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STUDENTS EMOTIONS EVALUATION ON VIRTUAL LEARNING ENVIRONMENTS

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Abstract: The student interacts with the platform Virtual Learning Environment to follow the course lessons. This interaction has a great impact on the student's learning outcome. The need to design and provide educational platforms and resources that are not only accessible but also attractive to students has been emphasized. Therefore, it is important that users/students have satisfaction with its environment and interface. This article leave a list of emotions to evaluate the functionalities of educational platforms, validated by students and experts. This list of emotions in Spanish will be very useful for the field of Affectivity and Educational Technology, since it has the support of recognized professionals as well as students of higher education, of different ages and countries of origin, which enriches the validity and heterogeneity of the study.
Keywords: Human computer interaction, Affective Computing, User Experience, Emotional Evaluation, Virtual Learning Environments.

INTRODUCTION

In (VLE, for its acronym in English), the student interacts with the platform to follow the course lessons. A VLE should facilitate learning. This interaction between the student and the VLE has a great impact on the student's learning outcome [1][2][3][4]. The need to design and provide educational platforms and resources that are not only accessible but also attractive to students has been emphasized [4][5]. Therefore, it is important that users/students of an EVE have satisfaction with its environment and interface. Given the lack of consensus on what characteristics the VLEs possess, aspects, attributes and what criteria to take into account, the work cited in [9], was taken as a basis, which investigated the most important characteristics to take into account in the evaluation of a VLE. The functionalities of these VLEs may vary, but in general, they all have basic functions that are common to most of them. The work cited in [10], was taken as a basis, which investigated the most important characteristics to take into account in the evaluation of a VLE. Those authors determine the following characteristics to take into account when evaluating a VLE:

- **Pedagogical facility:** this category refers to the functionalities that the environment provides to teachers and students for the development of the teaching and learning process.
- **Support:** help and documentation: information of this type should be easy to find, focused on the user's task, with the list of concrete steps that will be carried out, and not be too long.
- **Content:** the content or courseware is the learning material that is made available to the student.
- **User interface:** consists of those aspects of the system which the user comes into contact, physically, perceptually or conceptually.
- **Error handling:** cancellation, revocation of actions, error prevention, error detection, error recognition, visible and clear error messages, recovery mechanisms and error solution.
- **Tools:** used for the management of academic content, improving user intercommunication.
- **Flexibility:** refers to the multiplicity of ways in which the user and the system exchange information. It involves providing user control, substitution capacity and adaptability.
- **Standards:** refers to how the web application conforms to norms, standards, conventions, or design guides in the web domain.

After identifying the characteristics of VLE, it is necessary to know the existing methods to evaluate these characteristics

from the affective aspect, considering that the UX emphasizes emotional aspects.

Several questionnaires can be used to determine how users affectively perceive interaction with a product. The UEQ [10] uses a semantic differential, i.e., it places opposite features and the evaluator must mark which of them is closer to his/her choice. It is available in several languages. It measures usability aspects such as efficiency, clarity and reliability, as well as user experience aspects such as stimulation or originality.

The instrument AttrakDiff [11], also evaluates a product using a questionnaire semantic differential format. However, it was designed to evaluate the hedonic, pragmatic, and attractive appearance of a product.

As well, there are questionnaires that help to understand the emotional state of the user about each detail of a product. These questionnaires contain different scales and structures to obtain a holistic and comprehensive picture of the user experience. Thus, the SAM (Self-Assessment Manikin) questionnaire [12] is an emotion assessment tool that uses graphic scales, represented by cartoon characters expressing three emotional elements: pleasure, arousal and mastery, to indicate the emotion levels of each dimension. Each of these dimensions is represented by five different states on a 9-point scale.

In this sense, LEM-Tool [13] proposes a representation of cartoons that express eight discrete emotions, using facial expressions and body postures. The instrument consists of four positive and four negative emotions.

In the case of PrEmo (Product Emotion) [14][15][16][17] this instrument allows conducting surveys distributed over the Internet. PrEmo is a self-report instrument that non-verbally measures, various user emotions, both satisfactory and unpleasant.

Another example of analysis of emotions in users is the work cited in [18] in which the instrument "Geneva Emotions Wheel +" (GEW +) is proposed, which is based on the existing instrument "Geneva Emotions Wheel" (GEW) [19]. The characteristics included in GEW + provide additional information on the emotional state of the user during the evaluation, information that was not previously obtained with the GEW instrument, such as the selection of the most representative emotion and the justification by the user of this selection.

These questionnaires use emotion scales that may be inaccurate and/or confusing for the people who participate in the assessments, in addition to the fact that not all of them can be adapted to assess the different functionalities of a VLE.

In order to offer an alternative to existing instruments, this work aims to obtain a scale of emotions and consider it when evaluating a VLE from an affective point of view.

The emotions scale used in PrEmo [20] was chosen as a base, due to the ease with which the emotions of the participants about the characteristics of a product can be consulted, in addition to being one of the best known and utilized instruments worldwide, therefore, one of the most tested methods and available in different languages, including Spanish.

In previous publication [21], we interviewed a group of experts in the field of Affectivity and Educational Technology, from several Spanish-speaking countries, those most significant emotions that a higher education student may express during the use of each of the VLE functionalities. The aim of the present work is to validate with students that list of emotions [21].

The article is organized as follows: section two presents related works, a summary of works that analyzed emotions and affectivity for VLE. Then, section three details the study conducted with high-level students, compiling the emotions that they can perceive when

evaluating VLE. Subsequently, section four analyzes the results of the study to validate the list of emotions obtained previously from experts, leaving as a result the final list of appropriate emotions to evaluate each VLE functionality. Finally, in section five the conclusions and future work of the research are presented.

RELATED WORKS

The works related to previous works that analyze emotions and affectivity for VLE. It is noteworthy that up to date few studies have been found [22-28], that clearly defines a list of relevant emotions to evaluate VLE:

With respect to attitude, enjoyment, experience, self-efficacy, and speed, the work cited in [22] provides an updated framework of the human factors that positively influence the success and effectiveness of VLE, which have the greatest influence on user satisfaction.

Two categories of emotions were used in [23], explicit: collected directly from the learner through self-reported surveys; and implicit emotions: those inferred discretely during the learning process. The authors indicate that VLEs pose several challenges in understanding the different types of affect experienced by a learner. Uses sentiment analysis with a bag-of-words model and does not consider other implicit measures of emotions.

Learnability and system effectiveness had a significant influence on user satisfaction. The study published in [24] examined the relationship of each usability attribute with the user's emotional responses. Should improve the user interface in terms of usability and user's emotional responses while using the system, to improve user satisfaction.

To evaluate the quality of an application at low cost using two scale-like methods: AttrakDiff and Hedonic Utility Scale. In [25] a UX evaluation on the Edmodo educational mobile application. It is necessary to adapt these methods to provide a more complete UX report, allowing users to subjectively report their experiences and, consequently, identify the problems that affected the UX.

Strengthening students' self-esteem and emotions have a decisive influence on whether students continue or abandon this educational process. In study [26], the most common web accessibility errors presented by the VLE and how these errors can induce different emotions in students were identified. The emotions were obtained from surveys answered by students.

In [27] developed UX evaluation metrics for VLEs. For the hedonic quality dimension, stimulation and novelty. While For the pragmatic dimension of quality with transparency, efficiency and reliability. The same lead author in [28] conducts a literature review and concludes that no UX evaluation method for VLE assesses user feelings.

To culminate this bibliographical review, the authors of the paper cited in [28], leave recommendations:

- Have students detail their experiences of how they felt about using a product and the difficulties they had
- Be specific using semantic differential scales
- Specify which aspects are being evaluated by adjectives or let students explain their evaluation
- As the VLE has many different characteristics and an adjective may fit one but not another
- Evaluation should be quick and simple
- Use quick and simple evaluation methods, such as semantic differential scales.

These contributions allow us to affirm the importance of performing an evaluation of the UX of VLEs from an affective point of view, this type of evaluations will contribute to

improve UX and user satisfaction. However, so far, there are no existing or no known yet publications that provide a valid list to evaluate the functionalities of a VLE.

STUDENTS TEST

When evaluating an educational platform, it is important to analyze how the user feels during its use. Therefore, it is important to know the perceptions of the interaction that users/students of a Virtual Learning Environment have with these platforms.

In previous publication [21], we interviewed a group of experts in the field of Affectivity and Educational Technology, from several Spanish-speaking countries, those most significant emotions that a higher education student may express during the use of each of the VLE functionalities. As a complement to that experience, in this opportunity a test with graduate and postgraduate students was designed, with the purpose of improving the list of emotions proposed by experts in order to provide reliability and validity to it.

QUESTIONNAIRE

A questionnaire was designed consisting of eight "multiple choice" questions with emotions, one for each VLE characteristic mentioned above, noting that they could choose more than one emotion or none at all. A copy of this questionnaire can be accessed from the following link https://drive.google.com/file/d/1pzKk-pS0F-Z5G07V4EciqH4qryMtctVH/view?usp=sharing.

The questions were along the lines of "For Pedagogical Facility: When using the functionalities provided by the educational platform for the teaching/learning process such as: doing group work, tracking schedules and class attendance, evaluations...it is possible that it makes me feel the following emotions...." and so on for all characteristics. This questionnaire was online, in Google Forms, resulting in a simple, economical and direct way of obtaining the opinion of the respondents. Students from Argentina, Colombia, Spain, and Brazil participated without any difficulty, and from any device, even from their own cell phones, thus avoiding the inconveniences of distance, time and synchronization.

SELECTION OF EMOTIONS

Participants were asked to choose from a set of emotions for each VLE characteristic, based on the initial list generated with expert support [21]. The student could choose more than one emotion from the suggested list (multiple choice) and even add emotions that were not in the proposed options and/or leave comments or recommendations through open-ended responses.

The scale of emotions emerged as result of the previous experience [21], in which the following negative emotions were defined with the support of experts:

- Indignation: rage, anger due to unmanageable behavior.
- Contempt: contempt, lack of affection.
- Dissatisfaction: Unsatisfactory experience.
- Disappointment: does not meet expectations
- Unpleasant Surprise: Unexpected negative characteristic.
- Boredom: Uninteresting characteristics.
- Tension: Nervousness, stress, lack of tranquility.
- Frustration: failure to achieve a goal, impossibility of satisfying a need
- Confusion: lack of understanding.
- In addition, the following positive emotions were defined:
- Desire: drive to use the tool.
- Inspiration: motivation to do new things

– Admiration: Appreciation of the tool.
– Satisfaction: Satisfied with the available features
– Fun: Fun experience.
– Commitment: obligation to comply

PARTICIPANTS

In order to validate the list of emotions for functionalities/characteristics of a VLE defined by experts [21], teachers from Argentina, Colombia, Spain and Brazil from different educational levels were asked to distribute the survey to their students. As a result, a sample of 36 students was obtained. The subjects were from different countries, of different age ranges, who participated voluntarily. In addition, each participant answered his or her own questionnaire without knowing the answers of his or her peers, thus avoiding response bias. Regarding age, 17 belonged to the 18-25 age group, 15 were over 30 years old and 4 were 26-30 years old. In terms of nationality, 19 students were from Argentina, 10 from Colombia, 5 from Spain and 2 from Brazil. This is an important aspect to take into account to indicate the representativeness and heterogeneity of the participants in terms of culture, language and preferences, enriching the validity of the study.

TEST RESULTS

For each functionalities of a VLE, were analyzed the students' responses. The results are shown in graphical form, for better reading and visualization. For this study, was performed a frequency analysis. This analysis was done for all emotions and for each VLE functionality. Table 1 shows in summary the number of emotions associated with each characteristic VLE according to the survey applied. As can be seen in the Table 1, where the first column on the left indicates the set of emotions analyzed. The light blue line separates negative and positive emotions. The first row presents each characteristic of the VLE. In the right part of the table the averages, minimums and maximums of each emotion were calculated, as well as the averages of the set of negative emotions and average of the positive ones.

	Pedagogical facility	Support	Content	User Interface	Handling Errors	Tools	Flexibility	Standards	TOTAL	average	min	max	average NegEmotions	average PositEmotions
Disgust	0	0	1	1	4	0	0	2	**8**	**1,00**				
Indignation	4	5	3	2	7	1	0	5	**27**	**3,38**				
Contempt	3	4	3	2	5	1	1	4	**23**	**2,88**				
Dissatisfaction	16	7	9	10	10	7	8	7	**74**	**9,25**				
Disappointment	11	7	9	5	8	5	6	9	**60**	**7,50**				
Surprise	5	3	4	4	7	1	3	3	**30**	**3,75**			**42,50**	
Unpleasantness														
Boredom	11	10	11	10	5	8	5	7	**67**	**8,38**				
Tension	18	0	0	0	0	0	0	0	**18**	**2,25**	8	117		
Frustration	13	7	6	5	7	7	4	0	**49**	**6,13**				
Confusion	15	15	7	9	11	6	6	0	**69**	**8,63**				
Desire	13	5	8	8	0	10	8	5	**57**	**7,13**				
Inspiration	7	5	10	3	2	4	7	4	**42**	**5,25**				
Admiration	4	4	9	9	3	10	9	8	**56**	**7,00**				**54,33**
Satisfaction	12	13	18	18	11	17	10	18	**117**	**14,63**				
Fun	5	3	3	5	0	4	5	3	**28**	**3,50**				
Engagement	21	0	0	0	0	0	5	0	**26**	**3,25**				

Table 1. Summary of e motions for each characteristic VLE.

Considering all features (table 1), the most chosen emotion was "satisfaction" (*satisfacción* in Spanish - green shading), while the least chosen emotion was "contempt" (*desprecio* in Spanish - orange shading). Then, doing an analysis respect to the emotions, it is observed that positive emotions were more chosen to evaluate all the functionalities of a VLE. However, as can be seen in Fig. 1, the choice of emotions behaves in a variable way for all functionalities, with a peak in the emotion "satisfaction" and average values in the rest. Being "disgust" the least chosen of all.

This list of emotions in Spanish will be very useful for evaluate affectively VLE functionalities, since it was constructed with the help of higher education students of different genders, ages and countries of origin, which enriches the validity and heterogeneity of the study.

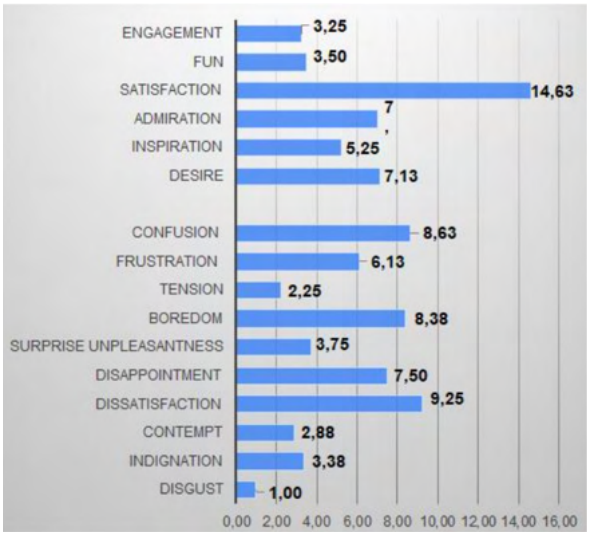

Fig. 1. General Average of Emotions.

VALIDATED LIST OF EMOTIONS FOR VLES

In order to compare the values of both experiences, were calculated the percentages of proportions of votes for each emotion in each VLE characteristic. That is, for example, if experts chose the emotion 5 times, the proportion results from dividing 5 by 12 (total number of experts who answered) and in percentage format would be 41%. In the case of students, it was divided into 36 (total number of students who responded).

We can appreciate the following similarities and differences: analyzing the votes for all VLE functionalities with respect to **disgust** (See table 2); we can notice that both, experts and students, did not choose it for "Pedagogical Facility" and "Support", 0% in this cell.

It should be noted that experts added the emotions tension, frustration, confusion and commitment in the previous instance, for this reason they were not chosen by the other experts since they were not part of the initial list at the time, which is why there are only student votes in these columns.

Analyzing these values (see table 2), it can be noticed for example that tension was only chosen for the functionality "Pedagogical Facility", zeros (0) in that column except in the 1st row. Similarly, engagement (in table 3) only appears for "Pedagogical Facility" and "Flexibility". The rest of the emotions were chosen for almost all functionalities. The same means for negative emotions in Table 4.

FINAL VALIDATED EMOTIONS FOR VLES

As a result of both experiences, was obtained a validated list of emotions for each VLE characteristic. To determine the final list of emotions for functionalities of a VLE validated by experts and students, it was determined as an inclusion rule that emotions that were chosen at least once, by an expert or by a student, would be part of this final list.

Table 4 shows a summary of the negative emotions selected by characteristic. The emotions that were selected are marked in green. In addition, the table 5 shows the positive emotions selected.

		Pedagogical Facility	Support	Content	User Interface	Handling Errors	Tools	Flexibility	Standards
Disgust	Student	0%	0%	3%	3%	11%	0%	0%	6%
	Expert	0%	0%	33%	25%	17%	8%	17%	17%
Indignation	Student	11%	14%	8%	6%	19%	3%	0%	14%
	Expert	58%	25%	25%	42%	83%	50%	42%	17%
Contempt	Student	8%	11%	8%	6%	14%	3%	3%	11%
	Expert	25%	33%	42%	33%	17%	42%	17%	33%
Dissatisfaction	Student	44%	19%	25%	28%	28%	19%	22%	19%
	Expert	100%	67%	75%	92%	100%	92%	58%	50%
Disappointment	Student	31%	19%	25%	14%	22%	14%	17%	25%
	Expert	75%	75%	83%	83%	58%	67%	67%	33%
Surprise Unpleasantness	Student	14%	8%	11%	11%	19%	3%	8%	8%
	Expert	25%	8%	50%	42%	58%	17%	42%	8%
Boredom	Student	31%	28%	31%	28%	14%	22%	14%	19%
	Expert	92%	58%	75%	75%	25%	67%	50%	33%
Tension	Student	50%	0%	0%	0%	0%	0%	0%	0%
Frustration	Student	36%	19%	17%	14%	19%	19%	11%	0%
Confusion	Student	42%	42%	19%	25%	31%	17%	17%	0%

Table 2. Summary of negative emotions per functionalities-VLE/Student/Expert.

		Pedagogical Facility	Support	Content	User Interface	Handling Errors	Tools	Flexibility	Standards
Desire	Student	36%	14%	22%	22%	0%	28%	22%	14%
	Expert	50%	33%	25%	42%	0%	33%	58%	25%
Inspiration	Student	19%	14%	28%	8%	6%	11%	19%	11%
	Expert	50%	25%	42%	33%	8%	42%	50%	17%
Admiration	Student	11%	11%	25%	25%	8%	28%	25%	22%
	Expert	17%	8%	17%	33%	17%	58%	50%	33%
Satisfaction	Student	33%	36%	50%	50%	31%	47%	28%	50%
	Expert	92%	58%	75%	75%	58%	100%	75%	75%
Fun	Student	14%	8%	8%	14%	0%	11%	14%	8%
	Expert	50%	8%	50%	58%	0%	42%	25%	8%
Engagement	Student	58%	0%	0%	0%	0%	0%	14%	0%

Table 3. Summary of positive emotions per functionalities-VLE/Student/Expert.

Negative Emotions	Disgust	Indignation	Contempt	Dissatisfaction	Disappointment	Surprise Unpleasantness	Boredom	Tension	Frustration	Confusion
Pedagogical facility		✓	✓	✓	✓	✓	✓	✓	✓	✓
Support		✓	✓	✓	✓	✓	✓		✓	✓
Content	✓	✓	✓	✓	✓	✓	✓		✓	✓
User Interface	✓	✓	✓	✓	✓	✓	✓		✓	✓
Handling Errors	✓	✓	✓	✓	✓	✓	✓		✓	✓
Tools		✓	✓	✓	✓	✓	✓		✓	✓
Flexibility			✓	✓	✓	✓	✓		✓	✓
Standards	✓	✓	✓	✓	✓	✓	✓			

Table 4. Negative Emotions selected for characteristic VLE.

Positive Emotions	Desire: Impulse	Inspiration	Admiration	Satisfaction	Fun	Engagement
Pedagogical facility	✓	✓	✓	✓	✓	✓
Support	✓	✓	✓	✓	✓	
Content	✓	✓	✓	✓	✓	
User Interface	✓	✓	✓	✓	✓	
Handling Errors		✓	✓	✓		
Tools	✓	✓	✓	✓	✓	
Flexibility	✓	✓	✓	✓	✓	✓
Standards	✓	✓	✓	✓	✓	

Table 5. Positive Emotions selected for characteristic VLE.

Finally, the emotions to evaluate during the use of each VLE functionality according to the opinion of experts and student users are listed in table 6.

CONCLUSIONS AND FURTHER WORKS

Affective UX evaluation of an VLE is critical to understanding learner/user preferences. Having more engaging user environments impacts the quality of an VLE and consequently, learner satisfaction. It is important that users/students of an VLE feel satisfied when interacting with these computer systems. Identifying positive and negative perceptions through such emotions. The main problem is that there is no validated list of emotions that students may experience when interacting with each of the functionalities of an VLE. The HCI community should consider these issues to identify aspects that influence users'

	Positive	Negative
Pedagogical facility	*Desire, Inspiration, Admiration, Satisfaction, Fun, Engagement*	*Indignation, Contempt, Dissatisfaction, Disappointment, Unpleasant Surprise, Boredom, Tension-Nervousness, Frustration, Confusion*
Support	*Desire, Inspiration, Admiration, Satisfaction, Fun*	*Indignation, Contempt, Dissatisfaction, Disappointment, Unpleasant Surprise, Boredom, Frustration, Confusion*
Content	*Desire, Inspiration, Admiration, Satisfaction, Fun*	*Disgust , Indignation, Contempt, Dissatisfaction, Disappointment, Unpleasant Surprise, Boredom, Frustration, Confusion*
User Interface	*Desire, Inspiration, Admiration, Satisfaction, Fun*	*Disgust , Indignation, Contempt, Dissatisfaction, Disappointment, Unpleasant Surprise, Boredom, Frustration, Confusion*
Handling Errors	*Inspiration, Admiration, Satisfaction*	*Disgust , Indignation, Contempt, Dissatisfaction, Disappointment, Unpleasant Surprise, Boredom, Frustration, Confusion*
Tools	*Desire, Inspiration, Admiration, Satisfaction, Fun*	*Indignation, Contempt, Dissatisfaction, Disappointment, Unpleasant Surprise, Boredom, Frustration, Confusion*
Flexibility	*Desire, Inspiration, Admiration, Satisfaction, Fun, Engagement*	*Contempt, Dissatisfaction, Disappointment, Unpleasant Surprise, Boredom, Frustration, Confusion*
Standards	*Desire, Inspiration, Admiration, Satisfaction, Fun*	*Disgust , Indignation, Contempt, Dissatisfaction, Disappointment, Unpleasant Surprise, Boredom*

Table 6. Final list of emotions per functionality of an VLE according to experts and students.

perceptions of their UX experience in order to develop better evaluation approaches.

As a contribution to evaluate affectively each of the functionalities of a VLE, a list of emotions, validated by experts and students, is left. In this sense, this work managed to define the emotions in Spanish according to each functionality of the VLE, contributing to the area of HCI in the context of education. This list of emotions in Spanish will be very useful for the field of Affectivity and Educational Technology, since it has the support of recognized professionals as well as students of higher education, of different ages and countries of origin, which enriches the validity and heterogeneity of the study.

As future work, it is planned to determine the scale to be used to perform an affective evaluation of VLEs. Subsequently, it is planned to implement affective evaluations of the educational platforms with the proposal list of emotions, for validation and feedback.

Another useful aspect to be analyzed in the future is the possibility of determining which emotions are most related to each characteristic, in order to consider them in both the design and the evaluation of the platform.

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