Feedback on a Self-education Module for AutoCAD: Development of a Self-education Module for Civil Engineering

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Abstract: This paper aims to present the work carried out to improve a self-education module for AutoCAD dedicated to a class of civil engineering students. The whole development and research about an evaluation method is led by students helped by researchers, in accordance with the principles of participatory design and user-centered design. After finding objective evaluation criteria such as utility, usability and acceptability, we translate them into subcriteria and questions applied to the module. Very few students took the survey and that is a major problem to draw conclusions and to get improvement lines for the module. Thus, all along the paper, we emphasize on the setup of the survey and focus is given to measuring the efficiency of the evaluation method itself.

1 INTRODUCTION

With the recent development of all kinds of online learning structures, more and more people get access to free educational resources. In higher education, the digital environment occupies a growing place, as it is cheaper than a regular course and easily adaptable to one's schedule. However, as a new education method, it deserves to be thought through and analysed in order to make sure of its efficiency (Miller, 2017). Beyond the module's content, its design should accommodate the student's needs, capabilities and ways of behaving (Norman, 1988), to make sure the module enhances learning and does not generate any frustration.

This project started after a class of civil engineering students from IMT Lille Douai expressed their need to be trained to the software AutoCAD (an Autodesk software: www.autodesk.com), which is widely used for drawing and editing plans in many construction domains. As there is no vacant slot in the course schedule, researchers from the school asked two students to develop a module available online. The next year, two other students worked on the module, re-arranged it and added some content.

Two years later after the beginning of the project, this paper is written to create a feedback methodology involving the students in all the steps and discuss the hypothesis made to analyse the results, and finally improve this self-training module.

2 RESEARCH APPROACH AND CONTEXT

Letting the students design, develop, analyse and improve the module (and lead this research project as well) is a conscious decision (Abras, 2004), in accordance with the principles of participatory design (Muller and Kuhn, 1993). In addition to the non-physical form of the course, it is non-compulsory, and it is not evaluated. Given that, the students are the most appropriate persons to design the module for two main reasons:

- They would know what it is to be a beginner and feel where the main misunderstandings are;
- They would know what is disheartening and how to keep up the interest.

In the field of applied mechanics, it seems that e-learning technologies are traditionally created and designed by the teachers only (Boucard, 2015; Mouton, 2015). Here, it is a student who conducts this research, from collecting the bibliography, to

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elaborating the evaluation method and writing this paper, giving the research its originality.

Another leading value of our project is design-based research (Wang and Hannafin, 2005), which implies to put the project directly on the spot, in contact with the users, instead of in a lab or an office. This choice makes sense, since the module is developed on demand of the students, for the students and by the students.

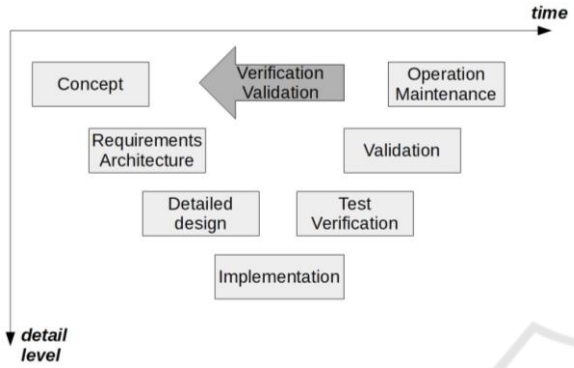

Figure 1: V-Model (Turner, 2007).

The project started two years ago, led by students from the batch. Following the V-model as in Figure 1, they identified the need by conducting a survey in the class. Their challenge was to find the adapted content and medium for the module. An introduction, simple drawing tools formations and small exercises (from drawing a line to copying a floor plan) were designed in the form of interactive slideshows, using the module Opale for SCENARIchain (Quelennec, 2010) (Gebers and Crozat, 2010). The module also contains indications on how to install the software, and it includes screenshots and video recordings of the software. The learner can navigate through the module either in a linear order or click on the different parts of the outline to skip some parts.

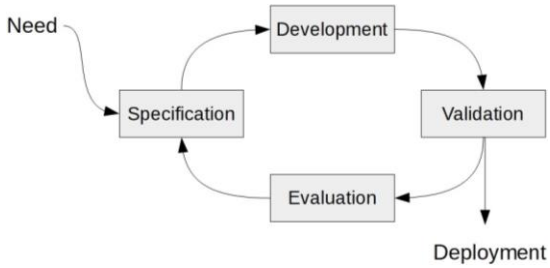

Figure 2: Iterative life-cycle (Nielsen, 1993).

After this first step, the module was created but still offers room for improvement. In order to offer a good quality education tool, it appeared as necessary to orient the module towards a continuous improvement process that is an iterative process described in Figure 2. During the second year of the project, the leaders of the project asked one student to test the module and to give them an oral feedback. Afterwards, they added some content and reformulated some parts of the module.

The object of this research project is then to define an evaluation method that would provide strong guidelines to improve the module. Thus, this method could be re-used on several cycles, even after changing the module (after adding some content or a reengineering process).

3 DEFINING AN EVALUATION METHOD

Many parameters influence the performance of the module. Not only parameters such as the content memorized or the difficulty of the exercises, but also the ease of navigation between the contents or the aesthetic of the module have an impact on the user experience, and consequently, how efficiently they learn. Three dimensions can be identified for the evaluation of a self-learning module (Tricot, 1999):

- The utility refers to the traditional pedagogical goals: increasing the student's skills and knowledge. It measures how well the teachers' objectives and what the students have actually learned match: this is what is evaluated in a classical course.
- The usability is the possibility to use the module and is related to the interface, the navigation and the coherence of the scenario.
- The acceptability expresses the way the user perceives the module (positive or negative opinions and attitudes). It can be individual as well as collective, and is influenced by factors such as culture, job, motivation, social organization, or practices that the module affects.

These dimensions can be translated in a list of criteria enunciated by Nielsen in his work on usability (Nielsen, 1993), as in Figure 3.

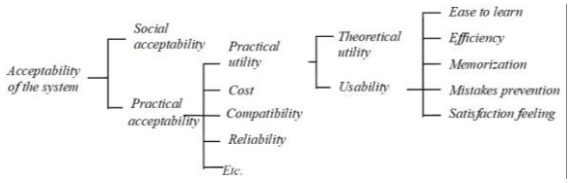

Figure 3: Nielsen's model (Tricot, 2003).

Although this graph shows a path, we consider that the different dimensions are not in a chain but can

be evaluated separately. The criteria are the ones we try to validate, or invalidate, through the evaluation.

The evaluation medium must take into account two mains requirements that we identified:
- Do not affect the user experience while he or she is doing the module;
- Provide reliable results by avoiding non-precise questions and focusing on the skills developed thanks to the module.

We consider different methods, like interviews (free, or directed by questions), screen recordings, form, analyse of the user traces (time, path…), comparison between experimented users and beginner and so on. An issue there is to determine what kind of data is available (Choquet, 2007). If we wish to develop the evaluation method in various schools and universities, the indicators should not require complicated programming or software installation, neither from the teachers nor from the students. In our case, we are also working on a very short cycle (six months) for the evaluation and the improvement of the module, with new students conducting the project every year. Because it is non-invasive, simple to design and simple to use, providing readable and objective results, the best way to get a feedback on the user experience turns out to be a form, carefully redacted. This type of evaluation is in accordance with the data collection protocol advocated in the THEDRE (Traceable Human Experiment Design Research) flowchart (Mandran, 2018). In our form, each question refers to one or several criteria, detailed in Figure 4.

Question	Criteria	Dimension
Have you managed to install the software AutoCAD?	Compatibility	Acceptability
Have you encountered technical problems while playing the tutorial?	Compatibility	Acceptability
Which following criteria are you satisfied with? *Information per page; Number of clicks per page; Clarity of the plan; Navigation between the pages; Size of the display; Clarity of the design; Aesthetics of the design*	Efficiency Ease to learn Satisfaction feeling	Usability
Do you think you master the AutoCAD tools seen in the tutorial?	Theoretical utility	Utility
Do the indications and helps given in the tutorial correspond to the software?	Reliability	Acceptability
Do you think the indications and helps given in the tutorial were sufficient?	Theoretical utility Ease to learn	Usability Utility
Did you get some external help? *No; Video tutorials on Internet; Forum on Internet; Written tutorial on Internet; Official AutoCAD website; Other student; ...*	Ease to learn	Usability
Would you have liked more help? *No; More indications; Chat between users; ...*	Efficiency Theoretical utility	Usability
According to you, is it important to search for functionalities and indication by yourself to learn how to master the software?	Efficiency Ease to learn	Usability
During the exercises and manipulations, were you able to tell if you were doing right or not? *Scale from* Never *to* Always	Mistakes prevention	Usability
Which parts of the tutorial have you completed?	Cost Theoretical utility	Utility Acceptability
How much time have you spent doing the tutorial?	Cost	Acceptability
Have you had breaks doing the tutorial? How much?	Cost	Acceptability
Do you have the feeling that you have increased your knowledge with the tutorial?	Satisfaction feeling	Usability
Do you have the feeling that you have learned fast with the tutorial?	Satisfaction feeling	Usability
Tick the elements that you feel capable of using alone	Memorization	Usability
Would you put AutoCAD as a skill on your résumé?	Social acceptability	Acceptability
After the tutorial, do you feel capable of using the tools and functionalities approached in the tutorial?	Theoretical utility	Utility

Figure 4: List of questions, corresponding criteria and dimensions.

A question concerning the whole module is voluntarily repeated twice in the form, at the beginning and at the end of the module (Do you think you master the AutoCAD tools seen in the tutorial? / After the module, do you feel capable of using the tools and functionalities approached in the tutorial?). These questions are meant to verify two aspects: firstly, as it is very general question evaluating utility, if the pedagogic content of the module is as satisfying as in a regular course. And secondly, this repetition acts as an evaluation for the form itself, checking that it does not changes the user's opinion. To meet its objective, the form should not affect the user's answers, and hence we expect the answer to be the same for the two questions.

4 EVALUATION PHASE

4.1 Presentation of the Sample

The first sample of students who tried the module is very small and consists of four students, in their fourth year of engineering school and specialized in civil engineering since one semester. All of them are beginners in AutoCAD. They volunteered to test the module on their free time and were asked to write down the time spent on the module and to fill the form.

4.2 Presentation of Answers

The form is designed using Google Forms, which allows to visualize the answers either in a collective way (percentages, charts and diagrams) or to each person's answers. As the sample is very small, it is possible and necessary to look very carefully each question and each individual.

4.3 Analysis of the Results: Feedback on the Module

We want to identify what points of the module have to be improved. For example, the bar chart in Figure 5 shows a critical lack of usability: only two criteria are validated by all the students, and most students are unsatisfied with the remaining criteria.

The analysis of the memorization results as in Figure 6 allows us to target the weakest parts of the module, that are the parts less memorized by the students.

The table in Figure 4 is used to determine if a criterion is validated or not for each user, and based on that, we are able to tell if in average, a dimension is validated or not. The results are presented in the form of a contingency table (Tricot, 2003) in Figure 7.

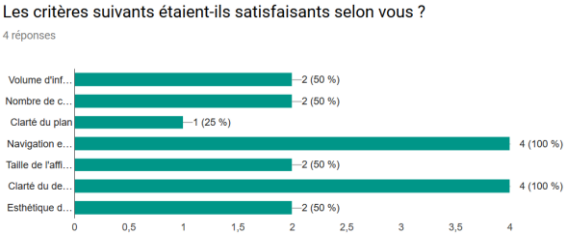

Figure 5: Result of the form (usability): In your opinion, were the following criteria satisfied?

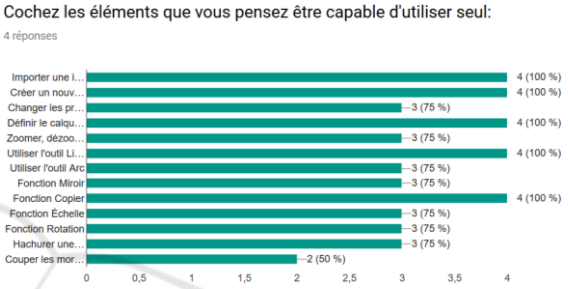

Figure 6: Result of the form (memorization): Tick the features that you feel able to use on your own.

For instance, for 2 people, the acceptability and the utility are validated, but not the usability. From the contingency table and from Figure 5, we deduce that the dimension that has to be first improved is usability.

		Acceptability			
		-		+	
		Usability		Usability	
		-	+	-	+
Utility	-	0	0	1	0
	+	1	0	2	0

Figure 7: Contingency table (Tricot, 2003).

4.4 Analysis of the Results: Control of the Evaluation Method

Finally, we want to check if our evaluation method meets its goals. The results we got from the students' answers are accurate enough to target several parts of the module that must be improved.

Only one student gave different answers to the similar questions. It is the same students who ticked the less items for usability in Figure 5. As the first of the repeated question comes rights after the usability

question, we can presume that his answer was influenced by the previous question.

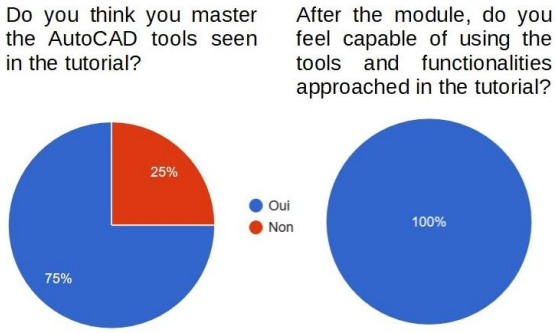

Figure 8: Result of the repeated question.

5 IMPROVEMENTS OF THE MODULE

For the tools less mastered by the students (cutting the exceeding lines, snap tool, orthogonality and angles), detailed explanations are added, including sometimes screenshots of the AutoCAD software or screen video recordings to show exactly how to do something (Mariais 2017).

Also, as the outline clearness is one of the major flaws pointed out by the students, the module outline is simplified. In fact, the module is structured in a lot of small parts with some of them containing only one sentence, harming the navigation fluidity between the different parts, creating potential confusion, loss of attention, or annoyance. Hence, small parts are displaced ("tips" and "hints" are grouped together, and often, the conclusion or the introduction is merged with an adjacent part) while parts are created for bigger topics (Autodesk account creation, zooming…).

Such modifications aim to improve the usability, by making the module easy to learn and pleasant to use.

6 FURTHER RESEARCH LINES

As said previously, the results obtained with our survey and our evaluation are limited by the very small number of students who tried the module. In order to get a precise feedback on the module, we have to focus less on the stats and more on the individual reactions and suggestions. This first survey can be considered as a pilot test, and to validate the method it is necessary to conduct this research within a larger number of users.

However, we are still able to find which dimension is the weakest and which points are not fully mastered by the students, in order to know what to do and on which content to make the module more efficient. The study proves that both the content and the form of the module are significant in terms of user experience, and both are improved in the new module.

In keeping with the continuous development process, the next step of this project is to propose the improved module to the new batch of students from our school and to collect answer from a larger sample of students by asking them to fill the same form. Analyzing the answers would prove that the modifications implemented have a real impact on the dimensions evaluated, and on usability in particular.

In addition, during the evaluation, we consider that utility, usability and acceptability were independent dimensions, in order to keep the evaluation method simple. But it is likely that improving one of the dimensions will affect, in good or bad, the two other dimensions.

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