

UC Merced

Proceedings of the Annual Meeting of the Cognitive Science Society

Title

Evaluating Learner Cognitive Load Using Concurrent Verbal Reports

Permalink

<https://escholarship.org/uc/item/18h3h96t>

Journal

Proceedings of the Annual Meeting of the Cognitive Science Society, 29(29)

ISSN

1069-7977

Authors

Kalyuga, Slava
Plass, Jan

Publication Date

2007

Peer reviewed

Evaluating Learner Cognitive Load Using Concurrent Verbal Reports

Slava Kalyuga (s.kalyuga@unsw.edu.au)
School of Education, University of New South Wales,
Sydney, 2052 Australia

Jan Plass (jan.plass@nyu.edu)
Steinhardt School of Education, New York University,
239 Greene Street, Suite 300,
New York, NY 10003-6674 USA

Keywords: cognitive load; concurrent verbal reports.

Two most popular methods for measuring cognitive load in learning are subjective ratings of mental effort and dual-task techniques (Paas, Tuovinen, Tabbers, & van Gerven, 2003). The first method is very rough although simple to implement. The second one uses performance on simple secondary tasks as indicators of cognitive load associated with performance on main tasks (Brünken, Plass, & Leutner, 2003). Evaluation of cognitive load characteristics of online or computer-based applications could also be based on concurrent verbal reports (think-aloud protocols) with audio and video tracking. The generated qualitative verbal data would reflect different types of cognitive load as expressed through the participants' own language.

Verbal data from think-aloud interviews should be coded using rubrics based on expected users' verbal expressions or remarks for different types of cognitive load. For each rubric, sample keywords and phrases need to be developed to serve as a coding scheme for classifying participants' remarks roughly corresponding to the sample words and phrases in each of the categories of cognitive load. In a recent pilot study with a group of 13 university students learning from a simulation of gas laws in chemistry, verbal data from the protocols was analyzed by screening digital recordings of each interview using the samples of expected responses. The recordings included the audio and screen captures from the participant's computer with a screen and audio recording software TechSmith Camtasia Studio.

Throughout the interview, general probes were used to elicit relevant remarks (e.g., *What's your strategy for learning? What are you learning? What's familiar to you? What's unfamiliar? What information are you paying most attention to? What do you ignore? What do you think of the amount of information and the way it is presented here?*). The probes did not explicitly mention difficulty and effort. Analysis of verbal protocols for indicators of cognitive load included locating relevant words, remarks, and expressions, and relating them to different sources of cognitive load that may inhibit performance and learning such as: spatially and/or temporally split elements of information that need to be integrated in order to achieve understanding; an excessive step-size and/or rate of information presentation that introduce too many new elements of information into working memory too fast to be organized and

comprehended; insufficient user support or guidance, especially for low-prior knowledge users; excessive redundant support overlapping with available knowledge of more experienced users.

The following examples are actual learners' remarks indicating various sources of cognitive load.

Spatial split-attention:

Watching them all at the same time could be difficult.

A lot of things to look at once.

This is really hard. Paying attention to gas particles, how they react to my changing aspects of the experiment; now trying to pay attention to the graph.

Temporal split-attention:

I forgot what I did at the previous one [step].

Need to refer back to previous step to see the change.

It's difficult to keep track of previous simulation.

I think I missed something, I go back to see pressure-temperature relationship.

Redundancy:

Repetitions, I've already realized the relationship from first two [steps].

Extra stuff; flames get in the way.

Excessive rate of information presentation:

Everything is moving at the same time.

It's difficult because of storing everything in my mind.

I have to remember what I'm moving

Lost track what I am doing. A lot of things.

Too much going on the screen; extra things, like a flashy show.

Relative cognitive load ratings of different experimental versions of the simulation based on the total numbers of cognitive load-related remarks coincided with the reversed order of the same experimental conditions based on learners' post-treatment knowledge gain scores, thus providing some evidence for the validity of the method.

References

- Brünken, R., Plass, J., & Leutner, D. (2003). Direct measurement of cognitive load in multimedia learning. *Educational Psychologist, 38*, 53-61.
- Paas, F., Tuovinen, J., Tabbers, H., & van Gerven, P. (2003). Cognitive load measurement as a means to advance cognitive load theory. *Educational Psychologist, 38*, 63-71.