Personalization of Immediate Feedback to Learning Styles

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Abstract

Feedback provided to a user is an important part of learning and interaction in e-learning systems. In this paper we present the results of our pilot experiment aimed to study interrelation between several types of immediate feedback presentation and learning styles (LSs) of users. In the experiment we used the feedback supported by Quiz Module of Moodle learning system. The obtained results demonstrate tendencies in interrelation between LS and immediate/summative feedback presentation and we suggest three hypotheses for future research.

1. Introduction

In e-learning systems feedback plays a crucial role in interaction. The feedback occurs in the process of assessment, during the navigation through the learning materials (for example, with navigational panels that inform the user about the current location within the course), communication and collaboration with other students. The alerts and the reminders that appear in the process of the interaction can be also considered as the feedback.

Personalization of the feedback offers possibilities to deliver feedback that is the most appropriate for the user's expertise and cognitive abilities in general and, in particular, to the current moods and attentiveness. One of the very few experimental studies of feedback in e-learning systems is [7], where the effectiveness of different types of feedback was studied. The results of that study have shown that the type of computer-based feedback did not have any influence on student learning, but at the same time the students reported distinct preferences for knowledge-of-response and response-contingent computer-based feedback.

This paper presents the results of a pilot experiment of the feedback personalization to individual LSs. The primary ideas for this experiment were presented in our previous paper [8]. In this paper we analyze those ideas investigating whether the way of feedback presentation in Moodle's Quiz Module might have the effect to the performance of students with different LSs.

The rest of the paper is organized as follows. The Moodle's Quiz Module's feedback is shortly overviewed in Section 2. Section 3 discusses the issue of personalization to LS in e-Learning system. In Section 4 we analyze the possibilities of the feedback adaptation to the LS and present the results of the pilot study. We conclude briefly in Section 5.

2. Feedback in Moodle's Quiz Module

Moodle (http://www.moodle.org) is an open source e-learning system designed using sound pedagogical principles and used in over 160 countries. Moodle includes *quiz module* that allows the teacher to design and set quiz tests, consisting of multiple-choice, true-false, short answer questions etc. We use the immediate and delayed (summative) feedback that is provided by the current version of Moodle (Moodle 1.7.1.) to the multiple-choice type of questions. Moodle supports the following types of feedback: immediate and summative (classified according to the students progress); knowledge of the response, corrective and elaborated feedback (classified according to the complexity); and, immediate and delayed (after all questions) feedback (classified according to the time of presentation).

The immediate feedback is given directly after submitting the answer. Of those possibilities that Moodle offers we decided to select: (1) detailed (elaborated) immediate feedback and (2) brief

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(knowledge of response) immediate feedback.

The delayed/summative feedback is given after a set of answers has been received. Of those possibilities that Moodle offers we decided to select: (1) brief delayed (summative) feedback and (2) detailed (elaborated) delayed feedback.

3. Adaptation to LSs in e-Learning Systems

The personalization to LSs has recently been actively studied and implemented in a number of adaptive e-Learning systems. There is a good review of the learning systems that implement personalization to LS in [1]. According to our knowledge, there is no reported research concentrated on the feedback adaptation based on LS in the e-learning context.

One of the problems in personalization is that there is no psychological theory that supports LS treatment interaction [3]. Also there is no agreement how to measure individual learning differences [2]. Coffield et al. in [4] identified 71 LSs and their dichotomies, from which they considered 13 most influential LSs.

Felder-Silverman's model [6] is one of the best suited and feasible LS theory in respect to eLearning design and development. Its suitability was recently evaluated for e-learning personalization in [9]. Felder-Silverman's theory places an individual's preferred LS in a four-dimensional space of independent descriptors: active-reflective, sensing-intuitive, visual-verbal and sequential-global [6]. We used 3 dimensions from Felder-Silverman LS model.

4. Feedback Adaptation to LS

The experiment on feedback personalization was organized at St. Petersburg State Technical University in the end of 2006.

4.1. Participants of the Experiment and the Experimental Procedure

The participants of the pilot experiment were ten students who had taken the Intelligent Systems course at St. Petersburg State Technical University. The experiment was organized during one of the practical sessions of the course.

In the first test – Index of Learning Styles [5] the learning style (LS) of each student is determined according to the Felder-Silverman' model [6].

The next four tests (17 questions each) considered the Intelligent Systems course material in the learning (self-evaluation) mode, where both immediate and delayed feedback were presented in brief and elaborated versions. Thus there were four

combinations of feedback. The final test included 10 questions related to feedback preferences.

4.2. Results of the Experiment

From those 10 students participating the pilot study, the results of 4 students are recognized to be unreliable because the students have too low scores in the tests that were presented in the learning mode (they did not correct their answers or they gave random responses to the questions.

The scores of the 6 students, grouped according active/reflective LS dimension, are presented in Fig. 1a. In Fig. 1b the average time used to pass the tests by active/reflective users is presented.
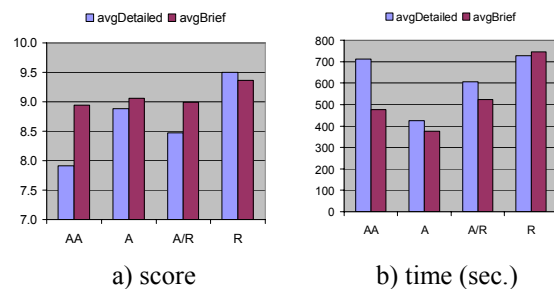

a) score b) time (sec.)

Fig. 1. Score and Time of Active/Reflective learners

There seem to be tendency that the users with the bias towards reflective LS perform better (score and time) in the tests where detailed immediate feedback is provided. On the other hand the active (AA) learners (and those who have tendency to be active (A)) were better (score and time) in the tests, where brief (knowledge of correct response) feedback was presented. Based on this we suggest the following hypothesis:

H_1 – the reflective students performs significantly better when the detailed (elaborated) immediate feedback is presented while the performance of the students with active LS are better when brief immediate feedback is presented.

In Fig. 2a and 2b the corresponding results of the users classified by sensual/intuitive LS are presented.
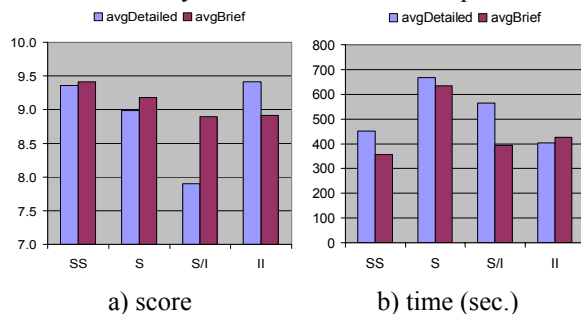

a) score b) time (sec.)

Fig. 2. Score and Time of Sensual/Intuitive users

The performance of the sensual users was in average better in the tests with brief immediate feedback. The intuitive users had the opposite results – their performance was better in the tests where detailed immediate feedback was provided. This leads to our second hypothesis:

H2 – the students with intuitive LS performs better when the detailed immediate feedback is presented, while the performance of the sensing users is better when brief immediate feedback is provided.

In Fig. 3a and 3b we present the average results of the users classified by global/sequential LS.

There were no learners with dominated sequential LS among the participants of the experiment. The learners with the bias towards sequential LS did not perform better in the tests where detailed immediate feedback was presented (as we assumed in [10]). The obtained results are somewhat confusing as the score of the global users and the users well balances between global and sequential learning styles were better with brief immediate feedback, while the users with the bias to global LS had the better performance in the tests where detailed immediate feedback was presented. (as we assumed in [8]).
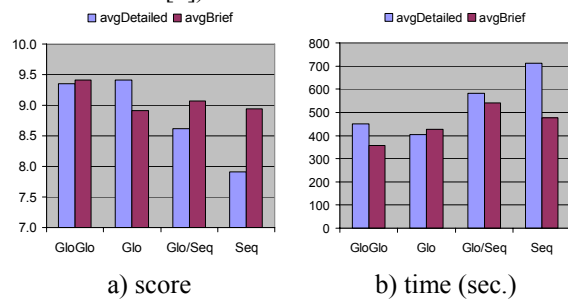

Fig. 3. Score and time of Global/Sequential learners

This gives reasons to the following hypothesis:

H_3 – the students with global LS have better performance in the tests, if brief feedback is presented.

The responses to the feedback preferences test were the following:
- all the students preferred detailed to brief immediate feedback;
- the majority of students preferred to have minimum of information presented in the feedback, but they think that they should have a functional possibility to receive maximum of the information in the feedback;
- 50% of the learners preferred to have individual (personalized) feedback, while 50% of the learners answered that they would prefer to receive the feedback same as the other users of the system.

5. Discussion and Further Work

Feedback adaptation to LS seems to be a promising aspect of the e-learning systems personalization. In this paper we have presented the analysis of the first results of the pilot study of feedback personalization to learning styles. The obtained results demonstrated the potential and the necessity of the further experimental research of the interrelations between the personal LS and the adaptable feedback parameters. Our ongoing work devoted to the experimental data collection with respect to the stated hypotheses. In the future we are planning to analyze the effect of LS combination and the possibilities of personalization of the e-learning systems to the users with certain combination of LS (e.g. {active, sensual, balanced glo/seq}).

6. Acknowledgements

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