudes towards using that object, the intention to use it, and ultimately, the use of that object.

Users' attitudes towards computer learning sources are even more significant nowadays. The increased need for continuous development of computer skills has prompted an intense pursuit of suitable knowledge sources. Students tend to assess each knowledge source hastily and relative to the other sources available for their specific learning needs. In the end, their learning strategies depend more on multiple qualities of sources and less on the longitudinal learning efficiency that could be achieved in an ideal learning environment. Consequently, attitudes towards knowledge sources are a significant indicator of users' future strategies for their exploitation. However, attitudes are not the only factor in determining behavior; inconsistencies between attitudes and behavior are to be expected.

Although several studies have delved into ADs' learning efficiency and drawn inferences about students' attitudes (e.g. Palmiter, 1993), this study was focused on students' elaborations of their first experience with ADs. The study sought to:

- Identify students' initial attitudes toward ADs' learning efficiency and appropriateness for computer learning,
- Recognize ADs' features and contexts of use that may influence those attitudes,
- Associate users' beliefs with personal characteristics (e.g., sex, prior computer knowledge),
- Suggest implications for enhancing the design of educational applications that incorporate ADs.

Research methodology

Individual interviews were conducted with forty-six 4th-year students of an academic department in a Greek university. Twenty students were female (43.5%) and twenty-six were male (56.5%). None of the students had had any previous experience with ADs, while all students had extensive experience with computers. During the interviews, students interacted with ADs that presented the development of web pages using a popular commercial application. Interviews averaging approximately 75 minutes in length provided quantitative and qualitative information about students' attitudes towards ADs. The interviews included four activities.

In the first phase of the study, students completed a questionnaire consisting of 4-point Likert scales, regarding their level of knowledge of web development and common desktop applications, their interest in developing web pages and their prior experience with ADs and the commercial application to be learnt. In order to identify the origins of students' prior computer knowledge, they were also asked to specify the sources of their knowledge about five computer content areas: programming, office applications, internet applications, games, and operating systems. Ten alternative sources that have been widely discussed in literature (Palaigeorgiou, Siozos, Konstantakis & Tsoukalas,

2005) as potential channels of computer knowledge were presented as possible answers: books, magazines, help system, internet, hands-on experience, television and radio, ICT in school, family, friends and educational multimedia applications. Students could select up to three sources for each content area, ordering them by their relative importance.

In the second phase of the study, students were requested to use an educational application that incorporated an extended set of ADs for learning about the development of web pages. ADs covered the full range of the software's functionality, lasted 2 to 10 minutes, and were organized in scenarios that showed the construction of sample web pages. ADs included the typical features that are widely encountered in commercial applications. For example their flow could be controlled by common navigating buttons, such as those used by most media players. Students were asked to use the educational application freely for 25 to 35 minutes, and to choose and watch the ADs according to their preferences. We expected that developing web pages would be an intriguing learning task.

In the third phase of the study, semi-structured interviews were conducted. These interviews lasted approximately 30 to 40 minutes and were tape-recorded. Interviews were focused on identifying the students' attitudes towards ADs after their initial use. Students completed a short questionnaire consisting of seven 5-point Likert scales that quantified their perceptions and beliefs about ADs.

In the fourth phase of the research activity, students were asked to use an alternative type of ADs to learn about the same application. Those ADs were organized in short steps and, at certain points, required students to execute sequences of actions in a simulated environment as a means of reinforcing the students' comprehension of the presented material. Students used those ADs for about 10 minutes and then commented on them in comparison with the ADs they had previously explored.

Finally, all audio-taped interviews were transcribed. Follow-up discussions among the authors were conducted and major themes were identified through examination of repeated references made by the participants.

Results

Prior experience and sources of computer learning

The questionnaire about prior experience affirmed that none of the students had previous experience with ADs. Despite the fact that their knowledge of HTML and web page development was relatively limited (M=2.06, S.D.=.95), they were greatly interested in web authoring tools (M=3.22, S.D.=.66). Conversely, all students had extensive experience with common desktop applications such as text editors and spreadsheets (M=3.61, S.D.=.65).

In order to examine the sources of students' prior computer knowledge, ten variables were calculated for each of the five content areas of the questionnaire (programming, office applications, internet applications, games, and operating systems). These variables corresponded to the importance of the ten knowledge sources for the related content area. Sources selected by the students were assigned a value (1 to 3), depending on their prioritization by students, while the rest of the variables were set to 0. The average use of each source was estimated as the mean of its usage for the five content areas. Table 1 shows the students' use of various knowledge sources for the content areas under consideration.

Table 1. Knowledge sources use for different computer applications

	HonE	*Friends*	*School*	*Book*	*Magaz.*	*Internet*	*H.S.*	*Family*	*EA*	*TV&R*
Oper. System	1.54	1.39	0.26	0.61	0.89	0.50	0.17	0.20	0.00	0.00
Office Applications	2.44	0.96	0.20	0.61	0.22	0.33	0.54	0.09	0.09	0.00
Programming	1.65	0.44	2.24	0.83	0.04	0.09	0.11	0.00	0.00	0.00
Games	2.02	1.57	0.00	0.00	0.48	0.22	0.07	0.04	0.00	0.07
Internet	2.24	0.72	0.50	0.22	0.57	0.83	0.04	0.09	0.00	0.00
Average	1.98	1.02	0.64	0.46	0.44	0.39	0.19	0.08	0.02	0.01

HonE, hands-on experience; H.S., help system; EA, educational applications; TV&R, television and radio

Students' responses supported our initial claim regarding the lack of adequate electronic sources for computer learning. As shown in Table 1, they developed their computer skills mainly through hands-on experience and social environment's help. For example, the most important sources for student's knowledge about office applications were hands-on experience and their friends' help. Similarly operational computer knowledge had also emanated from friends and personal efforts. Electronic forms of support, such as the Internet, help systems, and educational applications had limited contribution to their knowledge.

Students' answers also revealed that their learning strategies were differentiated into distinct types of software. For example, students' knowledge about Internet applications originated mainly by hands-on experience, while their knowledge about programming resulted from hands-on experience and school. Consequently, the appropriateness of ADs should be examined relative to the corresponding knowledge field.

Interview results

Semi-structured interviews questions were focused on students' beliefs about AD quality and appropriateness for learning different applications in various contexts of use. We analyzed and organized students' remarks along two axes: the first one refers to the perceived comparative advantages and shortcomings of learning through AD, while the second one concerns the investigation of causes that provoke students' differentiated attitudes. A brief description of the study's results is shown in Figure 1.

Perceived comparative advantages and shortcomings

Perceived advantages

ADs were praised for their authentic representation of task sequences. Students indicated that ADs accurately and cohesively displayed the continuity of user actions and system responses (e.g., *all actions seemed to be happening in real time and that helped me better comprehend the corresponding operations*). Furthermore, they thought the ADs expressly conveyed information that was only tacitly communicated by other knowledge sources, such as books and web pages. For example, ADs demonstrated the required mouse movements for executing an operation, the changes in focus involved, and the time typically necessary to perform a task (e.g., *if you watch the video, you will know how things happen, while, when reading a book with images, you expect that some things will not be described)*. ADs' realistic representation of the software's operational environment gave students the impression that they were executing tasks along with the narrator. Interestingly, many times, interviewers noticed students trying to take control over the demonstration and perform operations on the simulated environment. In some cases, students claimed that they felt as though they had executed the displayed operations and, hence, there was no need to try out the same tasks in the real environment (e.g., *while watching the sequence of the steps, you have the feeling that you are the one who executes the tasks*).

All students evaluated ADs' educational value relative to traditional instruction models and did not compare it with other electronic knowledge sources. According to students' remarks, ADs can simulate one-on-one teaching in an exceptional manner (e.g., *I felt as if I had a teacher or a friend showing me how the application worked*). Students argued that the new environment had one main advantage over the traditional one: it provided more control and autonomy over their learning. Students had the opportunity to select the topic to be learnt, and replay the AD's content whenever they wished so as to satisfy their immediate needs and preferences. Additionally, a few students assessed in quite positive terms the absence of emotional inhibitions that can impede the learning process (e.g., *I am not the kind of person who feels comfortable asking questions; in those demonstrations I just have to watch again whatever I do not understand)*.

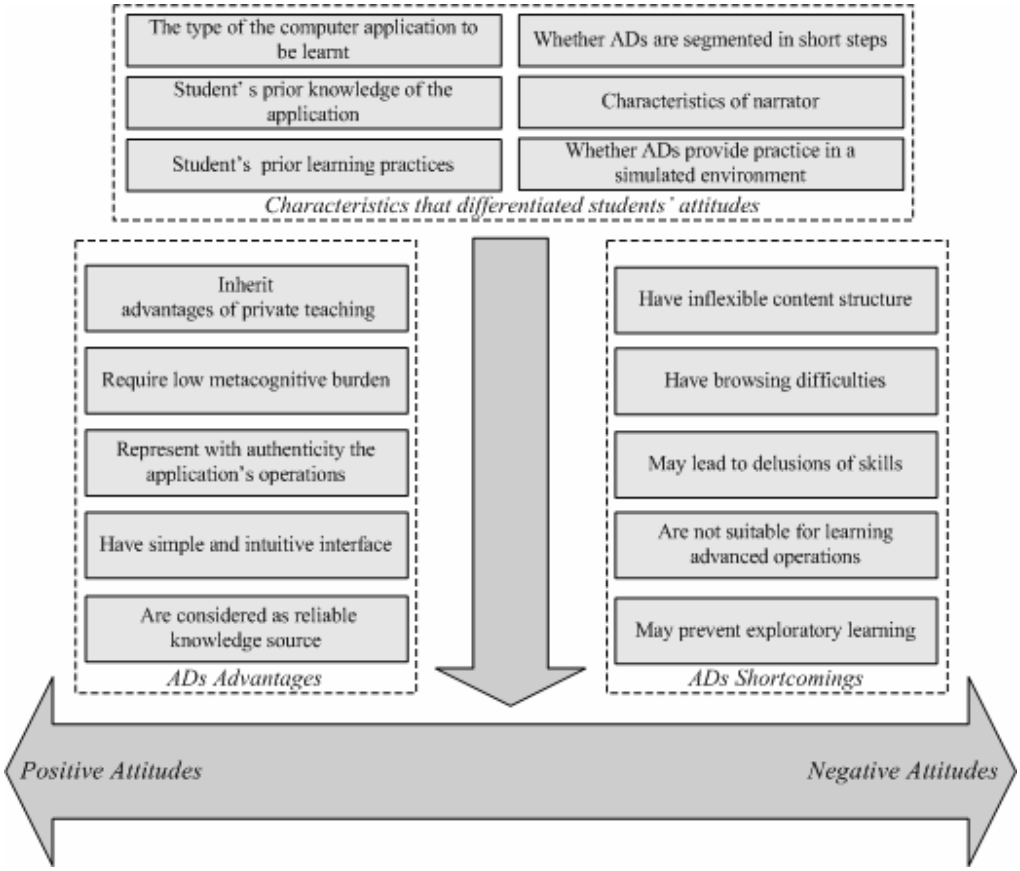

Figure 1. Study results

Students commented that ADs did not place significant metacognitive burdens on their comprehension. Students expressed their general learning objectives by selecting ADs and then they followed the learning path promoted by the ADs' authors. Their attention was directed by the AD narrator and they could simply replay those parts of the demonstrations they did not understand. According to some students, these characteristics rendered the learning process more pleasant. They stated that ADs could also be used when their concentration skills had ebbed (e.g., *I am not bored of using such applications. I usually stop reading a book when I am tired but I would probably continue to watch the video),* while some of them attributed entertainment characteristics to ADs (e.g., *even if I had low interest in this software, I could watch an AD, as I would read a novel*).

ADs were considered as reliable knowledge sources. Students assumed that authoring and production of ADs was time-consuming and presumed that their contents, by virtue of the time expended in their development, should be valid. Furthermore, almost all of the students stated that the ADs' interfaces were intuitive and familiar to them from other applications and devices they had used in the past (e.g., media players).

Perceived shortcomings

Several students contended that AD presentation structure was inflexible and sometimes inadequate to satisfy their learning preferences and needs. They could select ADs according to their objectives, but they felt both constrained and obligated to follow a predefined learning path that might not match their precise needs. For instance, a number of students claimed that the presentation was too fast and sometimes the pace exceeded their ability to assimilate the presented content. Others suggested that the narrator was verbose, since he described many operations of no interest to them. Similar user comments have been mentioned by Haas, Brown, Cao & Wilbur (2005).

Students also pointed out ADs' inherent browsing limitations on two distinct levels: the one concerned the selection of ADs available for watching and the second concerned the difficulty in finding the contents' key points. Students commented that AD selection was not an easy process because their short descriptions couldn't reveal the learning content presented. As a result, students found it necessary to launch each AD and examine its contents to identify whether it might satisfy their learning objectives or not. Students also argued that locating the AD's key points, such as the presentation of a specific operation, required an exhaustive exploration of multiple ADs. Essentially, students using ADs had to "*see to select*" as opposed to the traditional "*select to see*" navigational approach that prevails in most applications (e.g., *whenever he was saying something that I knew or was of no interest to me, I had to guess its duration so I could skip it*). The AD navigation toolbar was easy to use, but it did not provide sufficient information for locating specific points of interest. These characteristics, according to students, could have a negative effect on their speed of learning (e.g., *you had to search for the operation, close and open all videos…in each case, your progress was delayed*).

Despite the fact that the majority of students evaluated ADs' instructional value quite positively, three students made an unexpected observation about their side-effects. Those students stated that the delusion of executing actions along with the narrator could mistakenly make them believe that they had acquired certain knowledge, while they had not. They also indicated that ADs might eliminate informal forms of learning, such as exploring the interface, which often produce unexpected and positive learning outcomes.

Characteristics that differentiated students' attitude

As shown in Figure 1, positive or negative evaluations of ADs seemed to be systematically influenced mainly by three factors independent of the AD (*the nature of the computer application to be learnt*, *students' prior knowledge about that application,* and *students' prior learning practices*) and three characteristics of the AD (*narrator's characteristics*, *the offering of simulated practice,* and *the segmentation of the presentation in short steps*).

The nature of the computer application

We have noticed differences in students' evaluation of ADs' learning efficiency for learning different types of applications. Students had already developed distinct learning strategies for various types of software and, consequently, the ADs' appropriateness was evaluated in the context of the corresponding learning strategies. For instance, as indicated in previous research (Rieman, 1996), several students in our study claimed that, when they start learning an application consisting of familiar interaction objects (e.g., such as documents or drawings), they prefer to explore its functions by themselves. In this way, as they stated, they "*skip the psychological overhead of following a systematic learning process*". However, the overwhelming majority of the students commented that ADs would be their preferred choice, in case the exploration proved insufficient. Students also differentiated their assessment of ADs for learning applications that require substantial conceptual knowledge and do not incorporate complex interface features (e.g., programming environments). Students indicated that they considered other knowledge sources, such as books, to be more suitable for presenting theoretical concepts and schemas.

Students' prior knowledge of the application

Students' attitudes towards ADs were also differentiated according to students' prior knowledge of the application to be learnt, supporting Palmiter's (1993) corresponding claims. All students highlighted the ADs' significance in the initial stages of the learning cycle (e.g., *ADs are definitely more useful for novice users of an application*). However, more experienced web page developers said that it would be difficult to acquire a deeper understanding of complex operations without using any other sources (e.g., *an expert user, who usually requires more detailed descriptions will probably find ADs boring and quite slow*). Almost all students, when asked whether they would recommend ADs to their friends, answered that this would depend on their friend's knowledge level of the application. The relationship between the students' prior knowledge with their attitudes towards ADs will be further examined later.

Prior learning practices

Participants seemed to have developed tenacious beliefs about how the instructional presentation should be structured in order to be useful. Some of the students asked for a more function-oriented presentation, emphasizing that short ADs focused on specific tasks could accelerate learning (e.g., *ADs should be function-oriented to find them quickly and learn exactly what you want*). Those students stressed that, in this manner, ADs would seem more objective and they wouldn't have to watch an entire usage scenario to learn about a single operation. Conversely, other students were in favor of scenario-based ADs and stressed the advantages of watching the progressive development of pilot products (e.g., *I would like to select from a list of case studies and watch scenarios of the development of real web sites, such as a company's web site; it is more interesting*). Those students claimed that scenario-based learning is more motivating and can help them to make the coherent connection among the application's various functions. It is possible that students' preferences might emanate from their different learning styles.

Narrator's characteristics

Various characteristics of the narrator were identified as significant determinants of students' evaluations. Narrator's voice tone and accent, his style of commenting and presenting the various operations (e.g., joking, the method and speed of moving the mouse, the use or avoidance of keyboard shortcuts) colored the students' evaluations about ADs. For instance, several students were enthusiastic over the first narrator's friendly and humorous style, while they complained about the second narrator's literal method of presenting the application's operations (e.g., *the presenter's voice is awful*). Others noted that they would prefer a less personal and a more formal presentation (e.g., *this friendly style is annoying. I would prefer a more technical, less colorful style*).

Simulated practice

With regard to the use of ADs which were presented in the last part of the interview, students expressed contrasting preferences. The ones who liked practicing in a simulated environment commented that those ADs provided the opportunity to immediately apply what they had learnt in a safe environment and, hence, they could better comprehend the demonstrated tasks (e.g., *in the simulated environment, I can virtually complete tasks without the risk of making a mistake or messing up the application's settings… you participate and you feel more creative and happy with the result)*. On the other hand, some students believed that this form of "pretended" practicing resulted in only a mimicked implementation of the given instructions and offered them no benefit. (e.g., *I was frustrated. I was trying to understand and at the same time I had to do what was asked. I do not believe that I would learn better in that way because this kind of practice is disruptive*). Those students characterized the interaction with the simulated environment as a poorly designed dialogue (e.g., *you feel like a child in that you have limited capabilities in understanding; it guides you too much*) and claimed that it introduced new navigational problems (e.g., *you have to repeat all of the preliminary steps to watch again a particular task*).

Segmenting ADs

Segmenting of ADs into smaller steps is considered to enhance learning (Harrison, 1995). In our research, this feature was positively noted by several students who argued that, eventually, they could manage to adhere to the learning pace of the presentation. However, the rest of the students were reluctant to use the additional navigational elements that would allow them to alter the progression of the video, underlining that segmenting the AD into smaller steps eliminated the ADs' basic advantage, that of the continuous and cohesive presentation of an operation.

Attitudes questionnaire

Generally, most students were enthusiastic about their experience with ADs but, as previously mentioned, they also highlighted several problems. Students' answers to the closed-type questionnaire are presented in Table 2. The questionnaire was coherent with a Cronbach's alpha of .90. Students' responses were negatively skewed and

underscored their positive attitudes towards ADs as computer learning tools. Most students evaluated ADs as pleasing (M=4.41, S.D.=.98) and the overwhelming majority indicated that they would like to learn about computer applications using such demonstrations (M=4.28, S.D.=1.09). ADs were accepted with greater enthusiasm by females (t=2.043, p<.05), who evaluated more positive the efficiency (t=2.423, p<.03), the speed (t=2.553, p<.03) and the authenticity (t=2.599, p<.03) of learning through ADs.

In order to examine the relationship between the effect of students' prior knowledge of the web development application and their attitudes towards ADs, a median split on the variable of perceived knowledge was performed. Excluding students which had scored on the median, the split produced two groups of students: the first group represented those less knowledgeable of the application and consisted of 21 students, while the second group consisted of 17 students. Independent sample *t*-tests indicated significant differences in students' attitudes towards ADs (t=2.396, p<.03), with the less knowledgeable students evaluating ADs more positively. These results lend further support to the previous conclusion regarding novice users' preference for ADs.

Table 2. Students' answers to the closed-type questionnaire

	Total		*By Gender*				*Gender Differences**	
Questions	M	S.D.	Male	SD	Female	SD	t	Sig
ADs enable me to learn about applications in a more efficient way compared to other means (e.g., books, web pages, etc.)	4.07	1.12	3.73	1.15	4.50	0.95	2.423	0.020
The use of ADs can make computer learning faster	3.80	1.14	3.46	1.24	4.25	0.85	2.553	0.014
ADs make computer learning more authentic	3.87	0.98	3.58	1.10	4.25	0.64	2.599	0.013
ADs make computer learning more pleasant	4.41	0.98	4.27	1.12	4.60	0.75		
I would prefer to learn about the functionality of computer applications using Ads	4.28	1.09	4.15	1.16	4.45	1.00		
I am very satisfied from the ADs I selected and watched	4.15	0.99	4.12	1.11	4.20	0.83		
I would recommend ADs to my friends who wanted to learn about new software	4.20	0.93	4.12	1.11	4.30	0.66		
Scale	4.11	0.82	3.92	0.97	4.36	0.48	2.043	0.048

**Differences are computed using independent samples t-test*

Discussion

Our study reconfirmed that ADs constitute an appealing computer learning approach (Weiss, Knowlton & Morrison, 2002; Shneiderman & Plaisant, 2005). Students' perceptions were close to other studies' arguments. ADs were perceived as advanced instruction sessions in which students specified objectives and interests, and teachers presented adequate learning scenarios. This type of learning was considered to be particularly suitable for learning about computer applications, since it simulated accurately the real environment and conveyed knowledge that was tacit to other learning means (e.g., web pages or books). Students stated that ADs required low metacognitive efforts and could even be considered as a form of entertainment. However, students suggested that ADs in their current form have significant shortcomings. For example, students noted their inflexible content structure, their browsing inefficiencies and the possibility to lead to delusions of skills.

The results indicated four directions leading to improvement of ADs. The first one is related to the development of adaptive services. Students' comments revealed various opportunities for improvement, such as, adapting the content's structure to the students' prior knowledge and prior learning practices, or adapting the presenter's voice and behavior to match more closely the students' socialization preferences.

The second potential category for enhancements stems from the positive evaluation of simulated practice by many students and from the observation that students were trying to interact with the simulated environment during the presentation. Until now, ADs have been developed as distinct applications with limited capabilities to reproduce the functionality of the application. No research studies have examined ADs that are embedded in real applications and take advantage of their original interface and functions in their scenarios. Such ADs might enable students to develop exploration activities in parallel to the presentations.

The third area offering room for improvement involves the internal and external indexing of ADs. Visualization techniques, such as fisheye views of ADs' critical frames, could provide more useful information about their contents. The creation of links to specific points of interest within their scenarios could also improve the ADs' ability to better satisfy the students' needs.

Finally, since students have stated that they are willing to use ADs during periods of low concentration levels or for entertainment, it would be interesting to design ADs that meet those exact circumstances.

We have to underscore that the results of our study were entirely focused on students' first impressions of ADs. Hence, they should be generalized with caution. Extended usage of ADs is likely to provoke more refined attitudes. Our future research aims to examine the previously mentioned improvement opportunities.

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