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Effects of a Mobile Performance Support System on Students' Learning Outcomes

Wendy Kicken

Open University of the Netherlands, Centre for Learning Sciences and Technologies
Valkenburgerweg 177, 6401 DL Heerlen, The Netherlands
Wendy.Kicken@OU.nl

Slavi Stoyanov

Open University of the Netherlands, Centre for Learning Sciences and Technologies
Valkenburgerweg 177, 6401 DL Heerlen, The Netherlands
Slavi.Stoyanov@OU.nl

Abstract. Mobile performance support system (mPSS) adapted from Electronic Performance Support system (EPSS) used in industry, is a promising approach to increase students learning outcomes in educational settings. MPSS focuses on helping students to perform an authentic task with minimum support of others, providing them with sufficient information such as expert advice and procedures, just-in-time. Providing this support on a mobile device enables students to make their learning more efficient and relevant. To examine the effects of this approach on students' performance five pilot studies will be conducted (starting in May 2010) at five different courses provided at three different universities in Bulgaria and Spain. In addition students and teachers will be interviewed to examine their perceived effectiveness of the mPSS. Results will be used to formulate practical implications for the implementation of a mPSS.

Keywords: mobile performance support system; learning outcomes; students' perceptions; teacher's perceptions; triangulation.

Introduction

Performance support system (PSS) is a promising approach in business and industry training to empower workers to perform tasks with a minimum amount of external intervention or training (Gery, 2002). The idea of PSS could also be introduced in the field of education, making the learning process more performance-centred (Puterbaugh, 1990). In a performance-centred approach to learning this would mean that students are instructed to perform an authentic task, related to their future job, and are provided with access to a full range of information such as data, images, advice, tools, assessment and monitoring systems (Raybould, 1991), while performing this task. The support helps students to perform the task at hand with minimum support provided by others. One medium through which this support and information can be provided is by a mobile device. The use of *mobile* performance support system (mPSS) is further investigated in the pilot studies described in this paper. Mobile technologies offer the opportunity to embed learning in a natural environment. Furthermore, given the trend to lifelong learning, many 'students' are working adults with full-time or part-time jobs. Mobility offers them an opportunity to maximize learning time and to learn anywhere, anytime.

However, in order to be effective, it is important that the mPSS which is implemented in education is relevant and supportive for the different types of learning processes students can engage in (Leigh & Spindler, 2004). Different types of learning processes require different functionalities of the mobile devices. For instance, for learning processes in which information is studied independently, the mere distribution of structured information is sufficient. Learning processes which involve the acquisition of complex knowledge and skills require expert advice and performance support. Learning processes related to the construction of new knowledge or ideas requires the possibility of interaction with the environment and to brainstorm with others. By basing the design and use of mobile technology on the aforementioned processes, the mobile technology will have a meaningful contribution to the learners'

performance and learning (Laurillard, 1993; Raban & Litchfield, 2007). In the pilot studies, the mPSS will focus on both the distribution of structured information for individual processing and expert advice and performance support for complex knowledge and skill acquisition.

To evaluate the effects of a mPSS it is important to evaluate the effects of the system on the learning processes for which it was designed. The evaluation of the impact of mobile devices on learning and teaching is in research on mobile learning often an underestimated issue or it is dominated by anecdotal reports. Experiments have been used rarely and a combination of both quantitative and qualitative methods for data collection and analysis is often not considered as necessary. Ignoring the use of powerful methods for data collection and analysis considerably reduces the opportunity for making scientifically grounded conclusions, recommendations and predictions about the use of mobile devices for educational and training purposes.

In the pilot studies described in this paper, a post-test experiment-control group design is used, in which the effects of mPSS on students' learning outcomes and students' and teachers' perceptions of the effectiveness, efficiency and usability of the mPSS are investigated. The evaluation methodology used in these pilot studies combines both quantitative and qualitative methods for data collection and analysis and involves both students and teachers

It is hypothesized that the mPSS will help students to adapt the learning environment to their needs and to consult information just- in-time, which will have a positive result on their learning outcomes. Regarding the perceptions of the users of the mPSS (i.e., the students and their teachers) it is hypothesized that the feeling of being in control of when to learn, what to learn and to ask for support when needed, will have a positive effect on students' motivation. Teacher's appreciation of mPSS is expected to increase due to positive effects observed in their students' learning results and motivation.

At the time of writing, the development of the course material for mobile learning has finished and subscriptions for the courses are closed. The pilots will start in the first week of May and will last 4-6 weeks. The results of the pilots will be presented during the Earli Sig 6&7 conference.

Method

Participants

In total 139 students participate in one of five courses provided at either a Spanish university for distance education or one of two traditional Bulgarian universities. Students voluntarily decide whether they want to learn the topic by means of a traditional course (i.e., e-learning for distance education, or face-to-face meetings in traditional education) or by a course with mPSS. In total 11 teachers are involved in the pilot studies. Table 1 provides an overview of the courses provided at the universities and the number of students involved in the experimental and control condition.

Table 1. Overview of students in experimental and control condition per course.

Course title	University (country)	# students	
		Experimental condition	Control condition
Introduction to ITIL	UNED-DIEEC (ES)	20	15
Microprocessor architecture	UNED-DIEEC ()	15	15
Information Technology	Plovdiv University (BG)	20	20
Microelectronics	Sofia University (BG)	12	12
Electronics	Sofia University (BG)	10	0
	Total	77	62

Materials and measurement instruments

Course material. The course material (e.g., text, figures, graphs, powerpoint slides) from five existing courses provided at the universities involved in the pilot studies was redesigned to fit the standards for a mPSS. The course itself was already designed according to the principles of performance support system, including an advisory component, an information component, a training component, and an user-interface component (Mileva & Tzanova, 2002; Stoyanov et al, 2008).

Learning style questionnaire. Because students' learning style might influence the effectiveness the mPSS, the short 40-items Learning Style Questionnaire (LSQ) of Honey and Mumford (1992) is used to identify students' learning style (i.e., activist, reflector, theorist, or pragmatist).

Think aloud protocols. To investigate how students perceive the effectiveness, efficiency and usability of the mPSS, students are asked to perform two tasks in which they use the mPSS (e.g., upload a task and the necessary performance support to your mobile device) while they are at the same time encouraged to think out loud. The think aloud session is recorded, transcribed and analyzed.

Learning outcomes. To measure students' learning outcomes, students' grades for the performance tasks completed during the course are gathered.

Reflective questionnaire. The reflective questionnaire contains 30 open and multiple choice questions asking for students' opinion on: the effectiveness of the learning environment on students' performance, the effects of the learning environment on students' motivation, and the usability of the learning environment. Students' opinion is measured on a 4-point scale (1 = I totally agree, 4 = I totally disagree). The learning environment pertains in the experimental conditions to the mPSS and in the control condition to the traditional learning environment, which is face-to-face meetings or e-learning environment.

Interviews with students and teachers. Information on the experiences with the mPSS and its effectiveness on performance and motivation are examined by means of individual semi-structured interviews with both students and teachers. Interview questions pertain to (a) use of the mPSS, (b) perceived effectiveness, (c) perceived usability, and (d) directions for improvement of the mPSS.

Procedure

During the first week of the course, all students fill out the 40-items Learning Style Questionnaire. In the third week after the start of the course 10 students in each course perform a think aloud protocol. At the end of the course all students fill out the reflective questionnaire. Next, 10 students and 1 teacher of each course are individually interviewed.

Conclusion

The diversity of the students and the courses helps to gain more insight in factors that can positively or negatively influence the effectiveness of mPSS with respect to students' learning outcomes and perceived effectiveness. The results of the pilot study are used to formulate practical guidelines for the implementation of a mobile performance support system.

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