



Interweaving Activities, Feedback and Learner Model in a Learner Centered Learning Environment

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Abstract. International trends in education show a shift to student-centered approaches. This paper presents the Learner centered Learning (LcL) environment which is activity oriented, serves learning and assessment, provides multiple types of informative and tutoring feedback components at activity and question level and deploys open learner model to promote self-regulation. The use of the environment in higher education reveals positive results in learning and a promising blending of activities, feedback and open learner model.

Keywords: Activity · Feedback · Learner model · Learner centered Learning

1 Introduction

An emerging trend in education worldwide is student-centered learning environments inspired by the constructivist view on learning [1]. Within higher education institutions, these environments have been adopted as they underpin blended learning [2]. The student-centered learning environments focus on what the students are expected to be able to do at the end of the learning process [3]. Also, in these environments learners tend to show greater activity and responsibility for their learning. The learning characteristics of a student-centered learning environment may include an active and guided learning process, deep conceptualized learning with multiple perspectives and collaborative learning [1, 3].

Along with the learning process, assessment is considered an important component of an educational setting as it promotes learning when it is integrated with instruction [4]. Engaging students as active participants in assessment spurs them to develop capabilities in analysing their own learning and become self-directed. Feedback is an integral part of the assessment process and serves a critical function in knowledge acquisition. Therefore, feedback should guide and tutor learners towards the accomplishment of the intended learning goals [5].

Research approaches focus on meaningful student involvement throughout the learning environment. Open Learner Modelling has demonstrated significant learning gains in this direction [6]. OLMs, as a dynamic representation of the learner's knowledge, help users interpret aspects of learning and provide important information to prompt self-regulated learning and metacognitive skills [6].

In this paper, we present the design principles of the Learner centered Learning environment (LcL <https://lcl.di.uoa.gr/>) and illustrate how activities, feedback and OLM can be interweaved to support student-centered learning.

2 The LcL Learning Environment

The design principles of LcL are based on (i) the Activity Theory which is used as a framework for modeling learning situations where individualized learning is interweaved with collaborative learning and the concept of activity serves as a unit of analysis, (ii) the provision of feedback as a powerful moderator that enhances achievement, and (iii) the OLM which combines and expands ideas coming from the areas of computer-based interaction and collaboration analysis.

Activities. In the LcL environment, students are actively involved in the learning process by performing a number of activities. The activities are designed to address and serve specific educational functions and follow specific educational approaches. The educational function concerns either learning (knowledge construction) or assessment (ascertainment of students' prior knowledge, formative assessment or summative assessment). For the accomplishment of the educational function, the design of the activity may follow an educational approach that better supports and facilitates the educational function under consideration and may require the use of a specific educational tool. For example, for the ascertainment of students' prior knowledge, the concept mapping educational approach may be applied, requiring access to a concept mapping tool.

The activity addresses specific learning goals (i.e. learning outcomes on the basis of the revised Bloom's taxonomy) and applies an action framework. The action framework models attributes related to the type of the activity (i.e. individual or collaborative), the difficulty level, the degree of importance for the accomplishment of the defined learning goals and any accompanied educational material (e.g. a case study, the code of a program). In case of a collaborative activity, the action framework determines the collaboration model that learners follow; i.e. the number of group members, the role of each member. Depending on the educational function and the underlying learning goals, the assessment is automatic or is carried out by the educator in case of open-ended questions, questions that don't have a unique answer or questions that require justification.

The activities are assigned by the teacher at personal or group level. For each assignment, the teacher has to define various parameters such as deadline, availability of feedback, time to perform the activity.

Feedback. LcL attempts to support and guide learners by providing informative and tutoring feedback. Effective feedback aims to assist learners to recognize and understand their false beliefs, become aware of their misconceptions and inadequacies and reduce the gap between current performance and a desired goal [5]. Characteristics that influence the effectiveness of feedback concern the type of feedback, the amount of the provided information and the learners' individual preferences. In this context, multiple informative and tutoring feedback components are provided. The informative feedback

(i.e. verification feedback and performance feedback) inform learners about their current state; this information is included in the learner model. The tutoring feedback components guide the learners in the right direction and are structured at two levels, activity and question level. The feedback components at the question level are content-specific, while at activity level, they are topic-contingent. The tutoring feedback components are associated with various types of knowledge modules (feedback types) and are distinguished in two categories: explanatory and exploratory. The explanatory feedback may include knowledge modules such as a description, a definition and the correct answer whilst the exploratory feedback may include an image, an example, an advice on how to proceed, a question giving a hint on what to think about, a case study, a similar activity including the correct answer, and any responses given to the specific activity by other learners. The different categories and types of knowledge modules aim to serve learners' individual preferences and influence learning. Feedback may be delivered either immediately after performing a question or an activity. Immediate feedback can help fix errors in real-time while delayed feedback has been associated with better transfer of learning [7].

Open Learner Model. The LM keeps information about learner's knowledge level (qualitative and quantitative estimation), and learner's working behaviour. The learner's working behaviour involves feedback components s/he received, the corresponding attempts, the knowledge status, and the adjustment of grade made by the tutor to questions that require justification or do not have a unique answer. During interaction, learners may access the model and see the information that is dynamically updated. At the peer level, learners have the possibility to compare their own working behaviour to their peers. The externalisation of learner model aims to support the self-regulation and reflection processes. Learners' awareness is supported by presenting the values of various indicators (e.g. attempts per activity) while their metacognition is supported by presenting information resulting from the elaboration of interaction analysis data and performance data. This information is visualised in different forms and concerns the calibrated value of specific indicators; for example, personal, minimum, maximum, and average knowledge status through a graphical format at concept, activity and question level, average score by activity type, by learning outcomes level or by difficulty level, percentage of students that selected each one of the available answers in the case of multiple-choice questions, percentage of learners that received the maximum score for each question.

3 LcL in Higher Education

During the academic years 2018–19 and 2019–20, the LcL environment was used in the context of the undergraduate course “Introduction to Informatics & Telecommunications” aiming to support the learning process. The first year, a beta version of the environment was used in order to test its robustness and main functionality. Students' comments for improvements were focused on interface issues and notifications they considered necessary. A total of 277 students participated in the course while 208 of them used LcL during the semester. The assignments were made on a weekly basis following the organisation of lectures. The students that used LcL had better

performance in written exams (Fig. 1). During the second year, the study focused on the use of feedback and OLM. A total of 338 students worked out 94 questions. The students expressed their satisfaction regarding LcL environment (organisation of activities, provision of various forms of feedback, interface and content) and they characterized the OLM as a valuable and supportive means in learning which helps them to stay engaged and try harder. They appreciated the provision of various indicators and found interesting to compare their weaker areas with other students' to see if they too had struggled with the same area and encountered the same difficulties.

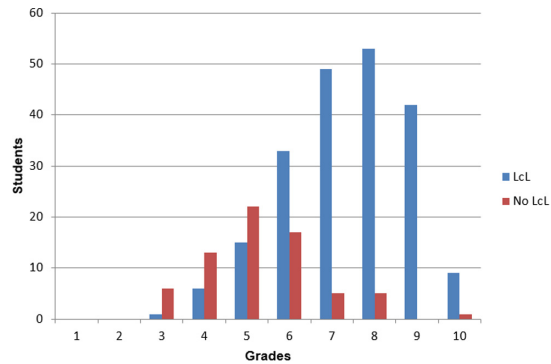


Fig. 1. Students' performance in written exams (2018–19 academic year)

Our future research work focuses on the support of adaptive functionality and especially on the combination of adaptation with gamification in order to enhance students' engagement.

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