Supporting self-regulated learning in a blended learning environment using prompts and learning analytics

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Abstract

Higher education institutions, teachers, and students face new difficulties and opportunities resulting from the introduction of modern technology into the learning process. The widespread of learning environments that integrate online learning and face-to-face learning may pose some opportunities as well as difficulties for some groups of students' self-regulation skills. Providing automated prompts may help to support those students with insufficient self-regulation skills. The use of learning analytics and multiple methods and data sources (data triangulation) may give better insight into the self-regulation process.

The objective of the proposed research is to explore the students' evaluation of the usefulness of prompts implemented in a blended learning environment. A secondary objective is to develop and evaluate a real-time dashboard designed to notify teachers of student responses to deployed prompts.

The research methodology will be grounded in action research and empirical research. The scientific contribution will be achieved through the development of artefacts and the performance of empirical research to advance understanding of the student's self-regulation in a blended learning environment.

Keywords

learning analytics, self-regulated learning, prompts, blended learning, dashboards, higher education

1. Introduction

In the past two decades, blended learning in higher education has been increasingly widespread [1]. The effectiveness of blended learning in relation to traditional learning is continuously reviewed [2,3]. Recently, Müller and Mildenberger [4] conducted a meta-analysis of scientific papers published from 2008 to 2019 and found that identical learning outcomes were achieved in blended learning as in a conventional classroom setting, with a reduction of time spent in physical space by 30 to 79% (division according to Allen et al. [5]). This research also revealed that it is not yet possible to identify for which specific competencies (or disciplines) a blended learning format is most appropriate.

Several teachers and institutions strive to develop personalised learning approaches in an effort to meet the needs of each student to the greatest extent possible. To be able to customise the approach, it is necessary to examine the views and habits of students. For example, information systems deployed in the teaching and learning process are sources of valuable educational data that may be used to monitor and assess the teaching and learning process

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[6], and play a vital part in the development of personalised solutions.

Learning analytics as a research area is focused on the "measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimising learning and the environments in which it occurs" [7]. The implementation of learning analytics is a complex process that requires capability building and certain specific competencies of stakeholders in the education system. In practice, learning analytics examples can be found at several levels (e.g., students, courses, programmes, institutions, and consortiums of institutions) [8]. When applying learning analytics, technology should be used wisely taking into account existing educational concepts and research knowledge [9].

Tsai et al. [10] provided an overview of trends and limits in the deployment of learning analytics in the European higher education system. According to their research, teachers and teaching staff are the primary users of learning analytics, and there is limited evidence of active engagement with students and the use of learning analytics to improve self-regulated learning skills.

Self-regulated learning includes cognitive, metacognitive, behavioural, motivational, and emotional aspects of learning. This area has been extensively researched in the field of educational psychology, and among the best known and most applied models is the Zimmerman's model of self-regulated learning, that consists of three main phases: (a) forethought, (b) performance, and (c) self-reflection [11]. Wong et al. [12] in a systematic review of self-regulated learning in an online environment and massive open online courses (MOOCs) demonstrated the need for further research of self-regulated learning in an online environment, particularly through an empirical approach. Furthermore, Viberg et al. [13] examined empirical research in which learning analytics were used to improve self-regulated learning and concluded that few studies related to the self-reflection phase of the Zimmerman model, and that the majority of research focused on measuring self-regulated learning and less on support.

In previous research, feedback and prompts have been identified as the most important elements that encourage self-regulated learning [12]. Prompts are "visual, textual, or spoken elements that the teacher uses to encourage understanding and are most often in a form of questions, although they can also be formulated in the form of advice or instructions" [14]. Another definition of prompts is "short hints or questions presented to students in order to activate knowledge, strategies or skills that students have already available but do not use" [15]. Additionally, students do not usually manifest self-regulated behaviour spontaneously without guidance [16]. Despite the fact that the research revealed a number of potential advantages of prompts for self-regulated learning, Schumacher and Ifenthaler [17] reported that learning analytics approaches have not been thoroughly examined during prompt implementation, and that future studies should also focus on the student's responses to prompts.

The proposed research will also consider learning design as an important element in educational interventions.

Specifically, these research questions will drive the proposed research.

RQ1: To what extent are students aware of self-regulation elements, such as metacognitive activities before/during/after learning, environmental structuring, help seeking, and time management in the blended learning environment?

RQ2: In a blended learning environment, which types of prompts (cognitive, metacognitive, motivational, or content-related) do groups of students find most useful?

RQ3: Is there a difference in perceived usefulness of the same type of prompt based on the mode of learning (online and face-to-face)?

RQ4: How does the implementation of specific prompts affect

(a) student's engagement

(b) results achieved in formative assessment

(c) overall learning satisfaction?

What distinctions exist amongst student groups?

RQ5: Which components of the real-time dashboard for displaying student feedback on prompt implementation are important to students and/or teachers?

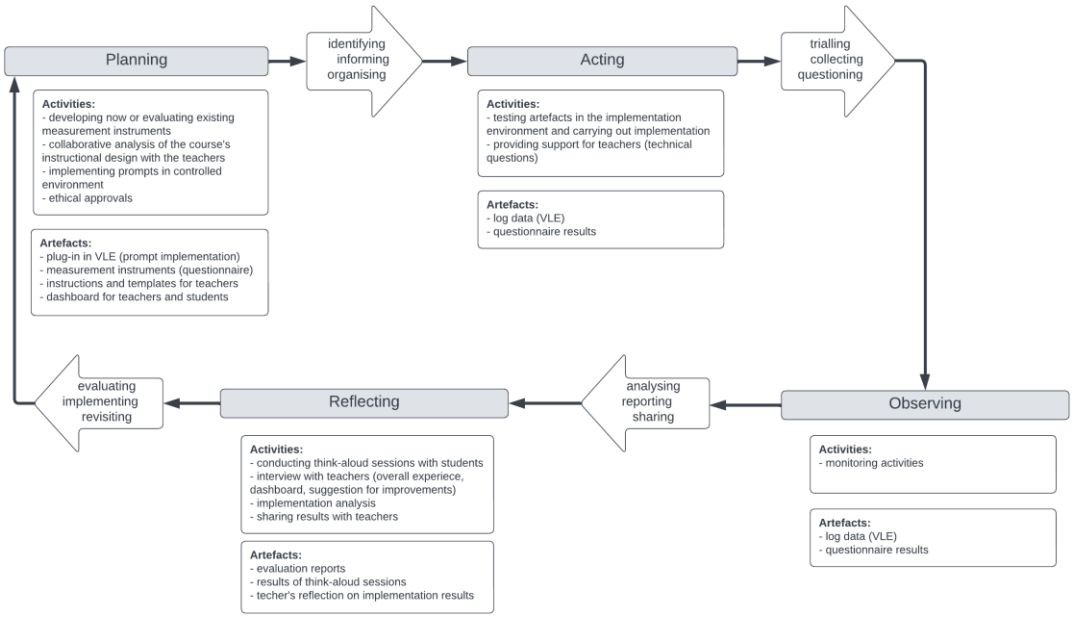

Figure 1: Proposed activities and key artefacts based on steps in Somekh's action research process (Source: Author)

2. Methodology

This proposed research will utilise a mixed-method practical action research design. According to Creswell [18], action research is used to address specific, practical issues that seek solutions to a problem, and both quantitative and qualitative methods may be employed. Somekh [19] proposes a four-step process for action research: planning, acting, observing, and reflecting. The proposed activities in each action research step and key artefacts are shown in Figure 1. Several research methods, including descriptive statistics, natural language processing methods (open-ended questions), statistical analysis, and nonparametric tests, will be utilised for data analysis. For statistical analysis, the statistical programming language R [20] will be used.

2.1. Planning

The initial literature review showed the research gap in the area of learning analytics approaches in investigating prompts for supporting students' self-regulation. During the preparation phase, an additional literature review will be conducted to synthesise the findings of prior research, identify appropriate measurement instruments, and provide an overview of the outcomes of prior empirical interventions.

The intervention will be designed as an iterative process, with a pilot trial followed by the main study. The interventions are intended to be implemented at two higher education institutions in Croatia, aiming to target around 340 students and 3 teachers. Ethical approval from participating higher education institutions will be obtained.

Teachers will be closely involved in preparations for implementation (analysis of current learning design of a course, defining specific goals of prompt implementation, finding appropriate learning types, and defining prompts based on selected models).

During this phase, the appropriate measurement instruments will be evaluated (linguistic evaluation) or, if necessary, a new measurement instrument will be developed.

2.2. Acting

This activity is a key component of the research proposal. During this phase, the developed artefacts will be used in the real environment.

The dominant research method used will be pretest-posttest nonequivalent groups design, a type of quasi-experimental design. One group of students will be exposed to an intervention, while the other group will not. The two groups will then be compared. According to previous research [21], in order to eliminate confounding variables, the duration of exposure should not be excessively long (preferably 2 - 4 weeks).

Before the intervention, a priori statistical power analysis will be conducted to determine the required number of outcome observations.

During this stage, the measurement instruments will be evaluated in a real environment.

2.3. Observing

In this phase, monitoring activities and providing teachers with adequate technical support will be the primary activities. Data will be collected via system logs, measurement instruments and prompt feedback.

To monitor student progress, teachers will have access to a real-time dashboard with visualisations of student responses.

2.4. Reflecting

Teachers will receive the intervention results during the phase of reflection. In addition, they will assess the real-time dashboard that was accessible during the observing phase.

In addition, a think-aloud protocol [22] will be implemented to collect specific information about students' and teachers' experiences with prompt implementations.

3. Current results

A literature review with the focus on available measurement instruments (self-regulated learning, engagement, satisfaction and other relevant constructs) is currently in progress.

Based upon the initial reading of the literature and good practice identified, a prototype of plug-in for prompt implementation has been developed in Moodle LMS Platform (Figure 2). The plug-in makes it possible to embed prompts wherever an HTML editor is available.

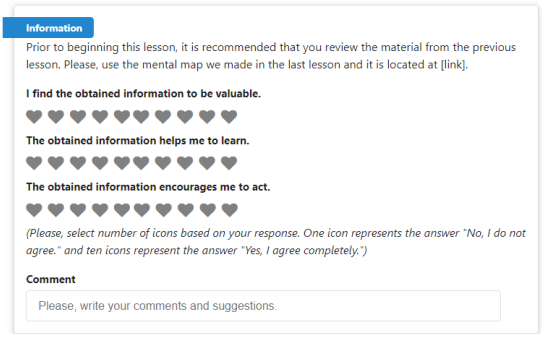

Figure 2: Prompt prototype. Students could rate prompts and give textual feedback (Source: Author)

Prototype of teacher's dashboard has been also developed (Figure 3).

Figure 3: Prototype of teachers' dashboard providing real-time monitoring of student's responses (Source: Author)

In order to test the feasibility of the proposed study, pre-pilot study has been conducted. 38 students gave consent to participate in the pre-pilot study. The students were second-year students of the informatology programme at the Faculty of Humanities and Social Sciences. 36 out of 38 students were female, while two were male.

Lessons learned from the pre-pilot study:

- the suggested plug-in is appropriate for prompt implementation and gives considerable design flexibility with respect to learning design
- students are more likely to rate prompts during face-to-face meetings than during online sessions
- the teacher acknowledged the advantages of monitoring student responses, and the input gained could be useful for designing course improvements
- think-aloud sessions conducted with two students gave valuable insights into the perception of implemented prompts
- adjustment of rating scale should be considered (10 or 7-level scale)

- it would be useful to collect additional demographic information in order to better understand behavioural differences among students.

4. Contribution to TEL domain

The expected contributions of the proposed research to the Technology Enhanced Learning (TEL) domain are:

- synthesis of empirical interventions and the results on supporting self-regulated learning with prompts using learning analytics in a blended learning environment
- development and evaluation of artefacts related to prompt implementation in real environment
- better understanding of students' self-regulation in blended learning environment using prompts
- results of empirical research on supporting self-regulated learning in blended learning environment using prompts and learning analytics. After completing experimental part of the proposed research, differences across student groups can be expected in terms of student engagement, formative assessment outcomes, and overall learning satisfaction. The combination of accessible students' demographic information with their responses and system data will provide insight into students' self-regulation practises and awareness.

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