Understanding User Feedback Through Negative Emotions: A Learning Experience

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Abstract
User feedback is an important topic to be taught in Software Engineering (SE) courses. Furthermore, it includes theoretical concepts related to questionnaires, the time elapsed, mouse movements, etc., that are used to understand the topic better. In this context, teaching and learning theoretical concepts in different courses are great challenges in education in universities, particularly in this topic, due to the lack of practical applications or examples in real-life problems. Therefore, it is important to adapt the theoretical concepts to the advancement of technology. In this paper, we propose an innovative methodology for teaching implicit user feedback through the analysis of actionable emotions (i.e., emotions triggered by the interaction with a software service). We apply our proposal during three sessions; in the first and second, students reviewed the theoretical concepts in class. The last one was carried out in the ICE-InnovaT studio, where a system recognizes negative emotions in real-time from a user who was interacting with a software service; in this session, the students were watching the results of the system during the user interaction. Our experience indicates positive results in the adoption of this new approach. Overall, students reported positive comments related to using emotion recognition technologies to understand implicit user feedback.

Keywords: Implicit User Feedback, User Emotion, Software Service

Introduction

User feedback is defined as the relevant information obtained from the interaction between the user and an application or a software system (Suni-Lopez et al., 2020). In the last years, user feedback has become more important due to its variety of applications, for example, it is used for evolving software (Dzvonyar et al., 2016), the adaptation of service configuration based on user needs (Suni-Lopez et al., 2020), recommendation systems (Morales-Ramirez et al., 2015), etc. For that reason, undergraduate programs in several software engineering courses related to Human-Computer Interaction (HCI), include this topic as part of the syllabus (Ardis et al., 2015).

Teaching and learning processes are great challenges, especially in higher education, because teachers must deal with different students' learning styles and needs (Riding & Rayner, 1998); in addition, different topics inside one course could require different teaching methodologies, which makes the teaching process challenging. In this context, the user feedback topic includes various theoretical foundations, and commonly, these concepts are explained unlinked to practical applications. In this sense, we propose a methodology for teaching implicit user feedback (subtopic of user feedback) through a real-time application based on the analysis of negative emotions generated by the interaction between a user and a software service; this paper presents our experience teaching user feedback by applying our methodology in the HCI course of a Systems Engineering undergraduate program.

The paper is structured as follows: Section 2 presents the background; Section 3 describes the proposed methodology; Section 4 details the experiment conducted for the methodology evaluation. Section 5 shows the challenges faced and lessons learned. Finally, conclusions and future works are presented in Section 6.

Background

The topics inside the Software Engineering (SE) Programs have been traditionally taught through lectures, using slide presentations and blackboards to support the explanations. With the objective of improving the teaching process, there are some proposals to teach SE knowledge using specific teaching methods (Chen et al., 2009) or simulating the development of projects (Claypool & Claypool, 2005; Fiovaranti et al., 2018). However, there are some specific topics inside SE that are relevant due to their real-world applications; if students understand the topic, they can propose interesting projects and applications. One of the current important topics inside SE is "*user feedback*" due to their variety of applications (e.g., recommendation systems, software adaptation); however, it contains many theoretical concepts and foundations that are difficult to teach, and it can demotivate students to learn this topic.

User feedback can be divided into two important concepts: explicit feedback and implicit feedback (Suni-Lopez et al., 2020). Explicit feedback is information that is reported explicitly by users through filling out questionnaires, reporting an error, suggesting new functionalities, or ratings. On the other hand, implicit feedback is collected automatically during the interaction with the application, some sources of this feedback can be facial expressions, time on the page, click-stream, scrolling, or mouse movement. Explicit feedback is the most used in different applications and it is based on form filling by the users. However, implicit feedback enables more sources for capturing information that can require applying modern technology and concepts.

In this sense, the proposed methodology is based on implicit user feedback that includes modern and interesting concepts for SE students, such as facial emotion detection (i.e., negative emotions), deep learning, and artificial intelligence. This combination of theoretical concepts of SE and modern concepts is suitable for improving the learning process in Software Engineering. The understanding of SE concepts is important for the development of real-world projects; for that reason, our methodology considers showing the execution of an application in real-time as well as the corresponding explanation during the user interaction, where students can see at the same time the relationship between user's emotions and implicit user feedback.

Live lectures

We propose an innovative methodology for teaching implicit user feedback through the analysis of actionable emotions (i.e., emotions triggered by the interaction with a software service). For this purpose, we carried out three sessions; in the first two sessions, students reviewed the theoretical concepts. We applied our proposal in the last session, which was carried out in the ICE-InnovaT studio, where a system recognized negative emotions in real-time from a user who was interacting with a software service; in this session, the students watched the results of the system during the user interaction.

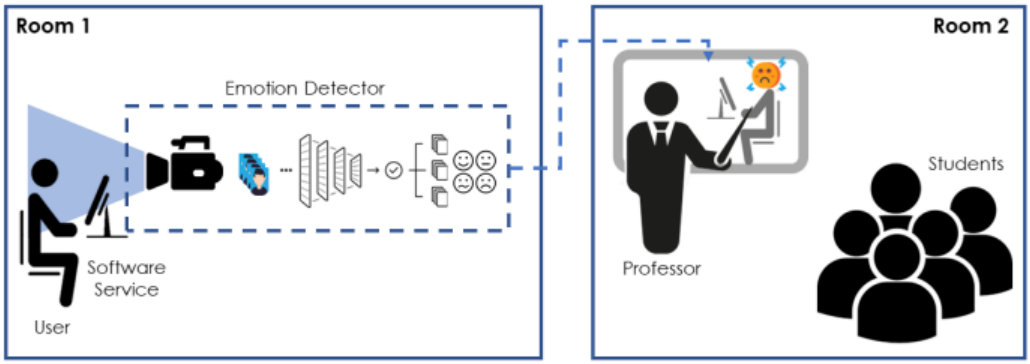

Figure 1: Pipeline of the proposed methodology

Figure 1 presents the pipeline of our proposal which takes place in two rooms; in the first one a user interacts with the software while the professor and students are in the second room. The following subsections present more details about this distribution.

Room 1

As it was presented in Figure 1, the experiment with the user and a software service (i.e., an e-commerce web service) is carried out in Room 1. Regarding the instrumentation, a quiet room was equipped with a computer, cameras, a desk, and a chair. In relation to the procedure, firstly, the subject was asked to read and sign the informed consent form, and an explanation was given about the objective and structure of the experiment. Afterwards, we requested him to stay quiet and relaxed for five minutes; then, the subject performed three different tasks (i.e., to try buying three items).

Figure 2: Setting up of Room 2. Left image shows the professor and the students, and right picture is the output of the emotion detector.

With the objective to analyze the user's emotions that are generated by the software service, we use a facial emotion detector that applies the web camera to collect facial images.

The emotion detector is based on MorphCast HTML5 AI SDK[1] which is a native JavaScript engine based on deep neural networks that recognize seven emotions (i.e., angry, disgust, fear, happy, neutral, sad, and surprise). Additionally, to stimulate the different scenarios of analysis (i.e., negative and positive emotions), we intentionally modified the software service functionalities to generate negative emotions in the user.

Room 2

Room 2 was implemented with two large TVs, one showed the user's face, and in the other, the real-time user's emotions were shown (see the right image in Figure 2). In this room, the professor explained the theoretical concepts of implicit user feedback to the students using and interpreting real-time user's emotions generated by interaction with the software service. Basically, when a negative emotion (e.g., anger, disgust, fear, or sadness) was dominant, the professor analyzed the relationship between the negative emotion and the current functionality that was being used.

Evaluation

With the objective to evaluate our proposal, we conducted a survey to understand the students' perception as a result of the proposed methodology for learning user feedback. In this survey participated 21 undergraduate students (2 female and 19 male aged 19 to 25 years old) enrolled in the Human-Computer Interaction course at Universidad de Lima, Peru. This survey was answered by them at the end of the third session, and it was composed of nine questions (see Table 1): seven mandatory Likert scale questions (their results are presented in Figure 3), one mandatory single-choice question, and one optional open question.

Analyzing the results for the Q1 question, the motivation to learn about implicit user feedback, most of students (85%) agreed this new methodology had motivated them. Also, only one student (5%) neither agreed nor disagreed. The 10% of students mentioned the methodology did not motivate them. Additionally, when we compared the students' comments, we noticed there exists a preference to motivate the theoretical classes with real applications (e.g., experiments). Concerning learnability (Q2), the 80% of the students

[1] https://www.morphcast.com/sdk/

considered the methodology permits them to clearly see the objective of the sessions and consequently acquire knowledge about implicit user feedback. For this case, the 10% remained in disagreement. Contrary to the Q1 question, the undecided increased to 10%. In addition, students commented that in theoretical sessions it was difficult to understand what the objective was.

	Question	Type
Q1	Did you feel motivated to learn about implicit user feedback with the proposed methodology?	Likert scale
Q2	Did you consider you learned what you were looking for through the proposed methodology?	Likert scale
Q3	Did you consider it is important to see the feedback analysis in real-time?	Likert scale
Q4	Did you consider this methodology allowed you to concentrate better during the learning process?	Likert scale
Q5	Did you believe that the use of this methodology influenced your learning process?	Likert scale
Q6	Are you motivated to deepen your knowledge about implicit user feedback?	Likert scale
Q7	Can you clearly see the importance of user feedback?	Likert scale
Q8	If you could choose the way to learn about implicit user feedback, which modality would you choose?	Single-choice
Q9	Do you have additional comments, criticisms or suggestions regarding the methodology used in the HCI course?	Open

Table 1: List of questions included in the survey.

Regarding the importance to analyze user feedback in real-time (Q3), 90% of students agreed the proposed methodology allowed them to recognize the importance of implicit user feedback to measure the quality of the software service. In this question, we did not have any undecided; but it resulted that 10% of the students were in discordance. Analyzing the student's comments, they easily understood the importance of collecting user feedback with the real-time application. Analyzing the Q4 question related to whether the proposed methodology allowed them to concentrate, 71% of the students agreed and 10% disagreed. However, we got an increase to 19%, who neither agreed nor disagreed. Doing the correlation with the student's comments, we found that since the practical session was carried out outside the regular classroom, in the ICE-InnovaT studio (open class), it allowed them to learn in a practical way, but also it was easy to get distracted.

As far as the influence of the proposed methodology in their learning process (Q5), 76% of students agreed, little high percentage of undecided (14%) remained, and 10% disagreed. As well, the students commented on the impact of watching a real-time experiment, which allowed them to create a connection between user experiments and the theoretical concepts learned during the session. When we asked whether the proposed methodology motivated

them to deepen and continue studying (Q6), 80% of the students agreed, and 10% reported undecided and disagreed. According to the comments, the students indicated after the third class they were influenced to search for more information about implicit user feedback and how the user's emotions can be used to measure software service quality and user experience.

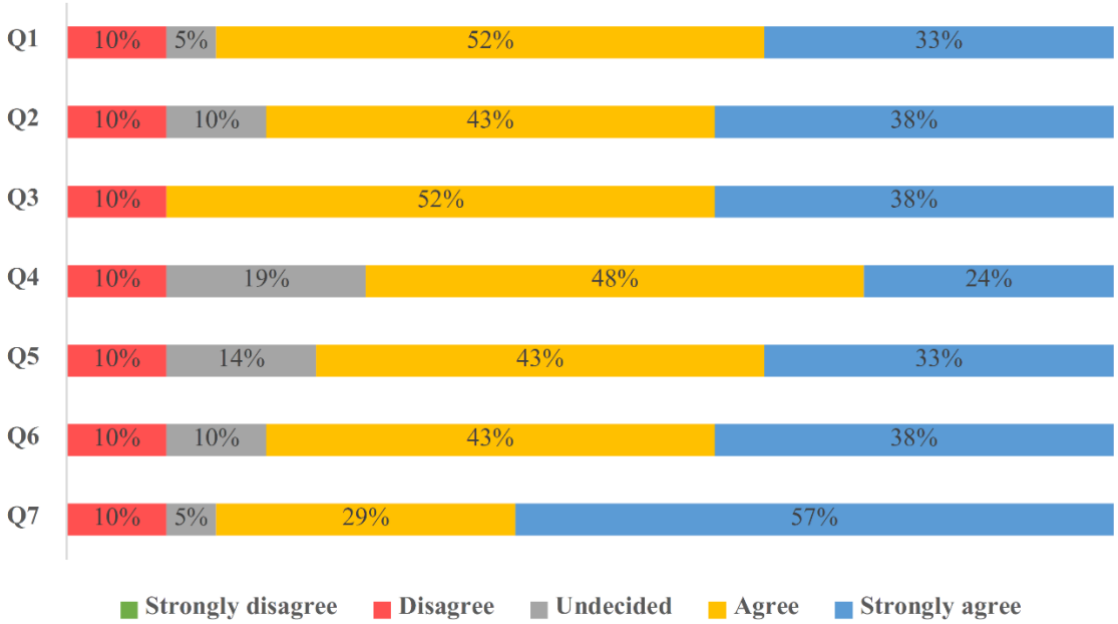

Figure 3: Summary of the obtained results for the seven questions that applied the Likert scale.

Regarding whether the approach allowed to clarify the importance of user feedback (Q7), most of the students totally (56%) or partially (29%) agreed with this statement (in total 85%); this result allowed us to infer that besides seeing the importance to analyze the user feedback in real-time, the proposed methodology allowed them to understand the importance to obtain user feedback because that information could be used to improve the software service quality. On the other hand, some students disagreed (10%), and some others were not sure (5%). Finally, the Q8 question was applied to ask students if they preferred to learn theoretical concepts with the proposed methodology or the traditional way, most of the students (95%) indicated they preferred this teaching methodology. However, we also obtain some students (5%) that prefer the traditional way. In summary, most of the students consider the proposed methodology as innovative and it allows them to learn about the ``user feedback'' topic. Additionally, this methodology has the potential to improve learnability and concentration during the session and motivates self-learning about the topic.

Challenges and Lessons Learned

In this section, we discuss the challenges identified by applying this methodology and what we learned as professors. The challenges we can mention are:

- **Student's background:** as the experiment was carried out with undergraduate students, one of the main difficulties was the difference in their profiles; each student has different objectives in the course (e.g., some students want to learn, and others only follow the course to complete the mandatory courses of their program). Additionally, the student's prior knowledge impacted the learning-teaching processes

since some had greater skills to design and run user experiments while others had a very basic vision. Even though refresh sessions for key concepts were carried out, the difference in the needed skills of the students proposed a challenge.

- **Experiment settings:** According to Suni-Lopez et al., (2020 we could test the software service properties on the user's emotions. For the teaching objectives, it is challenging to define which software service's functionality must be modified to generate adequate case studies (as we explain in Section 3, we modified some features of the software service to generate negative emotions in the user); also, as most variables were controlled by the experiment, the students analyzed a fictitious case study. However, as the objective was to show how to use negative emotions to measure a software service, we think that this challenge was managed according to the study's objective.

Conclusions and Future Work

This paper presented an innovative methodology to teach implicit user feedback topic, which is part of the Human-Computer Interaction course, discussing its use as a supporting method for teaching and learning intricate theoretical concepts. The novelty of this methodology is the use of actionable emotions in a real application. According to the survey, our proposal has the potential to help learnability and concentration in the students, and also it motivates students to learn by themselves. In general, students were enthusiastic and positive about this methodology due to the combination of theoretical concepts with interesting modern concepts (e.g., deep learning, image processing, emotion recognition) in a real-time application. As future work, we intend to conduct more evaluations, such as forming student groups according to their background to evaluate the importance of student profiles in the learning process about user feedback; also, reducing the variables controlled in the experiment settings to see the application in a real context. In addition, we intend to measure the effectiveness of our proposal regarding the general learning process of the topic.

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