International Journal of Engineering & Technology, 7 (2.28) (2017) 110-113

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research paper

Cloud-based solutions to the levelling education in physics in the context of Latvian education

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Abstract

With the rapid development of new technologies, the priority directions and goals of education are also changing. As the intensity of life is constantly growing, it requires new solutions. There is a high demand for not only different teaching materials, but also for a different organization of the learning process, a different educational policy, as well as the opportunity to quickly and continuously introduce new solutions. In 2017, "i-Zvaigzne.lv" publishing company presented a new cloud-based solution [1] "Online Tests in Physics for Grade 12" and [2] "Physics: High School course!" These are extensive electronic collections of online learning tasks, tests, tasks solution examples and tasks for self-testing in the Latvian language. The aim of the research - to theoretically analyse and empirically justify the use of cloud services in the context of levelling education**.**

Keywords: *Cloud-based solution; levelling education; Knowledge; National Exams (NE)*

1. Introduction

In the age of knowledge and information technology, it becomes obvious that the implementation of new and innovative solutions in the educational process should be a top priority. [3] The implementation of innovative technology tools allows to increase the capacity of the educational process as well as to individualize the teaching process, taking into account each learner's individual needs and capabilities. As the intensity of life is constantly growing, it requires new solutions. [4] There is a high demand for not only different teaching materials, but also for a different organization of the learning process, a different educational policy, as well as the opportunity to quickly and continuously introduce new solutions. [5] A wide range of educational materials for STEM subjects and other subjects is available on the World Wide Web, but learners (it refers to the situation in Latvia) often encounter the problem of not having high quality materials, relevant for their level of education, in their native language. Even in situations when young people have a high level of proficiency in English, materials created in other countries often do not correspond to a certain level of education. In 2017, "i-Zvaigzne.lv" publishing company presented a new cloud-based solution [1] "Online Tests in Physics for Grade 12" and [2]" Physics: High School course!!" These are extensive electronic collections of online learning tasks, tests, tasks solution examples and tasks for self-testing in the Latvian language. [6] The use of the cloud-based solution and the use of resources have many advantages over locally installed solutions and the use of stored resources. [7] At the moment, course management systems, training management systems and collaboration solutions are available in the form of cloud services with high quality service provision, user support and availability of the service (usually 99.9%) regardless of the specifications of a computer, tablet or smartphone (model, system software, applications) and at a relatively small price or even free of charge, as long as the device is connected to the Internet. [8]

Enabling objectives:

1) To analyse the importance of cloud services for the improvement of secondary education and levelling process.

2) To demonstrate the possibility to implement cloud services in the context of secondary education and levelling education.

Research methods:

1) Analysis of scientific literature in order to formulate the theoretical rationale for the use of cloud services in the educational process in Latvian;

2) Development of a model of cloud service use to demonstrate the didactic aspects of the learning process;

3) Analysis and comparison of the National Exams results.

2. Theoretical background

2.1. The main reasons for the different acquisition levels in STEM disciplines

As higher education institutions accept young people according to their results in National examinations, it is necessary to find out what kind of young people are coming to the university. What are the existing skills and abilities of young people and what universities should offer in order to supplement and develop the necessary skills? When finishing high school, young people in Latvia have to pass National Exams (NE). [9]

The aims and tasks of the general secondary education programmes (hereinafter – education programme) is determined by the National General Education Standard. The Cabinet Regulations provide [9] (The Cabinet Regulations No. 281 of 21 May 2013, Annex 27) a number of general secondary education programmes:

- Comprehensive education (without intensive teaching in any particular subject);
- Humanities and Social Sciences programme;
- Mathematics, Natural Sciences and Technical Sciences programme;
- General education with emphasis on a particular vocational subject.

Each of these programs has a different number of exact sciences, and teaching hours (for example, in physics there are from one to six hours per week), so finishing 12th grade students do not have the same level of subject acquisition. If a student chooses to take the NE in physics, but he has been trained in a programme where there were only one or two hours of physics a week, there is a need for levelling the course. [9] The NE in physics is currently an optional exam. Subject program samples of general secondary education do not provide for any course repetitions in physics during 12th grade. If a number of students in a school choose to take the physics exam, the teacher will develop his own physics program, which includes repetition of the course. However, if only one students (or none) in a school chooses to take the NE, then in the number of comprehensive schools materials before the exam are not repeated. This leads to mediocre results in the National Exams and students unprepared for studies. [9]

2.2. Cloud- based solutions to the levelling education

The use of cloud-based solution and the use of resources have many advantages over locally installed solutions and the use of stored resources. At the moment, course management systems, training management systems and collaboration solutions are available in the form of cloud-based solution with high quality service provision, user support and availability of the service (usually 99.9%) regardless of the specifications of a computer, tablet or Smartphone (model, system software, applications) and at a relatively small price or even free of charge, as long as the device is connected to the Internet. [10] The main advantage of choosing cloud services for an educational institution is that there is no need to support and manage the infrastructure. [6] Teachers can manage all their classes and tasks online, creating and administering assignments and assessments, collaborating with teachers of other subjects, and providing feedback to their students. Students can collaborate with their teachers and classmates, as well as have access to all materials to successfully complete the course directly from the phone, tablet or browser (s. Fig.1).

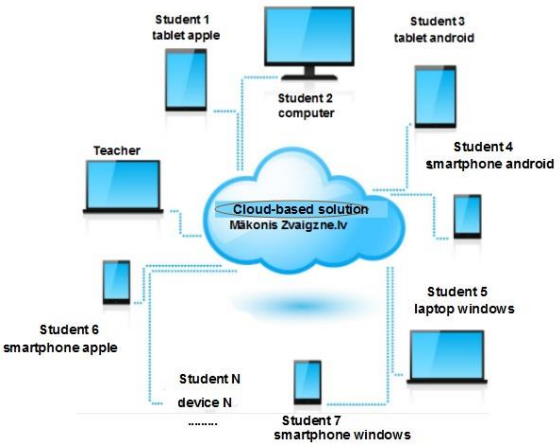


Fig. 1. Cloud- based solution (i-Zvaigzne.lv)

2.3. Cloubi Cloud-based options

Cloubi Cloud-based solution provides the possibility to ensure a targeted educational process and make it more effective. Cloubi Cloud tools can be used in the classroom which is usually much personalised. It gives an opportunity to enhance certain skills and to learn to read texts in an e-environment quickly and effectively. [8] Cloubi Cloud-based solution are flexible, which allows students to choose a suitable pace of their learning process, using the tools suitable for them, thus making the learning process more productive. [1] With Cloubi tools can create: [1]

- E-books (textbooks; exercise books; hybrids; enhanced e-books)
- Task packages
- Teacher materials
- Skills tests and online exams
- Mobile apps
- Training courses

2.4. Examples of tasks (Cloubi Cloud-based solution i-Zvaigzne.lv)

Cloubi Cloud task engines allow for the creation of over 40 different exercise types. Some examples: [1], [2]

- In the Arrange task the learner must determine the correct order of the alienable elements which may contain text or multiple media elements. The drag gable elements in the task can be organized either 1. horizontally 2. vertically or 3. be manually aligned (s. Fig.2).

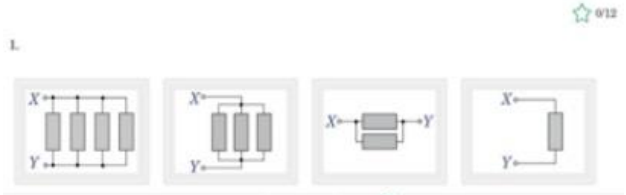


Fig. 2. Task example (Cloub i-Zvaigzne.lv) [2]

- [1] The Open Task is an upgraded task type combining features from the File Upload and Writing tasks. Open tasks enable rich text editing possibilities for learners such as special character palettes, options to upload different media and documents, and a word limit / word count. [2] The WYSIWYG editor including the WIRIS maths editor makes the task especially suitable for subjects and topics requiring mathematical formulas
- [2] The Multiple Choices is a versatile and popular task type. Our task engines enable several variations of the task: you can show the answers in several ways, include media, randomize the alternatives or allow multiple alternatives to be selected as answers. In the example tasks below the answer alternatives are demonstrated in four different variations. (s. Fig.3).

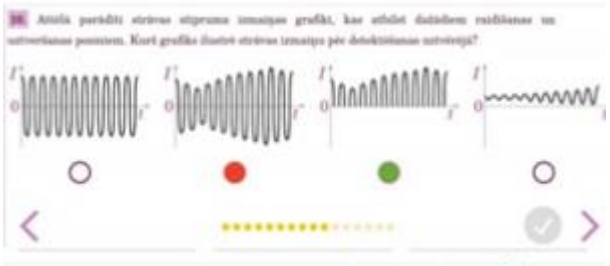


Fig. 3. Task example (Cloub i-Zvaigzne.lv) [1]

3. Results and discussion

The launch of the materials was preceded by a pilot study (2014-2017). During the study high school students, teachers and seven Riga Technical university preparation course groups were offered two new cloud materials developed by “i-Zvaigzne.lv” - "Online Tests in Physics for Grade 12" and " Physics: High School course!” A total of 1736 students and 15 teachers were involved in the study over the three-year period. Pilot materials were only

available to the students and teachers involved in the study, which made it possible to obtain reliable results.

3.1. The didactic model

First, a didactic model (s. Fig.4) of cloud-based solution implementation was created, which was followed by inviting schools and teachers to test it, in collaboration with the publishing house "i-Zvaigzne.lv". The author of the article carried out the study at the Riga Technical University preparation courses and in the 12th grade of Riga State Gymnasium No 3. Other data were obtained from a teacher and student surveys and the results of the NE in physics. It should be noted that the use of cloud-based solution makes the knowledge transfer process more demanding, as the learner has to take responsibility for the knowledge comprehension process by striving for new quality information. The theoretical knowledge transfer model focuses on the information which is transmitted using the technology tools of cloud-based solution and on the ways learners perceive the provided information. [6] For cloud-based solution to be used efficiently both at high level and levelling education, it is essential that teachers have sufficient technology skills in order to be able to perform relevant functions: coordinate the teaching process, to advise, to correct the subject materials, to test the level of knowledge. In turn, students can use new opportunities - learning in a new environment, autonomy and motivation.

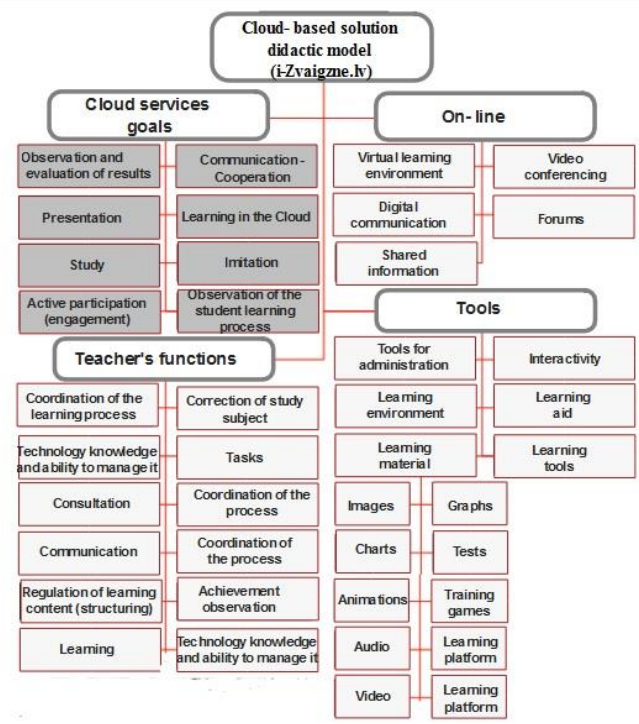


Fig. 4. Cloud- based solution didactic model (i-Zvaigzne.lv)

3.2. The analysis of the research results

A questionnaire was conducted in collaboration with publishing house "i- Zvaigzne.lv" and National Centre for Education to establish the significance and usefulness of the cloud services. Descriptive statistics and dependency analysis were used to process the data. The analysis of the research data was carried out using SPSS statistical program (version 17.00), the charts and tables were created using MS Excel. The target research group consisted of students of Riga Technical University preparation courses and high school students and teachers, who voluntarily applied for the pilot study of the cloud-based solution. Having analysed the results of the research, it was determined that there were no significant differences in the demographic indicators, but significant correlation coefficients were obtained analysing:

- the age of the students involved
- National Exam results

3.3. Comparison National Exam results

Having analysed the results of the research significant correlation coefficients was obtained analysing the National Exam results 2015 year and 2016 year (s. Fig.5).

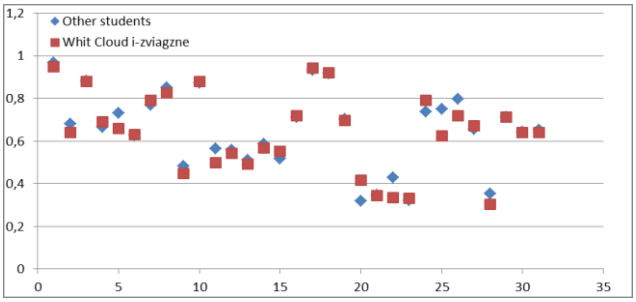


Fig. 5. Comparison National exam results 2016 (averages results)

In what kind of tasks do the results differ significantly?

- First, these are tasks that contain several lines of text. The textual information is presented in more than three lines. (s. Fig. 6).

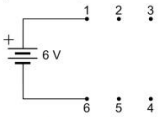
LU Cietvielu fizikas institūtā zinātnieki izveidoja jaunu kompozītmateriālu ūdeņraža uzglabāšanai. Lai izveidotu šādu materiālu, viņi pētījumu laikā mainīja kompozītmateriāla sastāvu un mērīja nemainīgā temperatūrā, cik liels ūdeņraža daudzums tiek absorbēts jaunā kompozītmateriāla noteiktā tilpumā. Kurā rindā ir pareizi norādīts minētā pētījuma neatkarīgais un atkarīgais lielums?

	Neatkarīgais lielums	Atkarīgais lielums
A	temperatūra	kompozītmateriāla tilpums
B	kompozītmateriāla tilpums	temperatūra
C	kompozītmateriāla sastāvs	absorbētā ūdeņraža daudzums
D	absorbētā ūdeņraža daudzums	kompozītmateriāla sastāvs

Fig. 6. Task example 2016 [9]

- Secondly, these are tasks that contain research elements, which require first making certain actions in one's head, calculating, comparing and drawing a conclusion (s.Fig.7).

Slēgumu veido baterija, kuras EDS ir 6 V, divi vienādi rezistori un vadu nogriežņi. Rezistori un vadu nogriežņi ir ieslēgti starp punktiem 1; 2; 3; 4; 5 vai 6, taču nav zināms, kā tie saslēgti. Baterijas iekšējo pretestību neņem vērā!



Lai noskaidrotu slēgumu, ar voltmetru izmērīja spriegumu starp dažādiem punktiem. Ieguva šādus rezultātus:

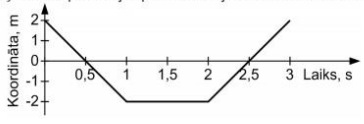
- Spriegums starp punktiem 1 un 2 ir 0 V
- Spriegums starp punktiem 2 un 3 ir 0 V
- Spriegums starp punktiem 3 un 4 ir 6 V
- Spriegums starp punktiem 4 un 5 ir 0 V
- Spriegums starp punktiem 5 un 6 ir 0 V
- Spriegums starp punktiem 6 un 1 ir 6 V

Dotajā zīmējumā attēlo rezistoru un vada nogriežņu izvietojumu!

Fig. 7. Task example 2016 [9]

- Thirdly, these are graphical tasks for analysing graphical information (s. Fig.8).

Ķermenis pārvietojas pa taisnu līniju. Grafikā attēlota tā koordinātas maiņa atkarībā no laika.



Kurā laikā ķermenis atrodas miera stāvoklī?

A tikai 0,5 s
B tikai 2,5 s
C gan 0,5 s, gan 2,5 s
D no 1 s līdz 2 s

Fig. 7. Task example 2016 [9]

Multiple-choice tasks and tasks corresponding to the first cognitive level of activity were performed in exactly the same way. The proportion of easy, medium and difficult tasks for students was similar. Data analysis showed that 2% of students did not mark any option or marked more than one option in one of eight level 1 cognitive tasks and in twelve out of 2 and 3 level tasks. This sug-

gests that these students were not were confident in their responses, and/or upon completion of the test, forgot to return to the unfinished tasks. Many students were not able to recall and recognize acquired natural science language elements - concepts and units, or to recognize their symbols etc., or they had misconceptions about them.

4. Conclusion

Some Based on the theoretical and empirical analysis to formulate the following findings:
Cloud-based solution provides the possibility to ensure a targeted educational process and make it more effectively.
Cloud-based solution can be used in the classroom autonomously for revising the course materials before tests or centralized exams and for levelling education, which is usually much personalised. It gives an opportunity to enhance certain skills and to learn to read texts in an e-environment quickly and effectively.
Cloud-based solution are flexible, which allows students to choose a suitable pace of their learning process, using the tools suitable for them, thus making the learning process more productive.
However, there are student groups (mostly students aged 17-19) who need strong teacher guidance in order to be involved in the learning process. It may be attributed to the lack of motivation or insufficient background knowledge of the subject. The most appropriate form of levelling education would be cloud solution, because they are flexible and personalized, because students can set their own pace of learning and adapt the portions of learning materials to their level and ability.
The learning process is stress-free, since the materials can be repeated when necessary at own pace and time. Studies can be continued or restarted at convenient time. Students via computer can study at home, at work or in the own companies. There are significant differences in the analysis of the results of National Exams in physics.
The students, who have acquired certain content areas in the cloud environment, demonstrated better results dealing with graphic tasks and processing visual information. These observations lead to a conclusion that the use of cloud services improves students' ability to perceive graphic representation of information and contributes to the development of reading skills.

Acknowledgement

I want to say big thanks to D.Phs. Atis Kapenieksfor for helping with data digging from the learning platform.

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