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Concept of Learner Behaviour Data Based Learning Support

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Abstract

In this article we present our developing progress with the multi-screen e-learning system initially developed and named as eBig3 system that gives users learning access by the means of computers, mobiles and TV, depending on their choice. In the new project JAUZI we build on our previous experience. We identified that insufficient learning support in traditional eLearning settings is the key obstacle to the broad deployment of eLearning and a cause for the high drop-out rate from these programs. As a remedy for this problem, we developed an algorithm to track user trajectories and to identify problem areas. Here, we present the analysis of the data we gathered and used to assign further user support provisions. The particular support provisions we designed were 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.

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Keywords: E-learning; Learning support; Messaging system; Multi-screen learning; Technology enhanced learning.

1. Introduction

Multiscreen 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

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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[1, 2, 3, 4]. Accessibility and availability of multi-media consumption devices offered users new multi-screen interaction opportunities and inspired novel usage scenarios[5, 6, 7]. 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[8, 5].

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 how the behaviour changes, especially due to technology developments adds, complications to finding an appropriate multi-screen learning solution.

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[9, 10]. To address this issue, we have designed special SMSs and emails to provide user and teacher support for an integrated and efficient e-solution[11, 12]. This paper presents some of our outcomes in our developing eBig3 multi-screen e-learning solution.

2. The Course delivery/support concept

In the eBig3 learning environment registration for a course is easy. Users simply send an SMS to an assigned phone number and give their name, surname and indicate a course number. Once received, the system simply logs users' personal data which is then saved. No need to request users' phone numbers since these are automatically registered along with the personal data and almost immediate a credentials file is set up. Users then receive an SMS giving the user name (usually their name) and password, and they can then access the course they registered for. The SMS and email communication system helps to maintain virtual contact with the learners. It strengthens the contact that is established in the seminars.

The system is managed by the Moodle Learning Management System (LMS) where the main e-content and activities are also stored. It ensures the efficient delivery of the course content and matches content delivery to learners' requirements such as learning level, volume, assessments and tests, and evaluations of the learning objectives.

Most significantly for our study, the LMS system also tracks user trajectories while they are logged into the course. This data is then read from the LMS log files, sorted and filtered by the JAUZI system (see Fig.1) to be ready for analysis. User behaviours are analysed by different predefined algorithms and appropriate responses are generated. With or without additional input (analysis) from the teacher the responses are then finalized and sent to users. The results of data analysis provide valuable information for the teachers and course developers.

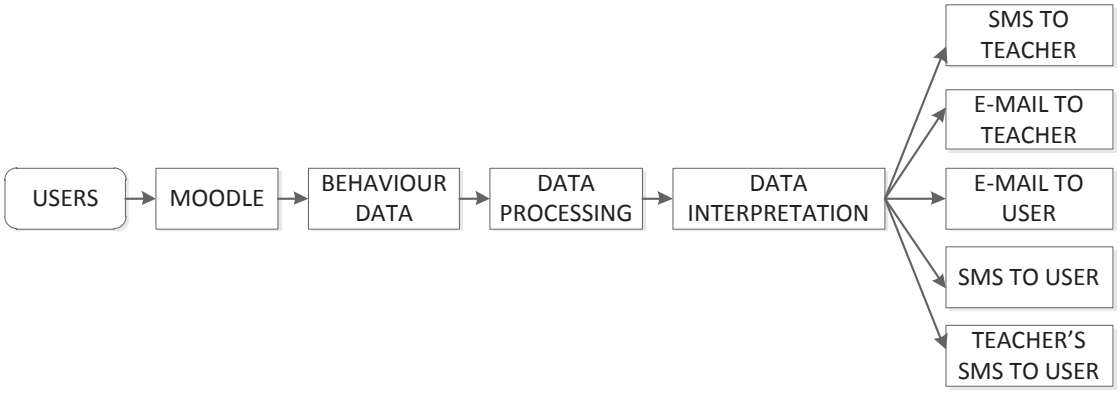

Fig. 1. eBig3/JAUZI data processing and interpretation diagram.

3. The JAUZI messaging group formation principles based on users behaviour interpretations

3.1. Data acquisition considerations

The JAUZI system's data processing model could be conceived of as a system that exploits basic information systems principles, including data input, data processing and data output[4] which are tailored with feedback links. The system oversees and manages the following activities: user registration, logins and logouts, course module activities, learning objects visiting duration and sequence, learning styles, and similar activities. These actions are then collected, processed and analysed against pre-identified criteria sets. From these results, user behaviours are flagged and they are batched with users exhibiting similar behaviours. Feedback is then generated by the system both in the form of SMSs and emails and users exhibiting certain behaviours are sent messages that give them relevant prompts (see Fig. 2). Learner response to the messages may prompt them to more active involvement in the course, and if successful will result in a message of praise and encouragement. All learner behaviours are measured and assessed.

In our study we have identified several external and internal factors that may impact on the users' activities and behaviours while engaged in the eBig3 learning system. For example, the efficiency of the technology of the course content delivery, the responsiveness of the learning support tools, how encouraging the collaborative e-environment become, how supportive the teacher-students' groups, as well as how actively teacher-student and student-student interact both in synchronous and asynchronous ways. Other important factors are task completion and assessments and the creation of new or re-used learning objects. All these identified factors may influence the learning process and students' behaviour within the system. We feel encouraged that the messaging system appears to cut down on the high dropout rate that is usual for e-learning courses. Our observations will be tested in further JAUZI system developments and piloting. Our previous results with the multi-screen eBig3 system showed that about half of the registered users finished their registered courses. These results were encouraging and a step in a positive direction.

JAUZI system could be considered as the aggregate instrument of innovative technological developments to enhance the learning process and reduce drop-out rates. When the JAUZI project was being launched the brainstorming team decided that the set of actions needed to be designed within the system.

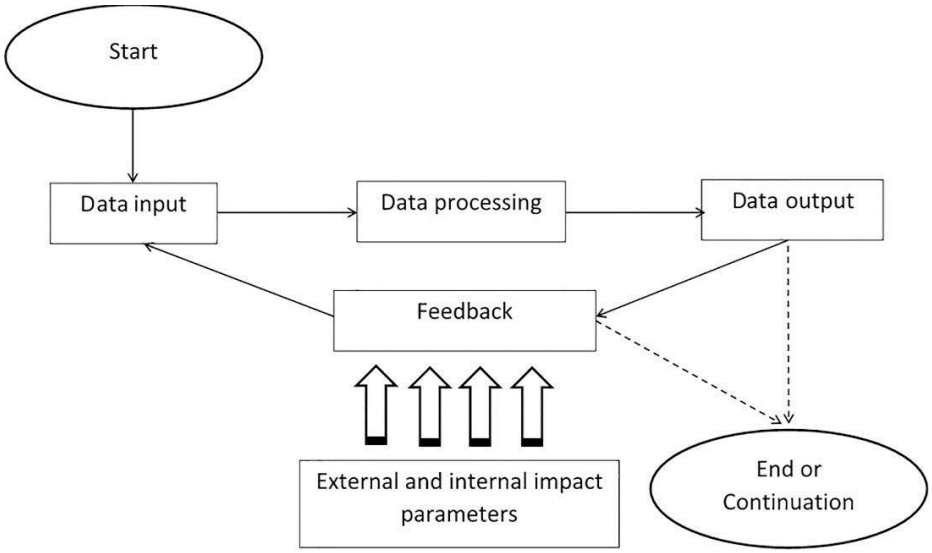

Fig. 2. Data processing general model (adopted from Laudons[4]).

The system's specification components as follow:

- A task reminder or "alarm-clock" for uncompleted tasks; viewed as the main component;
- Learning objects that are modern and ergonomic i.e. are eye-catching, graphic, and attractive;
- Tools for users to self-monitor the learning process;
- Tools to assess user accomplishments;
- Tools to make self-assessments;
- Ongoing feedback;
- Well planned exercises and tasks;
- Uploading and downloading capability;
- Reminders to users of upcoming events and activities (e.g. course tasks, exams, tests, blogs, group-work and similar activities);
- Self-assessment after each module or learning block to build on acquired learning and learn from mistakes;
- A mobile supportive user friendly e-environment;
- Learning support / a tutor within the virtual environment (both synchronous and asynchronous).

The JAUZI system needs to incorporate the following users preferences:

- Users want to self-manage learning but also be performance monitored;
- Users expect continuous feedback for various activities;
- Application need to be both computer and mobile phone savvy.

What can the JAUZI system give to users?

- It includes an independent assessment system;
- It may become part of an organisation's information system and act as a plug-in, for example;
- It will provide a service not generally available with other information systems such as self-management, but also performance monitoring;
- It will be geared to narrow marketing clientele; individuals who use both smartphones and computers daily;

- Smartphones users are more amenable to various modern applications including monitoring systems that act as prompts but at the same time are unobtrusive. The design of the messaging algorithms will be discussed in the next subsection of this paper.

3.2. Messaging group formation proposals

People are individuals and must be treated as such. They differ physically, but most relevant to the JAUZI project, psychologically and mentally. These differences inform their learning behaviors and styles. Therefore, a learning system such as JAUZI must be tailored to their needs and requirements.

We think that our previous positive experience with the eBig3 triple-screen approach[13] has allowed us to build on our success. The learner participation increased as the courses developed. Users became more active and their numbers grew. User feedback indicated that they felt encouraged by the messages and viewed them as a factor that kept them from dropping out[11].

We also learned during the course of eBig3 development that users were unique and required a more individualized approach. Moreover, we were able to identify that learner behaviours occurred in patterns and that these patters reoccurred with a number of users. As a result, we were able to assemble learners into batches according to behaviour patterns exhibited and respond with appropriate SMSs or email messages from the messaging repository. According to our results from user feedback we were able to identify several behaviour patterns. From these we were able to formulate messaging situational requirements that are diagrammed in Fig. 3:

- Learning time and style does not exceed by 20% the “ideal” learning acquisition pace;
- Learning time is 20% longer than the “ideal” acquisition pace; text dominates the learning style;
- Learning time is 20% longer than the “ideal” acquisition pace; the video dominates the learning style;
- Learning time is 20% longer than the “ideal” acquisition pace; the tests dominate the learning style;
- Learning time is 20% shorter than the “ideal” acquisition pace; the text dominates the learning style;
- Learning time is 20% shorter than the “ideal” acquisition pace; the video dominates the learning style;
- Learning time is 20% shorter than the “ideal” acquisition pace; the tests dominate the learning style;
- The user applied for the course but has not started learning as yet;
- The user has started learning, but his account has not been active more than two weeks.

So called "ideal" knowledge acquisition pace, noted in the first seven feedback groups was determined and designed by a team of course testers. The “ideal” pace was calculated as the average time spent in learning object acquisition and the time it took to follow the modules through in sequence. The JAUZI system will need to develop suitable measurement data and identify departures from the “ideal” learning acquisition pace. For each of the identified departures, the project will need to design appropriate messaging groups and store them in the information repository. The noted 20 percent deviation parameters are still under discussion. To set these messaging groups, at the first approximation we have applied Pareto principle[14]. The scaling for the parameters may be changed in accordance with course complexity. Observation and analysis of user learning style preferences will assist in determining time limits, selecting suitable learning objects and identifying convenient learning paths.

Fig. 3 below diagrams nine learner groups and their responses to messaging within the JAUZI system. The diagram indicates that messaging encourages learning motivation. It also signals a warning that after a two-week period of inactivity steps need to be taken to prompt users to return to the learning process; otherwise there is the danger that users will drop-out (see Fig. 3 in the group “Students-9”).

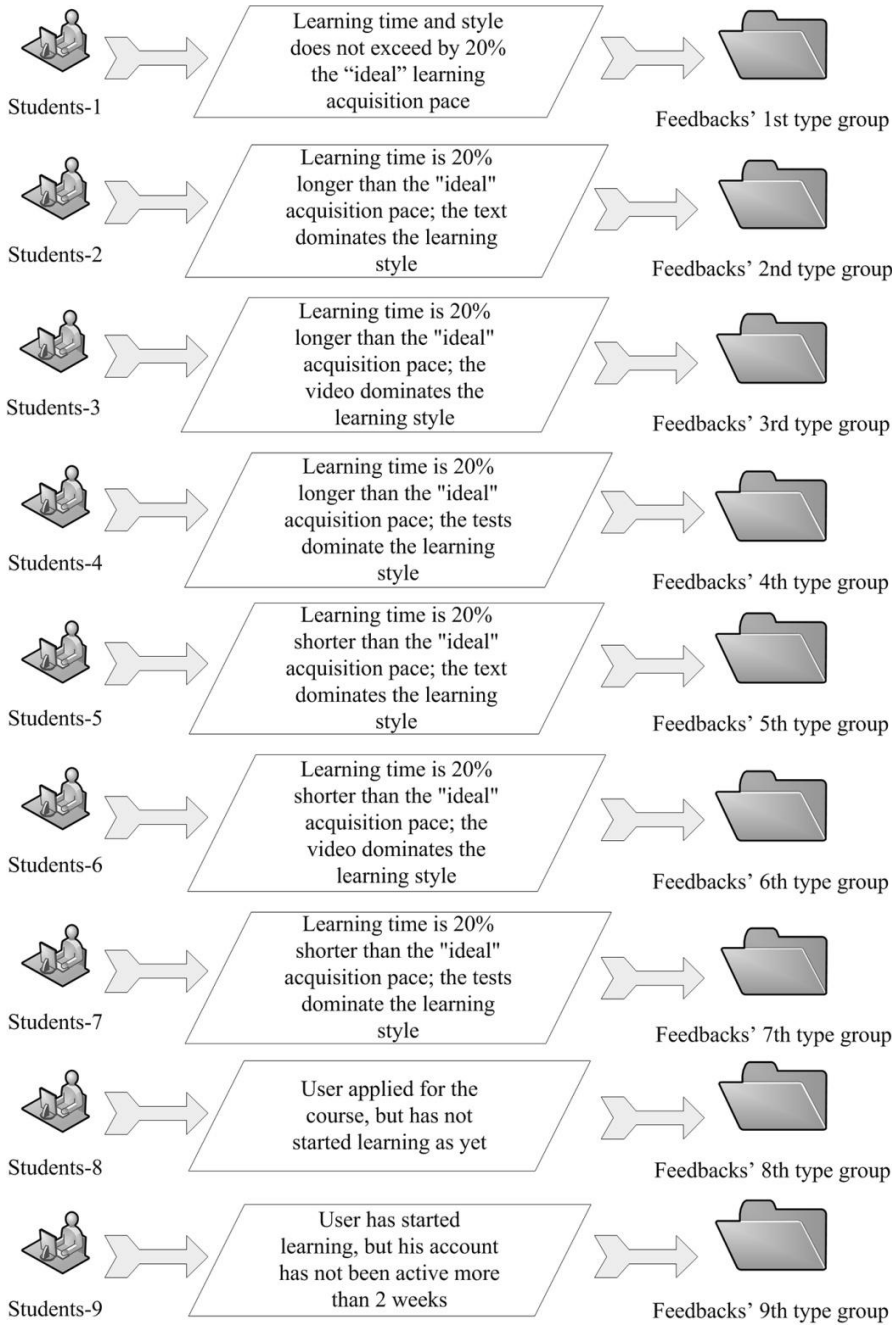

Fig. 3. Messaging group formation model.

Moreover, our eBig3 experiences alerts us not to forget those potential learners who have applied for the course and were registered by the system but have not started any learning activities (see Fig. 3 in the group "Students-8").

Timely feedback and an encouraging reminder can help engage registered student in course activities. The frequency of reminder messages depends upon the course structure and schedule, on the average they may be sent twice a month.

4. Conclusion

Multi-screen systems like eBig3/JAUZI meet the needs of lifelong learning of tomorrow better than the traditional single-screen based eLearning environments; mainly because the new devices and new electronic interaction modes becoming available to increasing share of population. This provides additional flexibility for participation in learning activities on users' terms; respecting their needs and wants to a greater degree. Obtained data indicate that learners' motivation to continue learning with multi-screen system can be greatly enhanced by additional support activities. Moreover, the data shows that user participation in course activity can be increased with daily SMS messages inviting learners to explore new content and participate in webinars. Reminder messages help to keep users engaged and make their course participation more regular and predictable.

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References

1. Covey, N. *How People Watch – the Global State of Video Consumption*. A global Nielsen consumer report. 2010.
2. Ericson. TV and Media 2014 - Changing Consumer Needs Are Creating a New Media Landscape. In: *An Ericsson Consumer Insight Summary Report*. SE-126 25 Stockholm, Sweden: Ericsson; 2014.
3. Enoch, G., and Johnson, K. Cracking the Cross.Media Code: How to Use Single. Source Measures to Examine Media Cannibalization and Convergence. *Journal of Advertising Research*, 50; 2010.
4. Turrill, D. *A Look Across Media - the Cross-Platform Report*. SVP Insights Nielsen; 2013.
5. Jenkins, H. *Transmedia Storytelling. Moving Characters from Books to Films to Video Games Can Make Them Stronger and More Compelling*. Technology Review; 2003.
6. Veglis, A. Modeling Cross Media Publishing in Radio and TV Stations. In: *Second International Conferences on Advances in Multimedia (MMEDIA)*; 2010. p.196-201.
7. Laudon, K., C., and Laudon, J, P. *Essentials of Business Information Systems (7th ed.)*. Pearson: Prentice Hall; 2007. p.432.
8. Bassbouss, L., Tritschler, M., Steglich, S., Tanaka, K., and Miyazaki, Y. Towards a Multi-Screen Application Model for the Web. In: *IEEE 37th Annual Computer Software and Applications Conference Workshops (COMPSACW);* 2013. p.528-533.
9. Yousef, A., M., F., M., Chatti, A., Schroeder, U., and Wosnitza, M. What Drives a Successful MOOC? An Empirical Examination of Criteria to Assure Design Quality of MOOCs. In: *IEEE 14th International Conference on Advanced Learning Technologies (ICALT)*; 2014. p.44-48.
10. Conole, G. MOOCs as Disruptive Technologies: Strategies for Enhancing the Learner Experience and Quality of MOOCs. 2013. Retrieved: 29.08.2014, URL: http://www.um.es/ead/red/39/conole.pdf.
11. Kapenieks, A., Zuga, B., Stale, G. and Jirgensons, M. Internet, Television and Mobile Technologies for Innovative Learning. In: *International Scientific Conference on "Society, Integration, Education" 2012*. Rezekne: RA; 2012. p.303-311.
12. Kapenieks, A., Zuga, B., Kapenieks, J.(sr.), Majore, G., Jirgensons, M., Ozoliņa, A., Apinis, B., Vītoliņa, I., Gorbunovs, A., Kudiņa, I., Kapenieks, J. (jr.), Gulbis, R., Treijere, M., Slaidiņš, I., Jakobsone-Snepste, G., Gibze, S., Kapenieks, K., Tomsons, Dz., Ulmane-Ozolina, L., Letinslis, J., Cakula, S., Balode, A., Blija, T., Vilkonis, R., Cibulskis, G., and Rutkauskiene, D. eBig3: A New Triple Screen Approach for the Next Generation of Lifelong Learning. In: *Recent Advances in Computer Science*. Rhodes Island: WSEAS; 2013. p.306-310.
13. Gorbunovs, A., Kapenieks, A., Kapenieks, K., and Jakabsone-Snepste, G. Advances of eBig3 Course Implementation and a Vision on the ePortfolio System Possible Integration. In: *Proceedings of the 7-th International Scientific Conference REEP-2014: „Rural Environment. Education. Personality", 7-8 February, 2014*. Jelgava: LLU. Vol.7; 2014. p.231-238.
14. Huang, L., and Jianfeng, N. Using Pareto Principle to Improve Efficiency for Selection of QoS Web Services. In: *7th IEEE Consumer Communications and Networking Conference (CCNC)*; 2010. p. 1-2.
15. Jiantong, Y., and Sanxing, C. The Screen Adaption Strategy for Mobile Media Based on Multi-Screen Integration. In: *6th International Conference on Information Management, Innovation Management and Industrial Engineering (ICIII)*; 2013. p.54-57.
16. Xinfeng, X., Zhongqing, Y., and Kaixi, W. The Design and Implementation of the Multi-Screen Interaction Service Architecture for the Real-Time Streaming Media. In: *Ninth International Conference on Natural Computation (ICNC)*; 2013. p.1600-1604.