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User behavior in multi-screen eLearning

Atis Kapenieks[a]*, Bruno Zuga[a], Aleksandrs Gorbunovs[a], Merija Jirgensons[a], Janis Kapenieks sr.[a] , Janis Kapenieks jr.[a] , Ieva Vitolina[a], Ginta Majore[a], Guna Jakobsone-Snepste[a], Ieva Kudina[a], Kristaps Kapenieks[a], Zanis Timsans[a], and Rudolfs Gulbis[a], Dzinatrs Tomsons[b], Lasma Ulmane-Ozolina[b] and Janis Letinskis[b], Antra Balode[c]

[a]*Distance Education Study Centre, Riga Technical University, Kronvalda bulvaris. 1, Riga, LV-1010, Latvia*
[b]*Liepaja University, Liela iela. 14, Liepaja, LV-3401, Latvia*
[c]*Latvia University of Agriculture, Lielā iela 2, Jelgava, LV-3001, Latvia*

Abstract

This article reports on the progress we have achieved as we continue to pilot new approaches using an eEcosystem that is based on a multi-screen concept to support e-learning. Here we recap our recent progress with the project JAUZI/eBig3 that is a multi-screen e-learning development. The approach effectively integrates the popular technologies of television, Internet, and mobile phones. It is a new way of using technology to support and encourage engagement in the lifelong learning process. Here we present the results of ten course pilots offered in 2013 with the eBig3-learning format as well as the teacher training courses offered by the MII project (Modern Education of Interests) in 2014. The target group of eBig3 courses was general public, but for the MII courses it was teachers. We compared the user behavior data from the various presented courses with the number of learning objects to the number of users. We found that the multiscreen eLearning approach with eBig3 increased eContent availability and in selected courses user motivation in optional courses trend to reach the motivation level of mandatory courses.

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Keywords: e-learning; m-learning; t-learning; Learning support; Messaging system; Multi-screen learning; Technology enhanced learning

* Corresponding author.
E-mail address: atis.kapenieks@rtu.lv

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1. Introduction

Each big breakthrough in education technology has announced and encouraged the creation of a new type of learning [1]. TV-education was inspired by the large scale penetration of television into people's homes; m-learning developed and gained popularity with proliferation of smart phones[2,3,4,5,6,7,8,9]. E-learning initially was regarded as a Personal Computer technology for education. Nowadays we usually refer to all digital education technologies as e-learning. The new challenge is when learners are using all three technologies to suit their style and convenience. Developers, however, design separate approaches for each of the three big learning technologies. Our approach seeks to meet the challenge of applying e-learning, m-learning and t-learning at the same time and adjusting them to the habits of users. To achieve this goal, we use an eEcosystem approach that is calibrated to user preferences.

This article reports on the progress of our continued pilot studies with the multi-screen concept as an approach to e-learning. In the initial eBig3[10] approach, we assigned a complimentary role for TV, Internet, and the mobile phone to ensure high quality user-friendly learning. The eBig3 approach has the capacity to respond to the skills and preferences of a large target group of users that spans all age groups of the life-long learning context. The approach is flexible and easy to use. It can reach, deliver content, and learning support to a diverse group of users and does not require continuous upgrading of technology and special skills[11]. It matched the requirements of the target group of the eBig3 courses that, of course, was the general public.

Another pilot project MII (Modern Education of Interests) was based on our previous eBig3 experience where the target group of the developed courses were public school teachers. The project objective was to train teachers to use various technological learning enhancements and later to organize school interest learning circles on:

audio/video preproduction, production, and postproduction;
mobile device applications and software;
designing and programming robots.

The teachers represented various subject areas: Science and mathematics, the social sciences, and the humanities. The short video material with learning objectives was prepared for each unit and presented in MII virtual learning environment. Learning environment contained also printable materials, presentations, exercises and tests. Registration to the learning environment was simple and fast. All that was needed was to send an SMS giving first and last name. The course format was organized into four full-day face-to-face seminars and a two hour webinars every evening except Sundays. Additionally, participants received SMS reminders outlining topics along with invitations to tune in for the webinars that took place every evening. All the webinars were recorded and made available in the MII virtual learning environment. The webinars were well attended. Often teachers' family members also joined. The teachers who were busy in evenings had an option listen to the webinars later at their convenience.

We compared user activity in the mandatory university e–courses, and multi-screen eLearning eBig3 courses (mandatory and optional). We used Mann–Whitney U non-parametric tests for testing distribution between two independent samples.

2. Related work

Multi-screen e-learning solutions are based on widely available, popular technologies; television, computers, and the internet. These devices were initially designed for other tasks such as audio-visual media activities, information retrieval, computing and communications. Technological progress has enabled many other applications, important among these is learning.

Although television still dominates audio-visual media consumption, the development and proliferation of other media devices such as laptops, tablets and smartphones over the last decade has given users wide access and choice for electronic interactions[12,13,14,8]. Accessibility and availability of multi-media consumption devices offered users

new multi-screen interaction opportunities and inspired novel usage scenarios. It is also true that due to computer processing power growth and broadband, TVs have outgrown their original purpose and are starting to be used as a substitute for PC in performing multiple tasks. Likewise, mobile devices are assuming many of the media interaction tasks initially available only on PCs[15,16].

At the same time, e-learning opportunities have been significantly expanded beyond the single (PC) platform, creating the preconditions for an integrated approach to technology enhanced learning. This potential has also created challenges for e-learning designers due to the variation of technology requirements across platforms and the necessity to find solutions for an integrate technology for e-learning delivery. Moreover, insufficient in-depth research of learners' behaviour in a multi-screen environments and limited understanding of how the behaviour changes due to new technology developments, adds complications to designing an appropriate multi-screen learning solution.

Proliferation and availability of connected computing devices have extended e-learning delivery opportunities

The most serious problem for meaningful e-learning delivery is the high dropout rate from these courses. When the number of students who enrol is compared to the number who actually receives certificates, the difference is staggering. This is especially true for the free university courses or MOOCs. Studies report dropout rates as being between 85%-95% on the average[17,18]. To address this issue, we have designed special SMSs and emails to provide user and teacher support for an integrated and efficient e-solution[19,10]. This paper presents some of our outcomes in our developing eBig3 multi-screen e-learning solution.

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3. Multi-screen eLearning concept

The multi-screen eLearning concept idea is to find the most efficient approaches and deploy the existing eEcosystems for next generation life-long-learning. The most typical components of user eEcosystem are computers, mobiles, and TV-sets.

The multi-screen eLearning course prototype consists of up to three kinds learning content intended to fit each media type: t-content, e-content, and m-content. An example of pure t-content is a Discovery channel documentary while an example of pure e-content is an e-course with text based content. M-content examples abound with the many mobile applications available for learning. Fig. 1. diagrams our concept of an eEcosystem and the relationship of the popular technologies that it contains.

In the eEcosystem we applied popular technologies like MOOCs and TV inquiry/voting. We also applied ELU technology (Enhanced Learning Unlimited) that was designed and developed in EU 6th Framework project. The features of the ELU project that we focused on were the development of methodology, the design and implementation of the technology required to enhance the Multimedia Home Platform into user-friendly e-learning creation environment and the development of specific content that demonstrated the changes that resulted from moving e-learning from its PC base to an interactive digital TV learning environment. By successfully applying these changes, we designed the model interactive TV suitable for t-learning content delivery and which enabled us to effectively implement our t-courses. The T-content was later evaluated by users at university and municipality environment. Feedback was positive and viewers have indicated interactions being meaningful enhancement to the video. Only few complained about the additional complexity during the video watching. The technology was built on MHP (Multimedia Home Platform) and user-friendly, but the IP TV technology superseded broadcast television interactivity in the following years. The ELU project, however, challenged us to look for new more accessible approaches to technology enhanced learning.

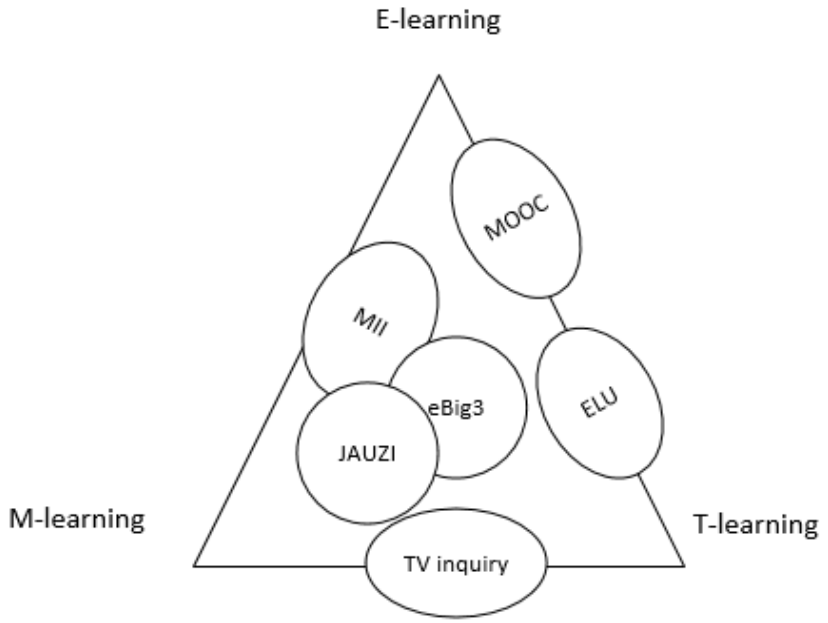

Fig. 1. Diagram of an eEcosystem and the relationship of the popular technologies that it contains.

Our next step after careful analysis of the existing eEcosystem was to develop a multiscreen eLearning approach that became the triple-screen version eBig3[10]. The new approach significantly improved user access and notably decreased the drop-out rate[20]. To match twenty-first century learning habits, we developed a new eEcosystem that effectively supported the contemporary learning style of the eBig3 approach. The focus was no longer on traditional text-based learning but addressed a multiple of learning strategies.

A boost for the development of contemporary learning strategies was the rise of video recording quality, along with improved editing and presentation techniques that created new opportunities for education technology design.

Our first large scale venture in contemporary educational design was the project Open Courseware in Riga City public portal in 2004. The content proved very popular, and received million mouse clicks in Latvian speaking community with size two million people.

The recent upsurge of MOOCs supports the trend that video content is gradually replacing text-based content. MOOCS are still ahead in supporting contemporary learnings styles that prefer knowledge transfer technology that are broadly encompassing and can support a wide range of learning strategies and processes.

The contemporary learning strategies were applied to the multi-screen eLearning MII project. MII was a dynamic and popular solution for teacher training in Latvia in 2014. The MII model will again be used in the 2015 teacher training project that is upgraded with enhanced features.

Our latest concept for advanced eLearning was the project JAUZI. The focus of the project was the problem that insufficient learning support had been given in traditional eLearning settings and was the key obstacle to the broad deployment of eLearning. Moreover, it was a cause for the high drop-out rate from these programs. As a solution, we developed an algorithm to track user trajectories and to identify problem areas. The specific support provisions we designed are based on a multiple messaging system: SMSs to users, to teachers and also emails to users and

teachers. The JAUZI support system is designed respond to potential critical actions in learners' behaviour and to quickly provide a remedy[21].

4. User behaviour in an eLearning eEcosystem an discussion

As an approach to study user behaviour in various eLearning settings within the eEcosystem, we recorded the number of mouse clicks users applied for each learning situation users participated in. The profile of user activities for each course is presented in **Fig. 2**.

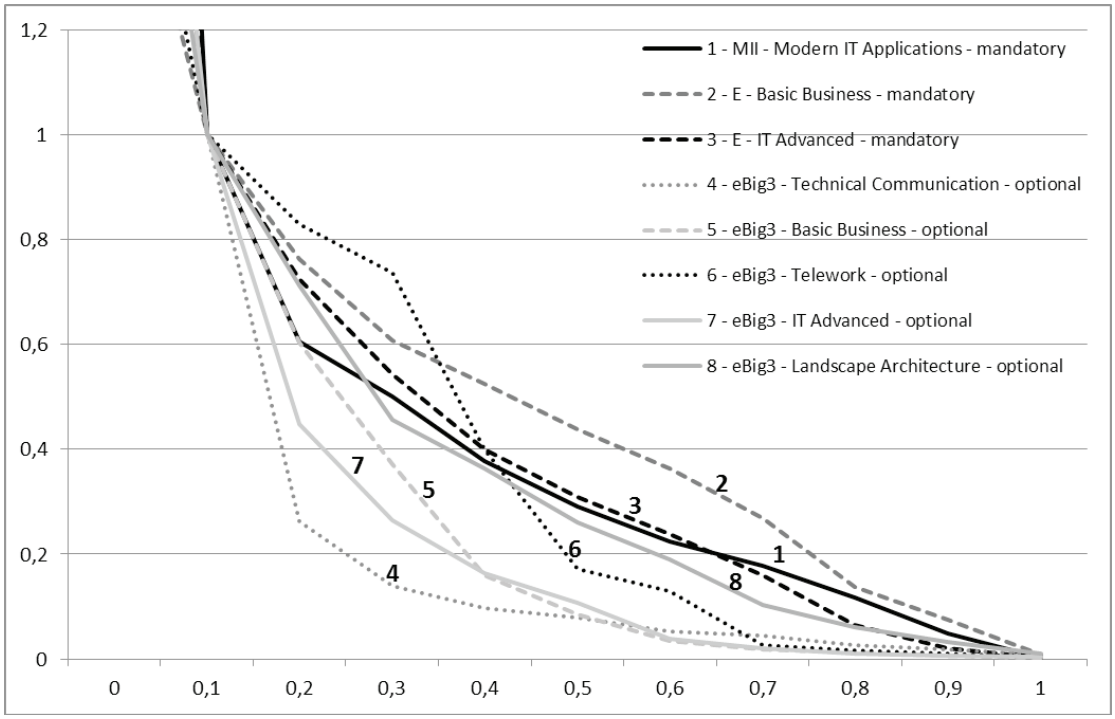

Fig. 2. User activity distribution (UAD) for different courses under various conditions:

We compared the data from the various presented courses with the number of learning objects to the number of users. We normalised the number of users at the number one while the mouse clicks were normalised at user 0,1 and the level was normalised at level one. The graphed curves for each course are diagrammed in Fig. 2. The normalised curves of the graph profile the effectiveness of course content and delivery approach in relationship to the target group's expectations.

The course delivery conditions varied according to their optional or mandatory status, subject area, content, and the project for which they were aimed. The course delivery conditions for Fig. 2 are presented in Table 1.

Table 1. Course content and delivery conditions.

No	Course content	Optional or Mandatory, target group	Subject area	Content
1	MII Modern IT Applications	Mandatory, teacher training	IT applications	
2	E-course Basic Business	Mandatory, student training	Business	The same as 5

3	E-course IT advanced	Mandatory, teacher training	IT advanced	The same as 7
4	eBig3 Technical Communication	Optional, adult training	Communication	
5	eBig3 Basic Business	Optional, adult training	Business	The same as 2
6	eBig3 Telework	Optional, adult training	Telework	
7	eBig3 IT advanced	Optional, adult training	IT advanced	The same as 3
8	eBig3 Landscape Architecture	Optional, adult training	Landscape Architecture	

The data in Fig. 2 and Table 1 show user activity distribution (UAD). The data in both diagrams indicate that user activity is higher for mandatory eCourses than for optional ones. That means that motivation in mandatory courses is higher because there is a stronger need to complete the courses. In most optional courses the motivation is lower because the participants can leave the course at any time for any reason. The reasons may vary and could include that users need only a limited part of the course content or achieve only a certain course level or they may not like the delivery approach or the content as well. The outlined UAD in mandatory courses identifies the limits of possible increase of motivation in optional courses. The UAD for optional courses varies among courses. The UAD in Landscape architecture and Telework course is close to the mandatory course UAD. That means that Landscape Architecture and Telework course participants are more highly motivated than participants in other more traditional courses. Users possibly expect on immediate benefits of new knowledge in gardening, and working at home. The diagrammed UAD has the potential to be a strong and dynamic quality indicator for eLearning courses. The monitoring of dynamic development of UAD data could be the powerful approach for specific course delivery support dictions and actions in multi-screen eLearning.

We compared user behavior in e-learning courses: optional eBig3, and mandatory MII and university e-courses. In order to determine the difference of UAD in different courses we used the Mann–Whitney U non-parametric tests for two independent samples.

Table 2. Mann–Whitney non-parametric test results between mandatory and optional courses with the same content (IT advanced).

Test statistics	User Behavior
Mann-Whitney U	120,000
Wilcoxon W	291,000
Z	-1,610
Asymp. Sig. (2-tailed)	,070

The results demonstrated that the test statistics do not exceed critical values and UAD distribution is equal among mandatory IT-advanced courses and eBig3 IT-advanced optional courses on probability level 95%.

5. Conclusion and future work

In the two projects we developed, we studied the user activity distribution (UAD) for e-learning courses given in different formats: mandatory university course, mandatory eBig3 teacher training course; and optional multiscreen eBig3 learning courses. The results showed that the multiscreen eLearning approach in the eBig3 project increased eContent availability as well as showed trends in user behaviour distribution. IT-advanced courses demonstrated that user activity in optional courses can reach the activity level of mandatory courses. In our future work, we plan to continue UAD studies for particular learning objects as well as for individual users. We plan to identify the key reasons for increase the optional course user activity up to the activity level of mandatory courses.

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