Multimodal Software for Affective Education: UI Evaluation

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Abstract: This paper focuses on evaluation techniques for multimodal software. We suggest how multimodal educational systems can help us and give a proposal for how to evaluate these systems. Our goal is to come up with human-computer interaction (HCI) evaluation techniques for multimodal systems to support *affective* education and adapt usability evaluation taking into consideration the cognitive walkthrough, the affective walkthrough, the heuristic evaluation and the pluralistic walkthrough. We are proposing two usability inspection methods: the multimodal affective cognitive walkthrough including pluralistic walkthrough with personas and scenarios and the multimodal affective cognitive heuristic evaluation. These are demonstrations of how the proposed MADE framework can be applied to well-known evaluation techniques.

INTRODUCTION

In the area of multimodal system design, user studies have been conducted to explore how users combine modalities when interacting with a system. The main idea of this paper is to adapt some well-known evaluation methods to the *MADE (Multimodal Affect for Design and Evaluation)* framework and answer the question: does this framework support evaluation of affect in a multimodal interface. The *heuristic evaluation*, the *cognitive walkthrough* and the *pluralistic walkthrough* belong to a family of techniques called *Usability Inspection Methods*, which do not need real users. We demonstrate the *MADE framework* using the evaluation methodologies and proposed *MADE walkthrough* and *MADE heuristics* (see Figure 1). The proposed MADE walkthrough is an adaptation of the cognitive walkthrough and pluralistic walkthrough, and we are adapting to develop new sets of heuristics for evaluating affective multimodal educational systems. An evaluation that shows users MADE will enable us to better explore the new design space of educational multimodal system design and will help us with our designs.

In this paper, we as system designers wish to evaluate a HCI system and we need to answer the questions: how might these principles be leveraged for evaluation, and does this software support affective use of multimodal design? We proposed the following usability inspection methods: affective adaptation of the cognitive walkthrough, having a proposed affective walkthrough system and adding a modification of the pluralistic walkthrough to it and the proposed MADE Heuristics.

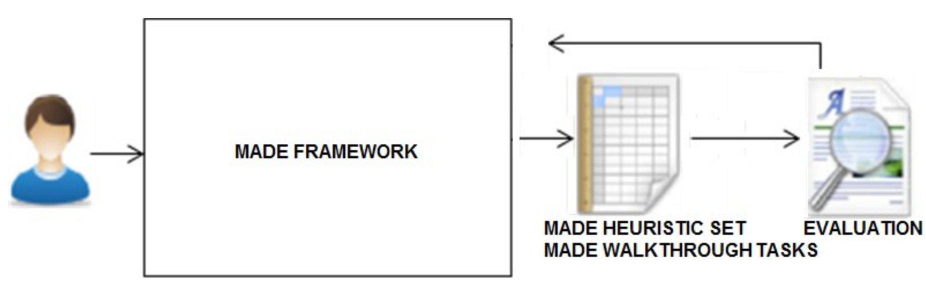

Figure 1: The MADE framework and the evaluation.

In the next section we give a brief overview of the proposed MADE framework, which we are adapting well-known evaluation methodologies to.

OVERVIEW OF THE MADE FRAMEWORK

We have proposed the MADE framework based on principles of multimodal design and theories of multimodal interaction. We considered both *affective* and *cognitive strategies* of learners while interacting with a multimodal system, which has *multiple sensory modalities* (visual, auditory or tactile) and *quasi-sensory modalities* (e.g. narrative or persuasion) domains with *learning objectives* for education and learning. For learning objectives there are a number of affective strategies and cognitive strategies. We introduced a compact model of affective multimodal systems to increase affective and cognitive aspects of users in a multimodal educational environment.

We have reshaped the three domains of Bloom's taxonomy for learning (Bloom, 1956), and considered the multiple sensory and quasi-sensory modality domains to help the affective and cognitive strategies. Figure 2 shows our MADE framework that has learning objective, affective and cognitive strategies and uses multiple sensory and quasi-sensory modalities to help and support the learning objective.

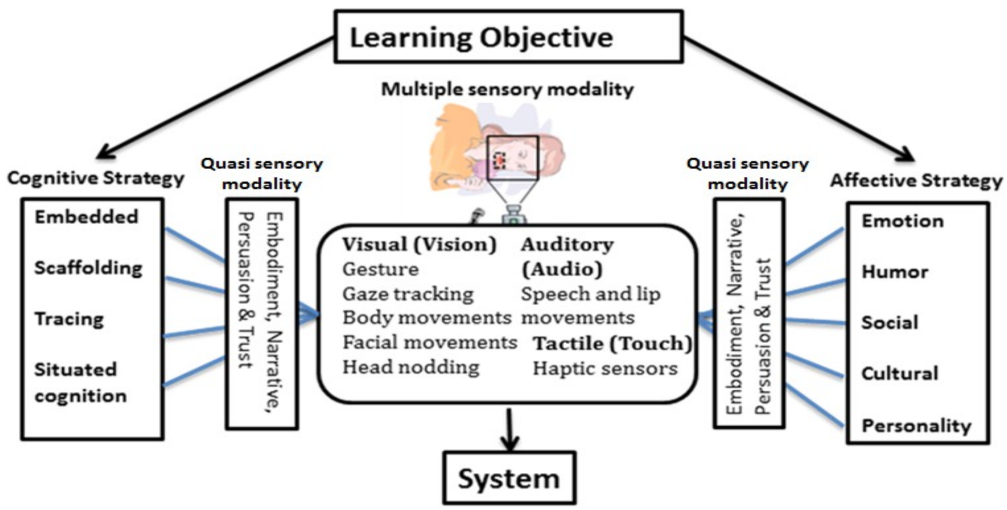

Figure 2: The proposed MADE framework.

The learning objective controls the metrics, affective and cognitive strategies and the linkages. These strategies will inform the instructor, student and educational technologies._In the next section we explain heuristic evaluation, cognitive walkthrough, pluralistic walkthrough, user testing, prototyping and the proposed usability inspection methods. All will be used for the framework.

EVALUATION METHODOLOGIES

We focus on heuristic evaluation, cognitive walkthrough and pluralistic walkthrough. First, we describe the heuristic evaluations. They are a low cost, fast and efficient method of being able to identify any usability issues that may occur with the system. Most people who use heuristic evaluations would perform them based on their intuition and common sense (Nielsen, 1990). A heuristic evaluation shows a list of problems as well as indications of how to solve each problem. It is one of the most cost-effective methods to discover usability issues in the design process (Kühnel, 2012). The next usability inspection method is the cognitive walkthrough. Walkthroughs are an alternative approach to heuristic evaluations for predicting users' problems without doing user testing. They involve walking through a task in a system and noting problematic usability features. Cognitive walkthroughs involve simulating a user's problem-solving process at each step in the human-computer dialog, checking to see how users progress from step to step in these interactions and if the user's goals and memory for actions can be assumed to lead to the next correct action (Nielsen, 1994). A key feature of cognitive walkthrough is that they focus on evaluating designs for ease of learning (Rogers, 2011). The third usability inspection method is the pluralistic walkthrough. This method involves following a scenario and the discussion of potential usability issues (see Table 1). The next evaluation technique is the user testing which actually test the users. It's a technique in user-centered interaction design to evaluate a system by testing the users, e.g. applying the heuristics. The last evaluation technique is prototyping. Prototyping is the process of developing prototypes. Prototypes are experimental and incomplete designs that are inexpensive and quickly developed. Prototyping is an essential part of iterative user-centered design that enables designers to try out their ideas with users and to collect feedback.

Usability Inspection Methods		
Method Name	Brief Description	Who Is Involved?
Cognitive Walkthroughs	Simulate users' problem-solving processes. This test evaluates whether the simulated user's goals lead from one action to the next correctly.	Usability specialists, e.g. HCI experts
Heuristic Evaluation	An informal way to determine whether the interface conforms to established usability principles	Usability specialists, e.g. HCI experts
Pluralistic Walkthrough	This method involves following a scenario (e.g. a possible software use), and the discussion of potential usability issues.	Representative users, Developers, and HCI experts

Table 1: Summary of software usability testing methods – usability inspection methods.

In the next subsection we develop some walkthroughs and heuristic. Now we give a detailed exposition of cognitive walkthrough and pluralistic walkthrough, and after the proposed MADE walkthrough; the adaptation of those two walkthroughs.

Detail Exposition of the Cognitive Walkthrough

The cognitive walkthrough method was developed in the early nineties by Wharton et al. (1994). This method required asking four questions that the evaluator asks for each action, along with extensive documentation of the analysis (see Table 2) (Wharton, 1994).

The Cognitive Walkthrough Usability Inspection Method	
1	Will the user try to achieve the right effect that the subtask has?
2	Will the user notice that the correct action is available?
3	Will the user understand that the wanted subtask can be achieved by the action?
4	If the correct action is performed, will the user see that progress is being made toward solution of the task and get feedback?

Table 2: The cognitive walkthrough questions (Wharton, 1994).

Procedure

The cognitive walkthrough is a usability inspection method that links the system walkthrough to a cognitive model. It is based on one idea that the learnability of the system helps the usability, a standard approach in the usability literature for identifying "pain points" that cause users to fail at completing given tasks. These walkthroughs show that users of all skill levels are likely to encounter problems (Fry, 2012). Thus, it is all about how easy it is for the user to learn how to use the system. The evaluator will use the interface (in our case, multimodal system) to perform tasks that a typical system will need to accomplish. The actions and reactions of the system are evaluated according to the user's goals and knowledge through reactions to questions related to the method's cognitive model, the differences between the user's expectations and the reality. Similar to HCI evaluation methods, cognitive walkthrough focus on the basic principles of usability even though it focuses on the cognitive activities of users especially on their goals and knowledge while performing a specific task (Mahatody, 2010).

Detail Exposition of the Pluralistic Walkthrough

The pluralistic walkthrough (Bias, 1994) is used to identify usability issues in a piece of software in effort to create a maximally usable HCI, which each participant takes the role of a user walkthrough in the design. This method increases empathy and focuses on using a group of representative potential users, developers and usability and human factors professionals. They are asked to put themselves in the shoes of the users, to step through a task scenario, discussing usability issues and problems involved in the scenario steps and assumed the role of typical users in the testing, rising developers' sensitivity to users' concerns about the software design (Bias, 1994).

It begins with a brief overview followed by all participants going through the system. They represent with hard copy scenarios and write down their actions. The participants will have a semi-formalized discussion after each scenario. A session administrator moderates and facilitates the session to keep users motivated, comment on their actions, and not allow developers to influence users (Arvola, 2012).

	Five Characteristics of the Pluralistic Walkthrough
1	The method includes three types of participants in the same walkthrough session: users, usability experts and system designers
2	The system is presented with hardcopy panels and these panels are presented in the same order as they would appear in the system
3	All participants taking the role of a user
4	The participants write down the actions they would take to perform the given tasks
5	The group discusses the solutions to which they have reached. The administrator first presents a correct answer. Then the users describe their solutions, and only after that, do the designers and usability experts offer their opinions

Table 3: Five defining characteristics of the pluralistic walkthrough (Bias, 1994).

Proposed Modification to the Pluralistic Walkthrough for MADE

We explain the pluralistic walkthrough because we would like to consider the different user perspectives. First we describe it and then we explain how we adapt it. In the adaptation we won't have actual users; we will have participants playing the role of the personas in order to do the evaluation, as well as adding the instructor. Each different persona would say what they think about the scenario, e.g. if the one that is too confident, says: "I think it is great", that would benefit the one who needs encouragement. We are trying to tailor it to each of those personas.

Procedure

The pluralistic walkthrough consists of asking participants with a different perspective on the system to engage in a task scenario. It implies a procedure like the standard usability walkthrough however users, developers, usability experts, and instructors step through the design and together discuss usability issues that they discover during the walkthrough process. In the process, there are five defining characteristics (see Table 3) (Bias, 1994). First, there are three types of participants in the same walkthrough: representative users, product developers and human factors professionals. Each representative user can be a persona. We are basically representing the users through the personas. Therefore, we have participants (evaluators) playing the role of the personas. In the second part, a scenario is defined. Third, participants all presume the role of the user. The developers and the usability professionals will try to put themselves in the place of the users and make written responses. Fourth, participants will write down the actions they perform to complete the tasks in as much detail as possible, before any discussion, e.g. instead of " I would choose the fourth item on the list", he/she will write "Press the down arrow key three times, then press 'Enter' ", which produces some quantitative data on user actions. Fifth and finally, the discussion begins after participants have written the actions they would take to complete the tasks. The representative users speak first when discussing each panel. Usability experts and the product developers say their opinions if representative user's comments are exhausted (Nielsen, 1994).

This is a group activity that participants are presented with instructions, task descriptions and scenario packages. After, a system expert (usually a designer) will offer a brief overview of key system concepts and features. Next, participants will write the actions they would perform for specific task. When they are done with writing their independent responses, the "right" answer will be announced, and the representative subjects express their responses and discuss potential usability problems. During this time the system experts remain quiet and the human factors professionals simply facilitate the discussion among the users.

The Proposed MADE Walkthrough - The Affective Adaptation of the Cognitive Walkthrough, Adding the Pluralistic Walkthrough

The whole step in the cognitive walkthrough is to see if users understand the interface. We can enhance cognitive walkthrough for multimodal cognition and multimodal affect. We explained in the previous subsection how cognitive walkthroughs and pluralistic walkthroughs work. Below we describe how we change the cognitive walkthrough for the affective cognitive multimodal by adding the modification of the pluralistic walkthrough (see Figure 3).

Figure 3: Modification of the cognitive walkthrough and the pluralistic walkthrough for MADE.

In this part we bring the affective into the cognitive walkthrough and have some sort of blended cognitive affective walkthrough. When we modify it, we are not just talking about the learnability of the user interface, but the learning objective that the instructor has set up; thus, focusing on the cognitive learning strategy of the instructor. We separate the learnability issue in the education from the learnability issue in the user interface. And then we consider the affective strategy that the instructor has come up with, and propose the affective cognitive multimodal walkthrough. Therefore, it is all about the learner achieving the instructor's objective and learning the objective of the instructor, which is about the cognitive strategies and the affective strategies.

The proposed MADE walkthrough is based on Wharton (1994) and the paper of Dormann and Biddle (2008), which studied the affective elements of computer games. The idea of affective walkthroughs is that we walkthrough and seriously think about the affective manipulation that is going on and then reflect on how the design was successful and better understand how affective learning can be supported in the system. In multimodal systems specifically, the nature of goals and interaction typically involves both cognitive and affective elements. In these systems with interacting characters, affective strategy is naturally involved as a way of motivating learners and it influences the trust perceptions. Dormann and Biddle (2008) declared affective walkthrough for games. They considered emotions in users, the avatar and other characters; the relationships depicted between characters; the aesthetic issues that relate to these issues, and ask the following questions while taking into consideration the overall question of: how would the affective experiences persuade the experience and goals in gameplay (Dormann, 2008):

	The Affective Walkthrough for Computer Games
1	What might the player, their avatar, or other characters, experience emotionally?
2	What relationships are depicted or might emerge between characters?
3	What effect will the setting have on the player, their avatar, or other characters?

Table 4: The affective walkthrough questions (Dormann, 2008).

We proposed the MADE walkthrough by considering the learnability and the learning objective (affective and cognitive strategies that the instructor has come up with) to understand and analyze affective and cognitive strategies in education and multimodal software, based on Wharton (1994) and Dormann (2008):

	The MADE Walkthrough
1	Will the learner be able to use the multiple sensory modality correctly (learnability in the user interface) and taking into consideration the learning objective that the instructor has set up and the cognitive affective learning strategies of the instructor that might help the learner to achieve the right effect that the subtask needs (learnability in the education)? E.g. what cognitive affective strategies might help the learner achieve the instructor's cognitive affective objectives? And does the learner understand that a subtask like specific hand gesture with correct distance is needed to reach the learner's goal? What might the learner experience emotionally?
2	Will the multiple sensory modality helpful and does the learner notice that the correct action is available? E.g. is the multimodal system sound clear and visible?
3	Will the learner understand and associate the correct action by using the multiple sensory modality with the effect

	trying to be achieved? (Learnability of the user interface) E.g. the multimodal system sound is clear and visible but the learner does not understand the text and sound, and will therefore not respond to it.
4	When the correct action is performed, will the learner know that they have done the right thing, receive affective strategies, and see that progress is being made toward solution of the task? E.g. does the learner get haptic feedback, sound or written message when the correct action is performed?

Table 5: The MADE walkthrough.

As we mentioned in the previous subsection, we created the modified version of the pluralistic walkthrough for the MADE framework to consider in the MADE walkthrough. Here, we have different personas and we add the instructor to it (see Figure 4).

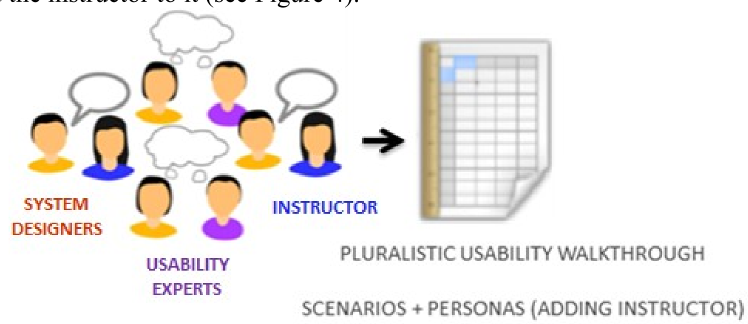

Figure 4: The modified pluralistic walkthrough.

Detail Exposition of the Heuristic Evaluation

In this part we first explain some heuristics including Nielsen's ten general principles of interaction design heuristics (Nielsen, 1994) and Sankey's fifteen multimodal design heuristics, which are used for education. Next, we explain Kort's affective model (2001) and Norman's emotional design model (2005), considering them in our heuristics. Finally, we use these two heuristics and affective models, and will come up with new kinds of heuristics. Heuristic evaluation is one of the most applied of the usability inspection methods and is essentially based on the identification of usability issues associated with a list of quality criteria. It involves examining the system independently using the recognized usability principles (the heuristics) and the usability issues (Nielsen, 1995). The set of heuristic evaluation rules are based on the usability principles developed by Nielsen and Molich (1990) and Nielsen (1994) to test the usability aspects of a system and to identify and classify usability problems that are still used today. Each heuristic item is displayed in Table 6.

Heuristic Number	Nielsen's Heuristics for User Interface Design
H1	Visibility of system status
H2	Match between system and the real world
H3	User control and freedom
H4	Consistency and standards
H5	Error prevention
H6	Recognition rather than recall
H7	Flexibility and efficiency of use
H8	Aesthetic and minimalist design
H9	Help users recognize, diagnose, and recover from errors
H10	Help and documentation

Table 6: Jakob Nielsen's ten heuristics for user interface design (Nielsen, 1994).

Procedure

In heuristic evaluation, each individual evaluator first inspects the system alone. Once all evaluations are done, the evaluators then can communicate and have their findings collected. This procedure is done to make sure independent and unbiased evaluations come from each evaluator (Nielsen, 1994). We believe that a custom set of design principles are needed so that heuristic evaluation can be used to find usability problems in multimodal affective educational systems.

The Proposed MADE Heuristics

First we explain Kort's affective model (2001), then Norman's (2005) three levels of emotional design model, and finally the proposed MADE heuristics. Kort proposed an affective cognitive model relating phases of learning processes. In Kort's spiral model the general guide is basically always taking the learner to the next step. We have a loop with an affective strategy at each time. First, the instructor challenges the learner and then he/she lets them explore. Next, he/she helps them to overcome the challenges and finally he/she affirms. It has a four quadrant learning spiral model in which emotions change when the learner moves through the quadrants and up the spiral. When we are at the challenge area, we are not learning because we have to try out new things (see Figure 5). In each quadrant we have:

I. The instructor must challenge the learner first.

II. Instructor lets the learner explore and try various things.

III. Learner overcomes the challenges.

IV. Instructor provides the learner emotional support and affirmation.

Therefore, it is a loop, which has an affective strategy at each step and the proposed heuristics that we explain next provides support. Affective design can support each of these four quadrants; a natural cycle having a natural affect appropriate to the task. To support *challenge*, the software should be stating the challenge, encouraging and overcoming (encouraging is an affect). For *exploring*, basically the instructor has to help learners to avoid errors, and supporting and encouraging them to try new things, e.g. in every stage an instructor applies an affective strategy to help this, to start off, we had challenge and encourage. *Overcoming* is when learners are blocked, and we encourage them to persist to overcome. This is when they have the right idea, but they just need to work harder connecting things. This is where they have to try out new things. Overcoming the wrong ideas from before is called *un-learning*. After, they get closer to the solution and finally when *affirmation* happens, we praise them and make them feel good that they have accomplished it; hence, we are giving affective support at each quadrant.

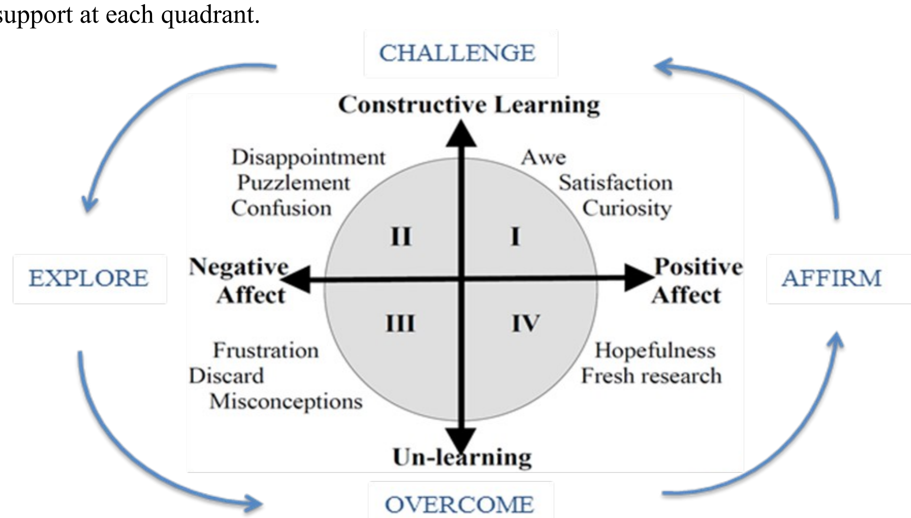

Figure 5: Kort's affective model (Kort, 2001).

In brief, when you learn something, there is a negative affect when doing something wrong and challenging. When we eventually do it right, we experience positive affect because we have done it right. The point is that our software has to work with the learner, and the instructor's job is to harness the negative affect by encouraging the learner, and harness the positive affect by praising the learner, saying that they have done the task right.

We introduce Norman's model (2005) before talking about the proposed heuristics. Norman explained three levels of emotional design including: *visceral*, *behavioral*, and *reflective*. *Visceral design* refers primarily to the nature of the user interaction (UI) and initial impact of its appearance (attractiveness, aesthetics, beauty, and visual appeal). *Behavioral design* is about look, feel and total experience of the use of the UI (pleasure and effectiveness of use, efficiency, errors, functional and usable). *Reflective design* is about the emotional reactions referring to the meaning of the UI; thoughts afterwards, how it makes us feel, the image it portrays, the message it tells others about the owner's taste and the value a UI brings to our self-image (self-image, personal satisfaction, memories, quality or relevance of the information, high in prestige, and rationalization and intellectualization of a UI) (Norman, 2005).

In short, visceral is about how system looks, sounds or feels, for example, image, speech or gesture. Behavioral is about interaction, for example if a learner does something right, the instructor will praise him/her, if he/she does it wrong, he/she will be supportive (how system interacting, rewarding, etc.). Reflective relates to the role in the world. For example, what the understanding of the learner is from the system (large sense). Visceral, behavioral, and reflective dimensions are interwoven through any design considering both emotion and cognition.

According to Norman (2005) the *visceral level* is quick at making rapid judgments of what is good or bad, sending appropriate signals to the motor system that is the muscles and alerting the rest of the brain, which is the start of the affective processing. The *behavioral level* is the site of most human behavior. Actions can be enhanced or inhibited by the reflective layer and in turn can enhance or inhibit the visceral layer. The top layer is the *reflective thought*, which does not have direct access to either sensory input or to the control of behavior. It watches over, reflects upon and tries to bias the behavioral level (see Figure 6) (Norman, 2005). Therefore, the sensory aspect is directly affecting the behavioral and the visceral and connects us to the reflective. The motor aspect is about how we behave, and the reflective is more how we reflect and our background.

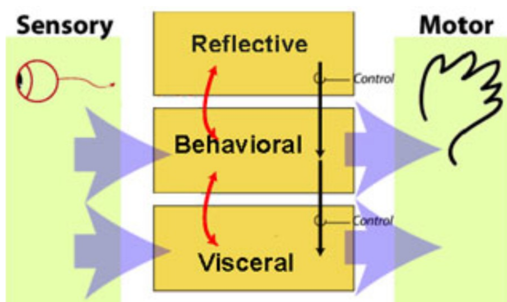

Figure 6: Three levels of processing: visceral, behavioral, and reflective (Norman, 2005).

In the MADE heuristics we are doing a comparison to Nielsen's original 10 heuristics (1994) by considering cognitive, affective learning and multimodality, all playing a role. There is some overlap with Nielsen's original list, which are the fundamental usability principles. The MADE heuristics derived from the problem categories we had identified and their descriptions of how these problems associated with each heuristic can be avoided and are presented below. The heuristics describe principles with the intention to create usable affective multimodal educational systems in order to prevent learners from facing common usability problems. One of our main objectives was to create heuristics that could assess learners using multiple sensory modalities, which are used in the educational environment. Sankey (2007) proposed 15 multimodal design heuristics. The author has tried to demonstrate distinct advantages for students in providing course resources designed to suit a range of different learning modalities (multimodal). We also reviewed Kort's model (2001), Norman's model (2005) and Sankey's model (2007), and we proposed a new set of heuristics.

In Kort's affective model, the general guide is always to guide and take the learner to the next step, which is more challenging to overcome. Therefore, the system status has a special meaning for an educational system and supports the learner with the learning. When we are following Kort's model and comparing heuristics, we are considering where the heuristics are providing learner affective support and encouragement to affirm the learner. We gave each MADE heuristic a short name and a longer definition. Table 7 shows the final set of proposed MADE heuristics for the usability evaluation of multimodal software for affective education, which is leveraging from Kort, Nielsen, Norman and Sankey's work.

Affective Design	Heuristics
Visceral	**Aesthetic and minimalist design:** Learning should not contain information which is irrelevant or rarely needed. Every extra unit of information in learning competes with the relevant units of information and diminishes their learning ability. Including additional music or sounds if that is an essential component of the learning interaction. The use of video may be preferred for a lecture style presentation (support Sankey's H6, H7, H12, H13, H15 and H16, and Kort's explore step).
	Help and documentation: Even though it is better if the multimodal software can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the student's task, list concrete steps to be carried out, and not be too large (support Sankey's H14 and Kort's explore step).
Behavioral	**Visibility of system status:** The multimodal software should always keep learners informed about what is going on, through appropriate feedback within reasonable time, so the learner knows how he is doing, and what to do to get better (support Kort's challenge and encourage step).
	Learner control and freedom: Provide the student with some control over the learning environment considering the emotional aspects, ensuring that the instructional strategy is made clear. Learners often choose system functions by mistake and will need a clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue. Support undo and redo. The learner has to have the freedom to try new things (support Sankey's H4 and Kort's overcome and challenge step).
	Error prevention in learning: Even better than good error messages is a careful design and learning objective providing cognitive strategies that prevent a problem from occurring in the first place. Either eliminate error-prone conditions or check for them and present learners with a confirmation option that the multiple sensory modalities provide before they commit to the action (support Kort's explore step).
	Recognition rather than recall: Minimize the learner's memory load by using the cognitive and affective strategies making objects, actions, and options visible. The learner should not have to remember information from one part of the dialogue to another. Instructions for use of the multimodal software should be visible or easily retrievable whenever appropriate (support Kort's explore step).
	Flexibility and efficiency of use: Acceleration strategy—unseen by the novice learner—may often speed up the interaction for the expert learner such that the multimodal software can cater to both inexperienced and experienced learners. Allow learners to tailor frequent actions (support Sankey's H6, H7, H12, H13 and H15, and Kort's explore step).
	Help users recognize, diagnose, and recover from errors: Instructor should monitor the students with the multiple sensory modalities and if students face errors, motivate and persuade students with the affective strategies. Error messages should be expressed with text or sound, precisely indicating the problem, and constructively suggest a solution, e.g. providing a video clip (support Kort's explore, overcome and affirm step).
Reflective	**Match between multimodal software and the educational environment:** The multimodal software and the instructor should speak the leaner's language using emotional and social factors, with words, texts, images and concepts familiar to the learner, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order (support Sankey's H2, and Kort's explore step).
	Consistency and standards: Consistent and intuitive mapping Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions (support Kort's explore step).

Table 7: The proposed MADE heuristics.

The first two heuristics leverage Norman's visceral model; the next six heuristics leverage Norman's behavioral model, and the last two heuristics leverage Norman's reflective model. The heuristics are based on Nielsen's model (1994), but our particular re-interpretation is enforced by Norman, Kort and Sankey's work.

CONCLUSIONS AND FUTURE WORK

In this paper we focused on evaluation techniques and have proposed usability inspection methods. Particularly, the purpose of this paper is to demonstrate multimodal educational software while considering the affective and cognitive strategies because they are important aspects in the field of HCI and education. Our main claim is that issues of affect have not been addressed for multimodal software evaluation (i.e. heuristics and walkthroughs) in education. The challenge is how theoretical models of HCI can inform multimodal affective evaluation in education. We adapted the well-known evaluation techniques to the MADE framework, and we proposed the MADE walkthrough and the MADE heuristics to evaluate affective educational multimodal software. This paper makes significant contributions in UI evaluation and usability inspection methods for affective education, and identifying usability issues in interactive educational multimodal software. In future, we apply these proposed evaluation techniques on some case studies to evaluate affective and cognitive aspects of the user and how these strategies can be leveraged in evaluating affective multimodal learning environments. It is hoped that the findings of this study may illustrate more student engagement with the learning materials by use of affective multimodal software, and encourage educators by considering the proposed heuristic sets and proposed walkthrough tasks presented in this paper.

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