Building a learning environment for research methods in psychology

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1. Introduction

Understanding research methodology can be very hard for students and several difficulties appear to them when faced with methodological problems. Certain applied courses expect students to have a good theoretical insight into research design and practical data-analysis while they have not been able to fully process the theory behind those. Theoretical courses provide the knowledge without the full context of practical research, which makes it hard for students to develop a profound understanding of the theory. Applied courses provide this kind of context without paying much attention to the lack of knowledge within the student population. This situation has created a gap between theory and applications of that theory. Most skills needed for applying research methodology cannot be learnt by merely absorbing knowledge. Designing experiments collecting data, or statistical analysis need some kind of problem solving skills which depend rather on insight in the problem than on theoretical knowledge. Such problem solving skills can best be taught using real life situations (Dewey, 1916). More importantly the context wherein problems are presented should correspond with the situations students will face in their academic or professional career.

The methodological issues mentioned above are sometimes hard for students to understand because they are presented in a very abstract way. Teachers, however, do not always have the time or the means to provide several examples or to present a context wherein these issues could appear. Modern information technology can be used to support methodology teaching by presenting a context and in that way making learning more attractive (Norman & Schmidt, 1992). Moreover students are given the opportunity to study the problems in a more elaborate way (Norman & Schmidt, 1992).

This paper presents ELEDES (short for Electronic learning environment for research design), a new software tool to simulate experimental data.

2. Fundamentals

The main objective of ELEDES is to let the user set up an experiment in an interactive way where upon designing the experiment a plausible outcome of the approach (a data-set) can be simulated in real time. In setting up an experiment, subjects are assigned to conditions, dependent and independent variables are chosen, and some parameters need be provided for these variables. For measured variables, parameters consist of the population distribution parameters (mean, standard deviation, skew and kurtosis), whereas conditions (independent variables) are indicated by some specific label (text or number). The simulated data are sampled from the population distribution provided. As a consequence each simulation run yields a dataset that is equivalent to what one would obtain if the experiment were actually carried out with a different sample of subjects. ELEDES was developed for both students and teachers. Teachers can use the program to simulate a set of (non-available) data to explain experiments of which the experimental design and the parameters of the variables, for example, are inferred from a research report. Moreover, entering different parameter settings consecutively, a teacher can demonstrate how different outcomes for the same experiment would show in the data-analysis. So, a single experimental setup could be employed to illustrate several different possible outcomes in terms of (in)significant effects that might be observed if the experiment were actually performed. In a similar way, threats to internal validity or biases originating from poor experimental design can be demonstrated.

For students ELEDES makes it possible to simulate the (possible) outcomes of an experiment themselves. By means of a graphical tool the dependent and independent variables are picked to draw a design. After designing the experiment, the student can virtually conduct it and obtain a simulated data file that is similar to the outcome of an actual experiment, depending on the entered parameters.

3. Features

Teachers of statistics and research methods often have access to only a restricted number of datasets to illustrate their courses or tests. ELEDES can be used to overcome this problem since it allows simulating a virtually infinite number of data files that can be submitted to almost any kind of statistical analysis.

Data simulation with ELEDES starts with drawing an experimental design in the design window. In the simplest case, the design is completed when some (dependent) variables are dragged to the design window, and two obligatory parameters (mean and standard deviation) are entered for each variable. Moreover, the number of participants assigned to each condition must be specified. By default a normal distribution is assumed for dependent variables, unless a specific skew and kurtosis are specified by the user. Running a simulation at this point would result in a (correctly set-up) data matrix with a column for the participant number and another column for each variable. Each row in the matrix would hold the "observed values" of a virtual participant.

Without further specification "observed values" are figures sampled randomly from a continuous distribution with the parameters provided by the user. However, further specifications can be made, among which the correlations between dependent variables. By providing a correlation coefficient between a dependent variable and any other, correlated datasets will be created. Moreover, discrete rather than continuous values can be opted for.

Data resulting from more complex designs can be simulated in a similar way by adding more conditions and/or variables to the design. Appropriate selection of parameter values can produce data sets that allow illustrating the effects of several threats to internal validity such as selection errors, history, selection by maturation, regression towards the mean, reliability of measures, order effects, …

4. Conclusion

ELEDES seems to be a promising tool to simulate data for education purposes in methodology and statistics courses. When designing exercises teachers are not limited to using existing datasets any more. Virtually every kind of experiment can be simulated. However investigations should be made of how teachers perceive the tool and which technical limits emerge when they are using it. With these findings further development will be effected.

Implementations of ELEDES in both "classical" (static use to generate data for exercises etc.) and "innovative" (interactive self-study, in-class in real time demonstrations, etc) are necessary to evaluate the effectiveness of this tool. Furthermore an assessment should be made of the added value for students and their motivation to use ELEDES. More teachers should be encouraged to start using the tool and investigate how students perceive and handle it. Results will be used for further development of the program. As a conclusion future research should not only focus on technical aspects but also on user-friendliness and on how to promote the use by students as well as teachers.

REFERENCES

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RÉSUMÉ

Beaucoup de concepts méthodologiques en psychologie sont assez abstraits, et même avec de bons exemples ils peuvent êtres difficiles à comprendre pour les étudiants. Un autre problème peut apparaître quand les étudiants doivent transférer leurs connaissances théoriques des méthodes de recherche à des applications de cette connaissance. Cet exposé présente ELEDES, un logiciel grâce auquel aussi bien étudiants que professeurs peuvent générer des données comme si l'expérience aurait été réellement réalisé. Les exercices qui peuvent être produits pour ce logiciel peuvent par exemple démontrer les vulnérabilités des « designs » non expérimentaux ou plusieurs dangers de validité interne comme les effets chercheur, histoire etc. Nous allons présenter les possibilités que présente ELEDES pour enseigner la méthodologie.