An Evaluation of Pedagogical Feedbacks in DIAGRAM, a Learning Environment for Object-Oriented Modeling

Mathilde ALONSO¹ and Dominique PYᵃ
ᵃLaboratoire d’Informatique de l’Université du Maine (LIUM), France

Abstract. This paper reports an experimentation of DIAGRAM conducted during Fall 2008 with students at the university level, in ecological context. DIAGRAM is a learning environment for UML class diagrams that provides specific interaction features and contextual helps for novice users; a diagnostic component enables the system to give advices and suggestions that are tailored to the learner’s diagram. The evaluation was conducted using the videos of the sessions. The results show that DIAGRAM is quite helpful for novice learners and suggest some ways to improve the environment.

Keywords. Assessment, UML, class diagram, interaction, help features.

Introduction

Modeling is a core topic in most Computer Science and Software Engineering curricula, and recent research works have focused on the design of computer-supported learning environments for modeling, particularly for object-oriented modeling [1] [2]. DIAGRAM is a learning environment for UML class diagrams, being developed and tested as part of a project of the LIUM laboratory [3]. Recently, we have integrated a diagnostic module that enables the system to provide the learner with natural language feedbacks which take into account the correctness of his/her diagram [4]. This paper reports an experimentation of DIAGRAM conducted during Fall 2008 with students in a UML course. The objective was mainly to assess the efficiency of the feedback messages. The evaluation was conducted using the videos of the sessions.

1. The Interaction in DIAGRAM

DIAGRAM is designed like an open class diagram editor that provides a subset of classic editor functions, specific interaction modes and help features for novice users. As the modeling task is not a well-defined process (there is no deterministic method to design an UML diagram), the system focuses on the acquisition by the learner of metacognitive regulation skills, i.e. processes that control the subject’s cognitive activities. They help to regulate and oversee learning, and include planning, monitoring

¹LIUM, avenue Laënnec, 72085 Le Mans cedex 9, France. E-mail : alonso@lium.univ-lemans.fr
and checking the outcomes of those activities [5]. The interaction in DIAGRAM has been designed to support the learner’s metacognitive activity throughout the sessions.

The diagnostic component in DIAGRAM compares the learner’s diagram with a reference diagram and lists the differences between these two diagrams [4]. The basic pedagogical differences are classified in eight categories: omission, addition, transfer, duplication of an element, merging, misrepresentation, reversal of the direction of a relationship and wrong multiplicity. These differences do not mean that the learner is wrong, strictly speaking, but they suggest that he could have made a bad choice. Thus, the feedback messages in the DIAGRAM environment are not classical feedback messages: they point specific parts of the diagram out to the learner so as to solicit the metacognitive regulation. As the diagnostic is performed once the modeling task has been completed, we mainly target the checking function. After reading the messages and checking the diagram, if the student is still convinced that his/her alternative solution is correct, he/she is free to leave it unchanged.

![Figure 1. Example of feedback messages in DIAGRAM](image)

Three kinds of messages have been defined in DIAGRAM: notify, question, and propose. “Notify” draws the student’s attention to some part of the diagram, or to the way he/she has modeled a particular concept. “Question” consists in asking the learner about the diagram’s properties. The questions are on a binary mode (the answer is “yes” or “no”) and encourage the learner to mentally check whether the diagram satisfies a given property. “Propose”, the most direct modality, consists in suggesting how to correct the diagram. This kind of help is provided only when the presence of an error is near-certain.
2. Evaluation

The experiment took place in Fall 2008 and involved eighteen students in second year of University Diploma for Science and Techniques (DEUST) working with DIAGRAM during four streams of three-hour practice session of UML Modeling course. During a session, each student practiced between three and five exercises.

We analyzed 86 exercises for a total of 306 calls of the diagnostic, which means that the diagnostic was called 3.56 times per exercise and per student. It results in 1924 messages. We studied the learners’ reactions after these messages, and classified them into four categories: correction (the student modifies the diagram in accordance with the message, 43.9%), modification (the student modifies the diagram in relation with the message but some difference with the reference diagram remains, 3.4%), no effect (the student does not take the message into account and does not modify the diagram in relation with the message, 41%) and irrelevant (the message is irrelevant because of a diagnostic problem, 11.6%).

We examined further the diagnostics that caused irrelevant messages, and found that they were due to wrong matches between elements of the two diagrams. As the diagnostic algorithm relies on structure and names to compare the diagrams, its performances deteriorate in some particular situations.

The correction rate is rather low (43.9%) but reaches 49.7% if we exclude the messages which are the consequences of a diagnostic problem. The explanation is that, as DIAGRAM’s feedbacks are related to one particular solution, students could ignore some messages if they were convinced that their own solution was a correct alternative.

Globally, the time spent on DIAGRAM after the first call of the diagnostic tool represents about one third of the total time. The students devoted much time checking and improving their diagrams, and the results look much better than if they had not benefited from the feedback messages.

An overview of this evaluation shows that the diagnostic in DIAGRAM worked fairly well (9 relevant outputs out of 10) but requires improvements in some specific situations. The feedback messages efficiently helped the students to reflect upon their diagram and correct their mistakes. The correction rate is medium, which meets our expectations, as the students could find alternative solution unknown from DIAGRAM. A second experiment, with a control group, is necessary to confirm these results.

References