Identifying Engagement with Learning in Serious Games

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ABSTRACT

Within the health sector, the effectiveness is a key factor for the deployment of Serious Games for training purposes. Engagement is central factor relating games to learning. Therefore, identifying player’s level of engagement is an important aspect to consider when assessing Serious Games effectiveness. This paper describes an approach to identify player’s engaged-behaviours based on users interaction traces. A trace is a history of users’ actions collected in real-time during their inter-action with a computer system. The process of identifying the level of engagement consists of transforming low-level behaviours (e.g. clicks) in contextualized high-level behaviours. The proposed approach is exemplified by applying it to the identification of engaged-behaviours in a serious game for training clinical procedures on sepsis treatment protocol.

Keywords

Serious Games, Engagement, Assessment

1. METHODOLOGICAL APPROACH FOR IDENTIFYING ENGAGEMENT IN DIGITAL GAMES

Bouvier et al. [2, 1, 3] have proposed a qualitative approach to identify users’ engagement and qualify their engaged-behaviours from their traces of interaction. A trace is the history of users’ actions collected in real-time from their interactions with a computer system. The basis of the authors’ approach is to transform low-level traces of interaction (e.g. clicks) into meaningful information represented in higher-level traces (i.e. activities). These high level traces correspond to engaged behaviours. A behaviour corresponds to a chain of actions (i.e. an aggregation of actions) actually performed by the user in the interactive system. From an operational point of view, a player is engaged if s/he manifests at least one engaged-behaviour. Considering some chains of actions rather than single actions provides comprehensive contextual information on behaviours and thus, facilitates their understanding.

To decide whether a behaviour reflects, or not, an engagement, the authors considered the question of the learners’ motives and needs that determine engagement. For that, based on the Self-Determination Theory [7] four types of engaged-behaviours were identified [2]: 1.) environmental, 2.) social, 3.) self, and 4.) action. To demonstrate how this approach can be applied to Serious Games, we describe next an example of use to identify engaged-behaviours within the sepsis fast track Serious Game. This example is based on real data collected during on-the-job training sessions with doctors in training at an academic hospital.

2. IDENTIFYING ENGAGED-BEHAVIOURS IN SEPSIS FAST TRACK SERIOUS GAME

In the Sepsis Fast Track Serious Game the player assumes the role of a physician and her/his goal is to confirm if the patient is or is not a case of sepsis, fill out the sepsis fast track form in the hospital IT system and carry out the appropriate medical interventions. The sepsis fast track form is composed of three main parts. The first is concerned with the systemic inflammatory response syndrome criteria, which are the body temperature, heart rate, and respiratory rate and is completed by the triage nurse. The second part registers the information confirming or not confirming the sepsis case suspicion is registered. It includes the registration of the arterial blood pressure, checked using the game mechanics Examine ECG Monitor, the exclusion criteria, checked using the game mechanics Examine Patient Chart, the Glasgow coma scale, checked using the game mechanics Examine Patient, and the lactate value, checked using the game mechanics Examine Arterial Blood Gas. In this part the sepsis fast track activation is also validated. Validating a sepsis case means, asserting that the patient identified by the triage nurse is in fact a sepsis case. Finally, the third part of form is concerned with the information about the therapy administered to the patient. This should only be used if a sepsis case is confirmed and validated. Also, the time when the patient had the therapy (hemocultures, antibiotherapy and fluid therapy) should be registered. A detailed description of the sepsis fast track Serious Game and respective game mechanics can be found in [6, 5].

The sepsis fast track is a point-and-click Serious Game meaning that all interactions are traduced by a combination of clicks in game objects (e.g. patient, nurse, ECG monitor). All clickable objects are represented in Figure 1. An example of a medical intervention is to confirm the suspicion that the patient has a sepsis. This medical intervention requires the physician to ask the patient about his/her current symptoms, to verify the Glasgow Comma Scale, to perform a blood test to verify the lactate value and examining the patient. In terms of interaction with the game (primary traces) these actions are represent by a sequence of clicks, moves and choices (game actions) spread throughout a game session (these are the operations in Figure 1). In order to aggregate them into meaningful actions a set of rules have to be defined to transform these primary traces into an intermediate transformed-trace (actions). An example of such rule is (see Figure 1)
This rule identifies actions that the player undertook to understand better how the game works. To identify the actions relevant for the medical intervention previously described a similar rule would have to be implemented. Finally, it is necessary to aggregate these actions in order to identify the high-level traces, meaning the activities. In the context of Serious Games the activities are the unit of gameplay that are closer connected to the learning objectives of the game. In order to identify the activities a second level of transformation rules need to be defined and applied to the intermediate transformed-traces. An example of such rule is:

\[(\text{consult action list.timestamp - consult help screen timestamp} <= 5000)\]

With this rule we can identify when and how many times the player tried to increase her knowledge about the game. By doing this transformation process, it is possible to identify the different dimensions of engaged-behaviours (Environ- mental, Self, Social, Action). In our running example we have shown how to identify environmental-engaged behaviours. A schematic representation of the process of identifying engaged-behaviours in the sepsis fast track Serious Game is depicted in Figure 1.

Combining these two sources of information and comparing it between different game sessions (in the context of sepsis fast track Serious Game, different clinical cases), we will be able to observe how the deviation of optimal performance evolves and in this manner understand how committed and how much effort the player placed in the learning activity (solving a clinical case).

3. CONCLUSION AND FUTURE WORK

In this paper we presented a summary review of definitions proposed to help clarify and understand engagement with learning. Based on these definitions and an approach previously used to identify engaged-behaviours in a social game we have shown how the same approach can be used to identify engaged-behaviours in a Serious Game for clinical education, the sepsis fast track Serious Game. By extracting these high-level behaviours from gameplay activity and comparing it with subsequent game sessions we can potentially have an indication of what was the player level of commitment and effort, and therefore engagement, in the learning activity during gameplay.

By relying on rules to capture the meaning of low-level traces, this also allows us to identify the situations where there was a deviation of the optimal performance, meaning achieving a certain activity by performing a certain number of wrong actions (intermediate transformed-trace). This can be accomplished by implementing rules that capture sequences of operations that also include operations that are not part of the resulting action.

This work represents the first part of an on-going research work that involves using this approach to identify engaged-behaviours of 17 doctors playing 5 different sessions of the sepsis fast track Serious Game as well as understand if there is a causal effect between the level of engagement and the level of knowledge retention.
4. REFERENCES


