Authors

Helena Matute
Departamento de Fundamentos y Métodos de la Psicología
Universidad de Deusto Bilbao
Spain

Miguel A. Vadillo
Departamento de Fundamentos y Métodos de la Psicología
Universidad de Deusto Bilbao
Spain

Pablo Garaizar
DeusTo Tech, Departamento de Telecomunicaciones Universidad de Deusto Bilbao Spain

Editor

Prof. Norbert M. Seel
Department of Education
Faculty of Economics and Behavioral Sciences Germany

Web-Based Experiment Control for Research on Human Learning

Synonyms

Evidence-based eLearning; Methodologies of learning research through the Internet; Online experiments on learning; Online methods for learning research; Research on e-learning; Software for human learning research; Web-based research on learning; Web-labs for the study of learning

Definition

Web-based experiment control software for research on human learning refers to any type of computer program designed to control the execution of human learning experiments via the Internet. These programs are designed to test the predictions of the different theories of learning, and to understand under which conditions learning progresses more rapidly, more smoothly, or more durably, which conditions allow for better learning and which ones induce more forgetting and interference. An additional purpose of this type of software is to compare the learning that occurs in the standard, well-controlled, psychology laboratory to that which occurs through the Internet. In order to fulfill all these objectives, such software needs to present the learning materials in a relatively homogeneous fashion through different computers and configurations and needs to allow for the manipulation of independent variables that are common in the area of learning such as number of trials, number and type of cues, number and type of outcomes, particular combinations of cues and outcomes, timing between them, and contexts in which the different phases of the experiment take place. The software also needs to accurately store the dependent variables (subjective judgment of causality, predictive responses, the timing in which the participant's responses take place, learning curve, and so on).

Theoretical Background

Since the 1980s most of the research that has been conducted on how human learning works, which variables affect the learning process, and how human learning can be explained (and thus, predicted, controlled, and improved) has been conducted through personal computers. Research participants (usually college students) were presented with stimuli whose parameters were controlled by a computer in the laboratory. These parameters included key factors such as timing, relationship to other stimuli, emotional content, or semantic and instructional value, in addition to more basic aspects such as size, color, intensity, location, or sensory modality. The speed and quality of the participants learning was automatically assessed through the registration of the way and time in which they responded to those stimuli. The development of methodologies of learning research

and the corresponding software was normally undertaken by the psychology researchers themselves, and therefore a huge and heterogeneous variety of experimental software exists today that can be used in the standard (offline) psychology laboratory. The natural evolution of such programs in the age of the Internet has resulted in that some of them have been adapted to be run online (see Matute et al. *2007a*). The main advantage of this adaptation is that the Internet has certainly come to facilitate the exchange and homogeneity of procedures and software among researchers and has multiplied the number (and heterogeneity) of participants that can take part in each experiment. There are also some potential risks of doing research on learning through the Internet, such as, for instance, the possibility of some participants repeatedly taking part in the same experiment. However, the potential risks have been explored and several solutions have been suggested that make the impact of these problems almost negligible (e.g., Kraut et al. *2004*; Vadillo and Matute *2009*).

Just like any other experimental psychology software, these web-based programs designed to conduct research on learning through the Internet will normally comprise several versions of themselves. The reason for this is that each version needs to include a different level of an independent variable whose effect on the learning process is to be investigated. The program will then execute one or the other version each time that a different user (research participant) clicks the link to start the experiment. For instance, a program designed to test the effect of massive versus distributed learning, would comprise at least two different versions that will be assigned at random to each participant. One of these versions would use massive training, with the learning trials being presented in a very rapid succession, one after the other, while the other version could use much longer intertrial intervals. Of course these variables could also be manipulated in a within-subjects design, with each participant receiving all conditions in a counterbalanced order.

There are many different research questions, theoretical perspectives, and backgrounds from which web-based research on human learning is nowadays being conducted. In general, we could say that online research on learning is being conducted to explore (a) methodological developments (to know whether online experiments are as reliable as laboratory ones), (b) generality of already known phenomena (to test whether well-known learning effects can also be observed outside of the laboratory), and (c) novel predictions of learning theories (to run new experiments that could either be run in the laboratory or through the Internet, in which case the researchers can benefit from the larger samples available in the web). Therefore, different web-based programs have been designed to investigate online different forms of learning such as, for instance, probability learning

(e.g., Birnbaum, and Wakcher *2002*), associative learning (Vadillo et al. *2006*), or causal learning and illusions of control. As an example, in an experiment designed to study how the illusion of control is acquired in the Internet, participants could be instructed to terminate stimuli that are being presented by the computer. The termination of the stimuli, however, does not depend on the participants' responses, but on a preprogrammed schedule. The result is that participants trying to terminate the stimuli will normally learn an illusory causal relationship between their behavior and the termination of the stimuli. This is an example of how several learning effects, in this case an illusion of control, can be equally acquired not only in the laboratory but also through the Internet (Matute et al. *2007b*).

Important Scientific Research and Open Questions

One of the hottest current debates to which these programs could contribute by providing the necessary evidence is the issue of whether learning through the Internet is better, worse, or similar than more traditional forms of learning. Both professional and lay people's discussions on these topics are often vehement but the scientific evidence is still scarce. Indeed, a debate exists on whether these two things are actually comparable (there are many variables that differ between traditional learning in the classroom and web-based learning at home). Experiments that compare how people learn through the web and how they do in the classroom using exactly the same materials is one of the comparisons that is needed, and this is what these programs can best do. The few experiments that have so far been conducted on this topic are showing, for instance, that using the identical e-Learning or digital learning

program in the classroom and through the Internet produces results that are almost identical in both locations. This has been shown in several simple associative learning tasks and through several different computer programs (Vadillo et al. *2006*). On some occasions, however, it has been observed that the same simple associative learning program produces slightly better and faster learning in the classroom, when the instructor is present (though silent) and everything is controlled, as compared to the Internet, where the participants are possibly exposed to a much greater number of distractions while they perform the experiment (Vadillo and Matute *2009*).

Thus, increasing the variability of these programs and the scope of tasks and domains to which they can be applied is of course one of the greater challenges for the future. Although associative learning is one of the few areas where these web-based experimental control programs have initiated their development, their extension to other areas, so that online and offline learning can also be compared in more complex domains, is a must. Information gathering and Internet learning is becoming so common in our generation and the ones to come that understanding the particulars of Internet-based learning and how this compares to more traditional forms of learning should be a research priority. Indeed, the popular assumption that because much learning currently takes place online it is necessarily better than more traditional forms of learning has not yet been supported by evidence. An evidence-based learning science will surely require that, in the future, most research tools used to investigate the learning processes are equipped with a web-based version.

If ethical norms for learning research

(and for human research in general) are important, this issue becomes even more critical when the research is conducted through the Internet. Ethical codes of conduct for scientists conducting research with human participants require, for instance, that the scientists guarantee the voluntariness, anonymity, and informed consent of the participants. Whereas this is relatively easy task to accomplish when the experiment is conducted in the University laboratory or in the school classroom, some additional (and different) measures need to be taken when the experiment is conducted through the Internet. For instance, providing an informed consent screen that the participant has to accept before starting the experiment does not guarantee that the participant has been informed. Most people would click on the accept button without even reading the information on the screen. Several good strategies to solve this and other ethical potential problems have already been discussed (e.g., Kraut et al. *2004*).

Another challenge for the future will be adapting these programs to run experiments on machine learning

. Whereas humans have been the only users of this type of experimental software in the psychology laboratory, the fact that these experiment control programs are now being run on the web suggests that machine learning systems could soon be accessing these programs (whether in controlled or in uncontrolled ways) and providing their data as if they were human participants. This could be positive, as it could be used to test the degree of learning in artificial intelligence and machine learning. This should also allow to test the predictions of our theories of learning as the similarity of machine learning with human learning and be contrasted (see e.g., learning algorithms). But it will be important that these programs incorporate a means by which both types of data, natural and artificial learning, could be easily discriminated.

Finally, an additional potential problem of current software for Internet-based research is its lack of a broad scope approach. Most of the available software is based on technologies that do not comply with any standard and that are proprietary or poorly adapted to heterogeneous execution environments. Ideally, the technologies used for this type of research should be more flexible and should allow, for example, to compare the results of experiments conducted in different languages, using the same web applications properly localized, or providing a similar user experience (UX) to those who access the web experiment from mobile devices with limitations regarding interactivity, connection speed, computing power, and energy consumption.

Cross-References

Associative Learning
Causal Learning & Illusions of Control
Evidence-Based Learning
e–Learning and Digital Learning
Information Gathering and Internet Learning
Learning Algorithms
Machine Learning
Methodologies of Learning Research: Overview
Probability Learning

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