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CONCEPTUAL DESIGN AND MODEL OF THE FEEDBACK SOLUTIONS IN THE ADAPTIVE INTEGRATED TECHNOLOGICAL SYSTEMS

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***Abstract**: Technology enhanced learning becomes the commonness in the nowadays educational process. Modern information systems open new departure in teaching and learning methods, enhance learners' critical thinking, reflection and competence development, broaden the ways in which the students are engaged in class activities, and as a result, lead up to the changes in existing educational paradigms. Latter findings acquired from the piloting of the experimental information system, based on multiscreen, so-called eBig3, approach, showed positive results in learners involvement into knowledge acquisition process by using of e-, t- and m-technology. This course demonstrated also another system's feature which has let its users had substantial benefit – the diminished dropout rate. It has spurred researchers on further development of the user-friendly adaptive system equipped with appropriate feedback generating tools. This paper observes possible solutions to improve the system's messaging tool and make it more intelligent. Conceptual design and algorithmic model of the proposed adaptive integrated technological system with the integrated feedback tool is introduced. The idea reposes on the observations that system user behaviours appeared in patterns and that these patterns reappeared with a number of learners; accordingly, they might be separated into a number of data sets and, based on that, several user groups depending on their behaviour patterns could be formed. Proposed system will have to generate appropriate messages from the message repository to corresponding user. This messaging system will be able to send both SMSs and emails to learners and course tutors. It will also support collaborative activities within e-learning environment.*

***Keywords:** Adaptive system; eBig3 learning; Feedback; Messaging; Reflection.*

I. INTRODUCTION

Technology enhanced learning becomes the commonness in the nowadays educational process. Modern information systems open new ways in teaching and learning methods [1], enhance learners' critical thinking, reflection and competence development, broaden the ways in which the students are engaged in class activities, and as a result, lead up to the shifting in existing educational paradigms [2]. ICT and educational experts expect that a synergy of new tools and technologies into nowadays learning and content management systems will bring us new potentialities which could enrich educational process [3]. Considering that today almost everybody for discovery and knowledge acquisition purposes consumes wide range and sorts of technological tools, including TV sets, laptops, smartphones, etc., it could be said that one of such development directions might be seen in the synergy of television, mobile and computerised systems, tools and technologies. In other words, we can speak about multi-media consumption devices and their multi-screen usage, which can give learners new opportunities in knowledge acquisition [4].

In 2011-2013 Distance Education Study Centre of the Riga Technical University has led the project which had the aim to encourage students keeping them in study courses within new designed information system. It has combined a wide spectrum of mobile and broadcasting technology with the capacity and flexibility of broadband. This approach gave a learner the possibility to choose a single

knowledge delivery channel at a specific time depending on availability and preferences. It also provided an additional combination of two or even three mentioned channels [5], and as a result, ensured learning anywhere anytime paradigm.

Created information system has got the name "eBig3", and learning approach – the term "eBig3 learning". The developed innovative solutions included integration of technical issues for cross–media learning content delivery, refinement of pedagogic considerations, development of shared understanding of target user learning contexts, production of learning content and organizing course pilots [6]. Latter findings acquired from the piloting of the experimental information system, based on multiscreen approach, showed positive results in learners involvement into knowledge acquisition process by using of e-, t- and m-technology. Implementation of three modes of technology into integrated system demonstrated also another system's feature which has let its users gain an offing, substantial benefit – the diminished dropout rate up to fifty per cent. This is much more than in so popular MOOCs where drop-out rate varies from 85 to 95 per cent [7], [8].

It has spurred us on further development of the user-friendly adaptive information system equipped with appropriate feedback generating tools. It would implement an adaptive strategy to ensure expected performance [9]. Further chapters observe possible solutions to create feedback formation subsystem, improve the system's messaging tool and make it more intelligent.

II. BACKGROUND

Beforehand we have got a positive experience with the eBig3 multi-screen learning approach which showed an increasing number of newcomers and their activity along with newly-courses prepared by teachers and offered within the system. Users' surveys show that the messaging system, which carried out mainly reminding and motivational functions, encouraged and motivated them learning and making activities within the system, as well it helped them completing the ongoing study course and prevented from drop-outs [10].

This experience emboldens project researchers to create similar, but more sophisticated, information system. We have got lessons identified in the form of users' activity data showing individualities of the learners which varies, sometimes a lot. This requires individual approach to the students, possibly, dividing them in groups depending on their behaviour within technology enhanced learning environment.

In 2014 we have collected, processed and analysed users' behaviour data in previous courses, employing Excel, Visual Basic and SQL software. After evaluation of the data of learners' activities and their preferences within multi-screen learning environment, which were realized by eBig3 approach, mentioned in the introductory chapter of this paper, it was concluded that system users' activities and their expression forms are not homogeneous ones. In students' activities we have found following differences and individualities:

- Time between registration entry (an accept given by the system to user about enrolment into particular course; made by sending to potential user his/hers registration data, including username and password, as well instructional notes about initial steps within the system) and submitter's first login into the system.
- Time between user's first and forthcoming login into the system.
- Time between frequentative logins – course modules visiting.
- Course modules visiting intensity.
- User's interests rise and their correlations with timeline.
- User's increased or reduced interest in acquisition of certain course module or its learning object.
- User's increased interest in learning objects in a form of videos.
- User's increased interest in learning objects in a form of text.
- User's increased interest in fulfilment of tests.
- User's increased interest in the combination of two from three abovementioned learning interests into one common scope of interests.
- Course modules' and learning objects visiting sequence.
- Activation of so-called "ideal learning time" and "ideal learning path" terms.

- Difference between the ideal, e.g. experts declared characteristics and student's choice.

These individualities ought to be included in development of proposed JAUZI (the acronym is derived from the Latvian title of the project: *"Jauni lietotāju uzvedības interpretācijas algoritmi radikālai zināšanu pārneses uzlabošanai eEkosistēmā)"* or *"New user behavior interpretation algorithms for radical improvement of knowledge transfer in eEcosystem"* – in English) information system's conceptual design and algorithmic model. Then there will be created application software, which would process users' activity and preference data, available in a matrix form, by algorithmic means. Data evaluation provided an opportunity to set more accurately directions in development of new adaptive information system JAUZI and its feedback subsystem.

III. CONCEPTUAL DESIGN

The idea reposes on the observations that system user behaviour appeared in patterns and that these patterns reappeared with a number of learners; accordingly, they might be separated into a number of data sets and, based on that, several user groups depending on their behaviour patterns could be formed.

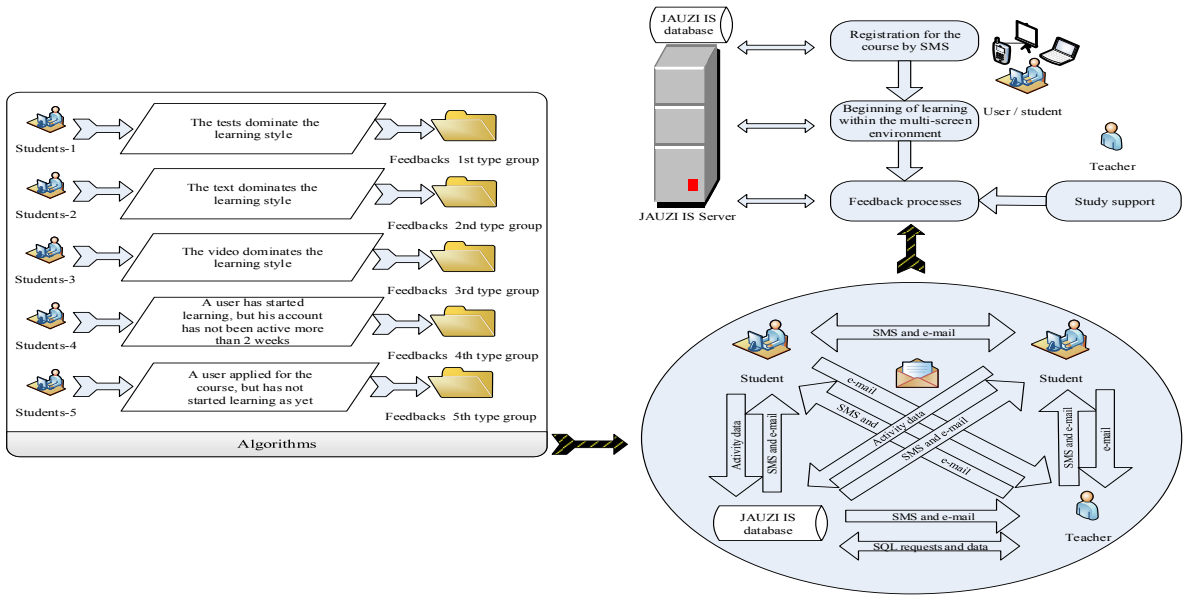

Figure 1. JAUZI conceptual design

Conceptual design of the information system JAUZI is made transposing there the base of new information system model, proposed JAUZI feedback processes' sub-model and feedback group formation sub-model based on system users' activity data within the system. This system ought to ensure (Figure 1):

- User's registration to the study course by receiving potential user's sent SMS in the defined format.
- Generation of the system's return message which contains registration instructions.
- Sending of the system's return message to potential user.
- Starting of learning process within multi-screen study environment.
- Feedback processes which would have to facilitate efficacious acquisition of learning materials and reduce students' drop-out rate. They include SMS and e-mail messages between system users.
- Tutoring support for users-students.
- Data collecting, processing, accumulating and storing in JAUZI database (onto information system server).

Feedback processes' sub-model (for example, at the bottom right in Figure 1) includes SMS and e-mailing services which are required to ensure effective messaging - data exchange between system users, facilitating the keeping of learners' interest in study process and system usage, as well enabling better acquisition of provided learning materials. This sub-model guarantee:

- SMS and e-mail messaging exchange between system's users-students.
- SMS and e-mail messaging sending from users-tutors to users-students.
- E-mail messaging sending from users-students to users-tutors.
- Messaging activity sending to the system's database.
- Generation of the system's feedback SMSs and e-mails and sending them to system users-students.
- Generation of the system's feedback SMSs and e-mails and sending them to system users-tutors.
- Data exchange and data mining – obtaining the data from the system's database necessary for the tutor to evaluate the learning course and assess learners.

Taking into account lessons identified, e.g. differences in system users learning styles, as well their activity and behaviour patterns within the system, we could be form several groups or batches of SMSs and e-mails according to expressed individualities. These SMS and e-mail clichés would be placed in the batches and chosen by the system depending on user's expressed activity or even inactivity. Namely, the following messaging situational requirements for these batches are formulated (for example, at the left in Figure 1):

1. Tests dominate the learning style.
2. Text dominates the learning style.
3. Video dominates the learning style.
4. The user applied for the course but has not started learning as yet.
5. The user has started learning, but his account has not been active more than two weeks.

IV. ALGORITHMIC MODEL

The user start activities in JAUZI information system by inputting system access username and password (Figure 2). The user is authenticated and authorized. In a case if the user is not registered yet, he/she is asked to follow registration procedures, which are the same as in previous eBig3 system: potential user sends an SMS to an assigned phone number, indicates his/her name and surname, as well a course number which is requested. As soon as the system gets these data, it logs user's personal data and save them. The user receives both system access information and user's instructions. The person cannot start learning in this system without registration.

After successful login the user starts activities within the system: acquires learning objects, uses social and collaborative environment, sends and receives feedbacks to/from other students and tutors. All the data about user's activities are assembled, processed, collected and stored into system's database. There defined SMS and e-mail messages from corresponding feedback batches according to users behaviour patterns are generated and sent to appropriate user (Figure 3).

Feedback formation sub-model (Figure 3) provides an availability to assess user's activities and behaviour patterns within this system. Necessary data for that are taken from the JAUZI information system database where users' activities are grouped in several batches according to their behaviour factors. Then the interpretation of learner behaviour is made and appropriate to user's behaviour feedback batch is chosen. According to this classification the system generates appropriate SMS or/and e-mail from corresponding feedback messaging batch. Assessments of learners' behaviour are made once a day.

In the case of the fourth and fifth feedback messaging groups there are additional specific characters. Thus, the system checks whether messages from conformable batch were sent or not to the user. This allows identifying a necessity of sending the SMS or e-mail. In other words, when the system finds that the user applied for the course but has not started learning as yet, or he/she has started learning, but the account has not been active more than two weeks, it checks whether reminding or encouraging message was sent in last two week period.

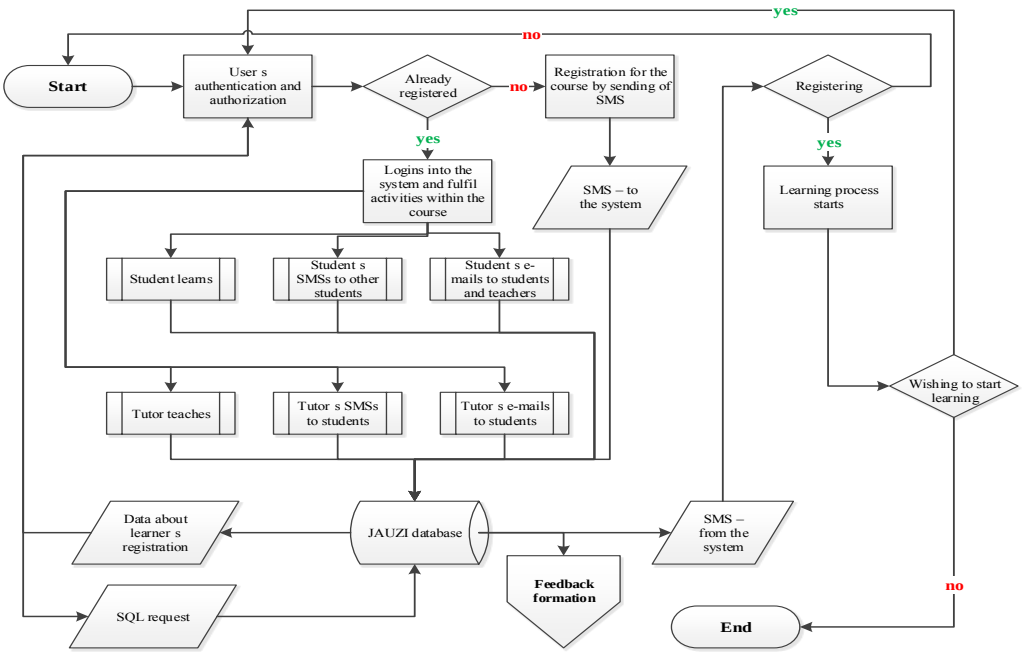

Figure 2. Proposed JAUZI algorithmic model

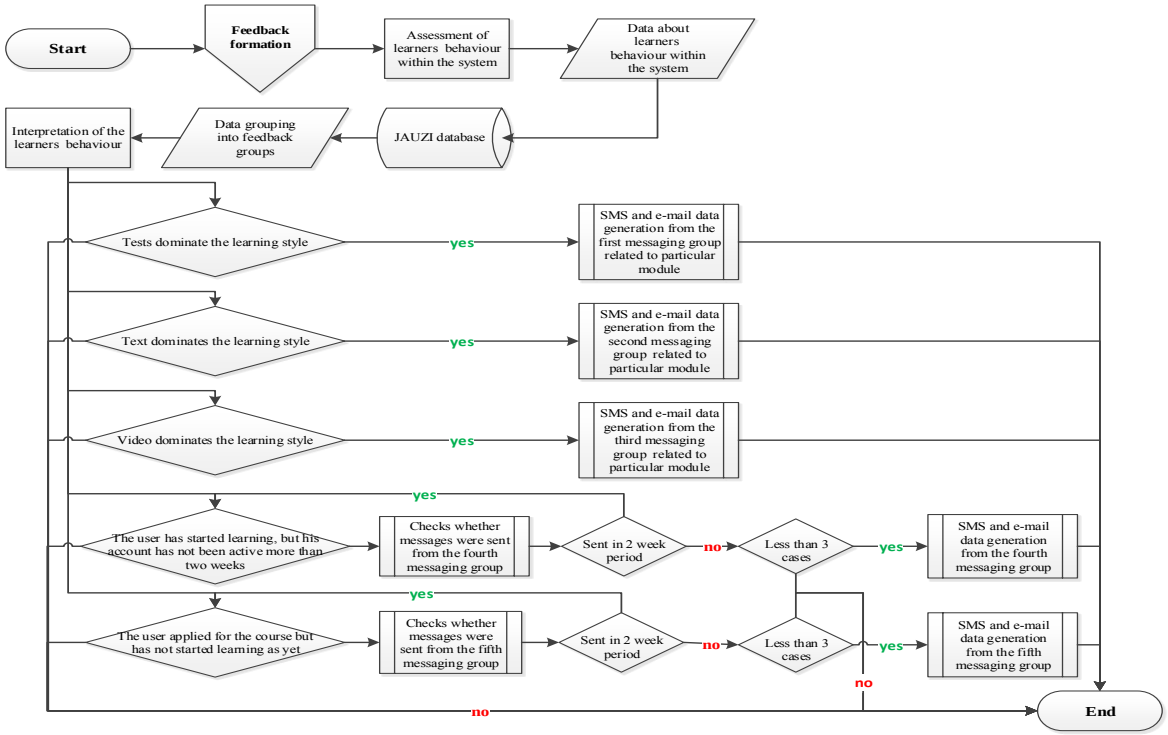

Figure 3. Feedback formation sub-model

If “yes”, new message will not generated and sent to the user. If “no”, the system will proceed to the next step and check how many messages were already sent from particular batch. If a number of sent messages is less than three, the system generates new message from corresponding messaging batch and send it to the user. If a number of sent messages is three, new messages will not be sent to the user. This solution allows avoiding of unnecessary intrusive and embarrassing steps.

V. CONCLUSIONS

Educational organizations constantly improve systems which they use to meet their defined goals. JAUZI multi-screen approach might be reasonable solution to enhance an efficiency of learning process, improve learning outcomes and avoid high drop-out rates among students.

Effective feedback messaging system provides highly effective responses on students' needs and asks. It could be considered as an additional powerful learning process supporting system.

JAUZI system allows course developers and designers evaluating which course module and even learning object attracts students' attention. This makes possible to analyse course structure and content, as well as applied methods and methodology, and as a result, improve them.

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