The effect of previous experience with information and communication technologies on performance in a Web-based learning program

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Abstract

The purpose of the present study was to analyze the influence of previous experience with information and communication technology (ICT) tools on performance in a Web-based course. Online activity was logged. Specifically, total activities carried out and five online activity measures were computed. One hundred and twenty university undergraduates participated in a Web-based course designed to train personnel trainers to apply ICT in training processes. Before starting the study, participants filled out a questionnaire designed to assess their frequency using ICT tools. At the end of the study, participants were asked to complete a questionnaire in order to collect information about their learning experience and their assessment of the virtual environment. Results suggest that previous experience significantly influences how people organize their online activities, but not the quantity of work carried out. Participants with more experience in the use of Internet tools, organize their work in the virtual classroom using less time and visiting fewer pages in each session. Previous experience did not influence the assessment of the virtual classroom as a training tool, since participants with both high and low previous experience gave extremely positive feedback on their Web-based learning experience.

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1. Introduction

The advance of the Internet in all areas of everyday life is modifying common practices in the design and development of training projects both in professional and academic fields. At universities, there is a growing trend in the number of blended learning projects that combine in situ training with virtual training supported by the Web.

There are great expectations surrounding online training because of its versatility (it is appropriate for all types of contents or subjects), its flexibility (at any time and in any place) and its personalization (it can be adjusted to meet the user’s requirements). However, it is time to contrast these expectations with empirical results evaluating the efficiency of the training programs that are being carried out. It is critical to investigate the effectiveness of Web-based projects as an instructional tool.

Beyond technological fads, the success and subsequent incorporation of ICT in training programs, whether in academic or professional fields, will depend on whether it can be reliably substantiated that they help to improve the quality of learning processes, making a real contribution to the achievement of the desired learning objectives combined with user satisfaction in the Web environment. In this sense, the effective design of Web-based learning environments will be of the utmost importance.

The effort devoted to the design of projects or training courses carried out in Web environments has not been backed up by an equivalent effort to gain knowledge about them and analyze the factors determining the success of Web-training projects. However, it is well-known that applying ICT to training processes modifies learning conditions in various ways, changing traditional student-teacher roles and skills. It is necessary to analyze how the roles of trainer and student are affected and to develop procedures to evaluate the impact of such changes on the efficiency of the learning processes.

There is a certain consensus that in the context of online training, virtual learners play a more active role. Web-based learning requires greater effort, involvement and skill from the student when managing information (Hokanson & Hooper, 2000). Learning concepts requires both carrying out the corresponding activities and being competent in information technology (use of a computer and Internet navigation). Students who are confident in their computing skills and suffer less anxiety when using computers are more likely to continue with the training course and to achieve better results (Osborn, 2001).

Not paying sufficient attention to these factors could explain the “failure” data in training which results in students abandoning the programs. This is one of the main threats to the development of online training. In fact, these failure indices are being handled as a quality criteria in the assessment of online learning.

The lack of skill working in a Web environment causes the user to undergo negative experiences. The phenomenon of being “lost in hyperspace”, frequently described in the literature (Danielson, 2002; McDonald & Stevenson, 1998; Otter & Johnson, 2000; Schoon & Cafolla, 2002), happens when a user gets to a point in which the structure of the hypertext has no meaning for him and he has no idea how to get to a place with which he is familiar (Aedo, Díaz, & Montero, 2001). Disoriented users find it extremely difficult to capture the global structure of the information, which means that they to continue to feel disoriented and this greatly hinders their understanding of the main content (McDonald & Stevenson, 1998; Rada & Murphy, 1992).

Although this is acknowledged as one of the greatest threats, little is known about the reasons for students dropping out. Sometimes (Wang & Newlin, 2002) it is associated with
low performance, which in turn indicates factors such as motivation, self-efficacy, perceived control, ICT experience, and navigation strategies. The latter is described as a critical factor affecting what is learned and how learning takes place in this context (Lawless, Mills, & Brown, 2003).

Previous experience in the use of ICT tools seems to be a differentiating factor between students who participate in Web-based training programs. Reed, Oughton, Ayersman, Giessler, and Ervin (1995) and Reed, Oughton, Ayersman, Ervin, and Giessler (2000) found that individuals with less previous experience in the use of computers navigated in a more linear manner and individuals with more hypermedia experience navigated more nonlinearly.

On the other hand, the relationship between the level of experience or previous computing skills and time invested in the online environment has been analyzed, giving very varied results in studies carried out by the same authors; some found that a negative relationship existed between experience with hypermedia and time on task within the hypermedia environment (Reed & Geissler, 1995; Reed & Oughton, 1997; Reed et al., 1995; Reed et al., 2000) or, in some instances, it is found that those users with more previous experience in using hypermedia programs spent more time using the hypermedia program which allowed them to navigate in a less linear way and to make more use of exploring the possible links (Kraus, Reed, & Fitzgerald, 2001). Nevertheless, previous computer experience was unrelated to user performance on measures of learning through the hypermedia case study program (Fitzgerald & Semrau, 1997).

Taking these considerations into account, the present study analyze the behavior of a group of users in a Web-based learning program testing whether previous experience with ICT influences performance and online activity. Furthermore, their assessment of their own learning experience and their evaluation of the tool is considered.

2. Method

2.1. Participants

One hundred and twenty college students were enrolled in “Personnel Training and Development”, a not compulsory course for Organizational Psychology.

The course was designed to train the skills that the “new” professional trainers need to develop in order to apply ICT. They must be experts in designing, implementing, and assessing training projects in which new technologies help to achieve a given set of educational objectives.

2.2. The course

The course included conventional (face-to-face) and Web-based sections. All students were encouraged to take part in the online cyberclass about the role of ICT in personnel training. The Web-based courses comprised four sections. Course materials were organized in small content units. Each unit included both topic explanations and exercises. Asynchronous online communication (electronic forum and e-mail) was built-in to the virtual environment. Basic bibliographic references, Web links, FAQ’s and a glossary were supplied as additional resources. Help and “where am I?” commands were always accessible to the users (Fig. 1).
2.3. Procedure

The virtual classroom was open for 36 days without interruption in the first term of the course. During this period students could work in the virtual classroom at any time and from any computer with an Internet connection. The initial and final questionnaires were given at the beginning and the end of their participation in the Web-based program.

The students’ online activity was logged. The logged data allowed us to determine how often participants visited each Web-site, what activities they carried out, and how long they needed to perform the different activities, as well as identifying a variety of other aspects of Web-user interaction.

At the beginning of the Web-based course, students were given a survey asking them to indicate the frequency of their use of different ICT tools. These data were useful to report on students’ experiences in new technologies and virtual courses. In the same way, at the end of the study, participants were asked to fill in a questionnaire in order to collect the user’s assessment of the Web-based course.

2.4. Measures

2.4.1. Previous experience

A global index of previous experience with a range of 0–1 was setup, taking into account the frequency of use of basic Internet tools (e-mail and browser) and previous participation in Web-based training projects.
2.4.2. **Online activity**

Logged data allowed us to compute five measures of online activity:

- Total hypertext sessions: Total number of sessions
- Total Web-site hits: Total number of Web pages visited
- Average path length: Average number of Web pages visited per session
- Total online time: Total time of online activity
- Average path time: Average online time per session

2.4.3. **Performance**

An index of classroom performance was created, based on the total number of activities carried out. A total of eight possible activities were proposed:

- E-mail: Using clients’ e-mails
- Navigation: Using Web browsers
- Forum: Participating in the electronic forum
- Characteristics: Thinking about main features of using ICT in training projects
- Models: Thinking about Web-based learning and teaching models
- Examples: Visiting and testing other ICT training programs
- Design: Designing an ICT training project
- Assessment: Assessing an ICT training project

In order to pass the online course, students must carry out at least four activities correctly.

2.4.4. **Assessment of the Web-based tool**

At the end of the study, participants classified the navigation environment, its design and the training efficiency of the virtual program, based on their own personal experience.

3. **Results**

3.1. **Previous experience**

The data obtained through the initial questionnaire shows that there are variations in the use of the different tools:

- The tool most frequently used by the participants is e-mail. Sixty percent of the participants regularly use e-mail (weekly or daily), 36.8% use it occasionally and 2.1% never use it.
- The 24.5% of the participants navigate daily on the Internet, 27.7% do so once a week and about half of the participants never or almost never navigate on the Internet (47.9%).
- Only 3.3% of the participants (four people) stated that they had previously visited a virtual classroom.

Applying the global indicator of previous experience in the use of basic ICT tools, the group of participants as a whole have an average level of previous experience (Mean = 0.41; SD = 0.21), with individual differences which allowed us to group them according to low (n = 32), average (n = 40) and high (n = 22) previous experience.
3.2. **Online activity**

Descriptive statistics about online activity are presented in Table 1.

3.3. **Performance**

With respect to the number of activities carried out, 76.7% of the participants completed at least four of the eight proposed activities (Mean = 5.5; SD = 2.53), which was the criteria used to pass the course.

On the other hand, there are significant differences in the participation registered for each of the activities ($Q = 27; p = 0.000$). The activity with least participation (59.2%) corresponds to ‘visiting and testing other ICT training programs’. The activity most frequently carried out was the ‘e-mail activity’, completed by 72.5% of the participants.

3.4. **Online activity and performance**

The analysis of the relationship between the navigation variables, online activity and performance shows (Table 2) that performance is directly related to the total time devoted to the learning program, the number of sessions carried out, and the total number of pages visited. The indicators of work per session present, between them, high and significant relationships: the number of pages visited per session has a correlation of 0.76 with the time used per online session.

The results show that among participants with higher performance levels, a greater number of Web-site hits and more total online time were registered (Table 3).

The analysis of online activity measures and performance data, through the principal component analysis with varimax rotation, shows two conceptual categories of online

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### Table 1

**Online activity measures**

<table>
<thead>
<tr>
<th>Measure</th>
<th>Mean</th>
<th>SD</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total hypertext sessions</td>
<td>5.03</td>
<td>3.72</td>
<td>1</td>
<td>19</td>
</tr>
<tr>
<td>Total Web-site hits</td>
<td>166.13</td>
<td>117.38</td>
<td>9</td>
<td>603</td>
</tr>
<tr>
<td>Average path length</td>
<td>41.48</td>
<td>36.23</td>
<td>4.5</td>
<td>280</td>
</tr>
<tr>
<td>Total online time</td>
<td>10945.33</td>
<td>7667.50</td>
<td>107.0</td>
<td>49,148</td>
</tr>
<tr>
<td>Average path time</td>
<td>2699.79</td>
<td>1683.02</td>
<td>53.5</td>
<td>10,483</td>
</tr>
</tbody>
</table>

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### Table 2

**Spearman correlation coefficients between online activity measures and course performance (n = 120)**

<table>
<thead>
<tr>
<th>Measures</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Total hypertext sessions</td>
<td>–</td>
<td>0.63**</td>
<td>–0.40**</td>
<td>0.65**</td>
<td>–0.49**</td>
<td>0.24**</td>
</tr>
<tr>
<td>2. Total Web-site hits</td>
<td>–</td>
<td>0.38</td>
<td>–</td>
<td>0.78**</td>
<td>–</td>
<td>0.28**</td>
</tr>
<tr>
<td>3. Average path length</td>
<td>–</td>
<td>–</td>
<td>0.18*</td>
<td>–</td>
<td>0.76**</td>
<td>–</td>
</tr>
<tr>
<td>4. Total online time</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>0.27**</td>
<td>–</td>
<td>0.26**</td>
</tr>
<tr>
<td>5. Average path time</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>6. Performance</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

* $p < 0.05$.
** $p < 0.01$. 
course activities: the work carried out (quantity) and the organization of the work (how). 75.3% of the variance is accounted for by these two components (Table 4).

The first component accounted for 42.8% of the variance and was loaded by the indicators which describe the workload required to carry out the activity in the virtual classroom, ‘how much they work’: total online time, total hypertext sessions and total Web-site hits, in addition to course performance (total number of activities carried out in the program).

The second component was loaded by the variables which describe the way the users organized their work, how they work, and included indices of average time used per session and the number of pages visited per session of work in the classroom. The number of hypertext sessions is also weighted in this component (although less than in component I and with a negative sign). This component of organization of the work accounted for 32.52% of the variance.

Performance in the virtual classroom is significantly related to the amount of effort and work invested: the more pages visited and more time spent in online activity, the greater the effort and the better the results. However, we did find that the variables referring to how the Web-navigation activities were carried out, the style of organizing the work, do not bear any relationship to performance.

Subsequent analyses have shown a relationship between previous experience in the use of ICT tools and the factor of organization of the work in the classroom ($r = -0.28$; $p = 0.001$). People with greater previous experience in the use of ICT tools organized their work in a different way to users with less experience. Those with more previous experience used less time and less visits to pages per work session. From this we can conclude that

Table 3

<table>
<thead>
<tr>
<th></th>
<th>Low performance</th>
<th>High performance</th>
<th>$t$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Course performance</td>
<td>1.87</td>
<td>1.45</td>
<td>7.49</td>
<td>0.50</td>
</tr>
<tr>
<td>Total hypertext</td>
<td>3.85</td>
<td>3.78</td>
<td>5.31</td>
<td>3.34</td>
</tr>
<tr>
<td>Total Web-site hits</td>
<td>116.52</td>
<td>124.42</td>
<td>178.66</td>
<td>112.27</td>
</tr>
<tr>
<td>Average path length</td>
<td>32.28</td>
<td>20.70</td>
<td>42.40</td>
<td>36.72</td>
</tr>
<tr>
<td>Total online time</td>
<td>7925.91</td>
<td>8961.50</td>
<td>11,371.77</td>
<td>5694.07</td>
</tr>
<tr>
<td>Average path time</td>
<td>2433.09</td>
<td>1832.73</td>
<td>2713.48</td>
<td>1653.10</td>
</tr>
</tbody>
</table>

* $p < 0.05$.
** $p < 0.01$.

Table 4

The results of the principal component analysis with varimax rotation

<table>
<thead>
<tr>
<th></th>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
</tr>
<tr>
<td>Total hypertext sessions</td>
<td>0.80</td>
</tr>
<tr>
<td>Total Web-site hits</td>
<td>0.93</td>
</tr>
<tr>
<td>Average path length</td>
<td>0.12</td>
</tr>
<tr>
<td>Total online time</td>
<td>0.92</td>
</tr>
<tr>
<td>Average path time</td>
<td>0.00</td>
</tr>
<tr>
<td>Course performance</td>
<td>0.47</td>
</tr>
<tr>
<td>Percentage of variance</td>
<td>42.82</td>
</tr>
</tbody>
</table>
previous experience has an effect on the way the work is carried out, although it does not seem to affect the effort used (amount of work carried out).

With respect to the assessment of the Web-based experience, participants evaluated positively the learning program with regard to its training efficiency (Mean = 7.28; SD = 1.25), the navigation into the Web-site (Mean = 6.92; SD = 1.46) and the tool design (Mean = 7.20; SD = 1.14).

Moreover, the lack of significant relationship between the variables of previous experience and performance, indicate that the results obtained or the previous experience in the use of ICT tools, do not influence users’ positive assessment of the virtual classroom.

4. Conclusion

The use of computers in different areas of academic life has become widely extended over the last few years, but the experience in the use of ICT tools is unequal and in general terms the level of university students, at least in Spain, is average, with broad individual differences. When implementing training based on the Web it is important to understand the effect that experience with ICT may have on the efficiency of Web-based training programs as training instruments.

The total time used for the task and the number of pages visited are being used to measure the most frequently used online activities. However, we strongly endorse the view that it is necessary to complete the information on the amount of activity registered in the classroom with information about how the activity is organized. The factorial structure obtained is, in this sense, of particular interest, since it shows that how the effort invested and the way the work is organized are components which bear a different relationship on the results obtained.

The students’ performance was satisfactory, bearing in mind that for some it was their first experience of Web-based learning. Although we found significant statistical differences between their participation in different activities, this must not be seen as negative. The performance obtained in an activity on a virtual learning program has been proved to depend upon the amount of effort dedicated to the task, and does not depend on the work organization or previous experience.

Participants were favorable in their assessment of the Web-based training tool, as much in the formal aspects as in its training efficiency. The lack of available information about progress being made is the most negative aspect of the learning environment used in this study and it seems that the amount of effort dedicated to the task may have influenced their evaluation.

The results of the present study indicate that the difference between students with low and high previous experience in the use of Internet tools does not lie in the amount of activity carried out during the training program, but rather in the way they organize their activity. Thus, users with greater experience distribute their work in more sessions of shorter duration and visit fewer pages per session, without this meaning less amount of total work carried out. Conversely to work carried out in previous studies, we found no relationship between previous experience and total time spent in online activity.

With regard to performance in the virtual classroom, the total number of pages visited and performance are positively related (Wang & Newlin, 2000). In the same sense, we have observed a positive relationship between the total time registered for the activity and performance.
These results, as well as the absence of significant relationship between the variables of previous experience and performance, show that although users with more experience with Internet tools have a different pattern of activity, this do not influence their performance at the program.

In summary, previous experience or being familiar with Internet tools outside of the training context, increases efficiency when participating in more structured learning projects with clearly defined learning objectives. Those with such computing skills develop the work in less time, which may be a highly motivating factor helping them to remain in the training program until the end and generates positive assessments of online training programs. Good results with respect to performance and satisfaction with the learning experience is a successful combination, which should lead to a reflection on the need for participants in Web-based learning programs to have a basic level of computing skills before joining a Web-based training program.

References


