Utility, usability and acceptability: an ergonomic approach to the evaluation of external representations for learning

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Abstract
Since the beginning of information and communication technology, many external representations were designed and distributed to schools and universities. But sadly, many of them are not used. Consequently, it is both interesting and useful to evaluate and to improve these external representations before trying to distribute them. Ergonomic approaches attempt to fulfil this type of goal: evaluation in order to improve. But these approaches are very often confused with usability evaluation. Confusing usability approaches and ergonomic approaches can lead to a deadlock. We conducted different studies in external representations' evaluation. These studies show that an external representations can be usable but not used, and vice versa. That is the reason why we propose an ergonomic framework where the quality of an external representation is defined by its utility, usability and acceptability. We present data, from different empirical studies, which allow us to say that these three dimensions are equally important and interrelate. We also found that these relationships are not always similar. Then, we defend an inductive approach to the analysis of the relationships between utility, usability and acceptability.

Extended abstract
Since the beginning of information and communication technology, many external representations were designed and distributed to schools and universities. But many of them are not used. Consequently, it is both interesting and useful to evaluate and to improve these external representations before trying to distribute them. Ergonomic approaches attempt to fulful this type of goal: evaluation in order to improve. But these approaches are very often confused with usability evaluation. Confusing usability approaches with ergonomics approaches can lead to a deadlock.

Amiel et al. (2002) analyzed an interactive learning environment (ILE), based on external representations, designed for the professional training of the maintenance men in the car industry, but which was rarely used by the 400 trainers. The ILEs did not have overwhelming defects in terms of utility and usability. The problem was linked to the organization of time, space and work, which were not compatible with the use of the environment. Galy et al. (2006) analyzed an ILE, based on external representations, used in pre-school by 72 teachers. They observed that the teachers do not link usability with ILE's acceptance. Acceptance was influenced by perceived utility and motivation.

These studies and others conducted in our lab have lead us to propose an ergonomic framework, where the external representation quality is defined by its utility, usability and acceptability.
- Utility is synonymous with relevance or efficacy. It answers the following question: Does the external representation allow the learner to reach his/her learning goal? It can be evaluated by learning measures, with tasks like recall, problem solving, and so on.
- Usability refers to ease of use. It can be evaluated with criteria like learnability, efficiency, memorability, less errors, satisfaction (Nielsen, 1994).

- Acceptance addresses the learners' desire to use the external representation. It answers the following question: is the external representation compatible with a learner's motivation, affect, culture, values, and also does it fit within the constraint's of the context.

We also found that the relationships between those three dimensions are variable.

These data contradict other authors' point of view. For Nielsen (1994) acceptability has two dimensions: practical and social. Usability and utility (i.e. the goal to which the device is designed to reach) are two dimensions of the usefulness (i.e. the goal which the device really allows to reach). Usefulness is itself an underused dimension of practical acceptability. The Nielsen's model has been criticized. In this model, acceptability cannot have effect on usability or utility. Dillon and Morris (1996) note that in this model, usability, which is however in the main concern of Nielsen and the majority of appraisers, (1) is necessary but not sufficient (2) makes it possible nothing to say about the use. According to Dillon and Morris' model (inspired by Davis' Technology Acceptance Model), it is necessary to introduce the concept of attitude of the user (perceptions, affects) to be able to include/understand the relations between utility, usability and acceptability. In particular, these authors insist on the utility and usability perception. These perceptions can be very different between them and very different from effective usability or usefulness: I can believe that this external representation will be easy to use but little useful for me, whereas it is actually difficult to use but useful for the development of my competences.

Then, we defend an inductive approach of the analysis of the relationships between utility, usability and acceptability: how the relationships between three series of tests measuring the utility, acceptability and usability should be interpreted? Let us imagine the case of an ILE that, following a set of tests, appears acceptable but unusable and useless. How do we know what it is necessary to improve? Can we believe that the improvement of usability will involve the improvement of utility? Should the utility also be improved? Or can we expect that the improvement of the utility will involve usability improvement? These questions concern the rationality problem, i.e. the problem of the relations between means and goals (Searle, 2001). Working out a rationality model is working out a model of the relationships between means and goals. But working out such a model does not guarantee the value of this model. A rational criterion in a field can be irrelevant in an other field (Tricot et al., 1999). That is why we prefer an empirical approach to rationality. An observed relation between attained goal and invested means can be said to be rational. We consider moreover that for each ILE, there is a mental representation (individual or collective) of this device (e.g. of its physical attributes) and of its rationality. This representation is constrained by the context (i.e. by the organization of time, space, work, knowledge in the school). We call acceptability the value of this representation. We defend the following position whatever the ILE to evaluate, and with whatever relation between usability, utility and acceptability.

What we propose to interpret is thus a set of results corresponding to an analysis with three dimensions: usability, utility, acceptability. Each dimension is thus a variable, on which one can realize measurements independent of the two other variables. For the same user, one can note them together results obtained according to three variables. The form of a set of points corresponding to N learners allows to describe between three dimensions.

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