Vadim Ermolayev
Nick Bassiliades
Hans-Georg Fill
Vitaliy Yakovyna
Heinrich C. Mayr
Vyacheslav Kharchenko
Vladimir Peschanenko
Mariya Shyshkina
Mykola Nikitchenko
Aleksander Spivakovsky
(Eds.)

ICT in Education, Research and Industrial Applications:

Integration, Harmonization and Knowledge Transfer

Proceedings of the 13th International Conference, ICTERI 2017

Kyiv, Ukraine
May, 2017

Ermolayev, V., Bassiliades, N., Fill, H.-G., Yakovyna, V., Mayr, H. C., Kharchenko, V., Peschanenko, V., Shyshkina, M., Nikitchenko, M., and Spivakovsky, A. (Eds.): ICT in Education, Research and Industrial Applications: Integration, Harmonization and Knowledge Transfer. Proc. 13th Int. Conf. ICTERI 2017, Kyiv, Ukraine, May 15-18, 2017, CEUR-WS.org, online

This volume represents the proceedings of the 13th International Conference on ICT in Education, Research, and Industrial Applications, held in Kyiv, Ukraine, in May 2017. It comprises 62 contributed papers that were carefully peer-reviewed and selected from 132 main conference and workshop submissions. The volume opens with the abstracts of the two keynote talks. The rest of the collection is organized in 2 parts. Part I contains the contributions to the main ICTERI conference tracks, structured in four topical sections: (1) Advances in ICT Research; (2) Information Systems: Technology and Applications; (3) Academia/Industry ICT Cooperation; and (4) ICT in Education. Part II comprises the contributions of the three workshops co-located with ICTERI 2017, namely: 3d International Workshop on Theory of Reliability and Markov Modeling for Information Technologies (TheRMIT 2017); 1st International Workshop on Rigorous Methods in Software Engineering (RMSE 2017); 2nd International Workshop on Professional Retraining and Life-Long Learning using ICT: Person-oriented Approach (3L-Person).

Preface

It is our pleasure to present you the proceedings of ICTERI 2017, the thirteenth edition of the International Conference on Information and Communication Technologies in Education, Research, and Industrial Applications: Integration, Harmonization, and Knowledge Transfer, held in Kyiv (Ukraine) on May 15-18, 2017. This year's edition focused on research advances, information systems technologies and applications, business/academic applications of Information and Communication Technologies. Emphasis was also placed on the role of ICT in Education. These aspects of ICT research, development, technology transfer, and use in real world cases are vibrant for both the academic and industrial communities.

The ICTERI 2017 Call for Papers as well as the main conference were structured into four tracks reflecting these research fields.

The conference program was complemented by two invited keynote talks, a PhD Symposium, poster and demo track, Ph.D. mentors panel, industrial IT Talks sub-event, and the contributions to three co-located workshops:

- The 3nd International Workshop on Theory of Reliability and Markov Modeling (TheRMIT 2016) addressing long-standing research and development aspects of reliability, security and safety modeling and assessment for modern IT systems
- The 1st International Workshop on Rigorous Methods in Software Engineering (RMSE 2017) focused on the aspects of formal techniques for specification and analysis of distributed software and cyber-physical systems, computer simulation
- The 2nd International Workshop on Professional Retraining and Life-Long Learning using ICT: Person-oriented Approach (3L-Person 2016) presenting new uses of information technology for life-long learning

The first keynote talk given by Dr. Aliaksandr Birukou from Springer Verlag GmbH presented the linked open data project using Springer Nature paper collections to make them openly available through the LOD portal. The second keynote talk was given by Prof. Yannis Dimitriadis from the University of Valladolid. This talk was about Technology Enhanced Learning. In particular, Prof. Dimitriadis focused on the ways to overcome the barriers of an effective and efficient classroom orchestration of innovative pedagogies.

The rationale behind the Ph.D. Symposium sub-event is to offer an expert environment for the presentation of the tractable ideas and early results of PhD projects or other research aiming at receiving a PhD. Young researchers joined the Symposium to take part in discussions and/or present their papers. They were offered a rare opportunity to exchange and discuss their research ideas with their peers, supervisors, and senior scientists working in the fields within the scope of ICTERI 2017. The PhD Mentors Panel provided the opportunity for Ph.D. candidates to listen to and discuss the visionary ideas and promising topics for Ph.D. research offered by several renowned experts.

Poster and Demo track at ICTERI 2017 called for software demonstrations, interactive models, real-time visualizations, novel technology applications. The two selected demonstrations were presented as live action in a way to enable interaction with the audience.

Overall ICTERI 2017 attracted a substantial number of submissions – a total of 155 comprising the main conference, PhD symposium, posters and demos, and workshops. Out of the 56 paper submissions to the main conference we have accepted 24 high quality and most interesting papers to be presented at the main conference and published in our proceedings. The acceptance rate was therefore 43 percent. Our three workshops received overall 76 submissions, of which 38 were accepted by their organizers and, also, included in this volume. Thus, the acceptance rate for ICTERI 2017 workshops was on average 50 percent.

The conference would not have been possible without the support of many people. First of all, we would like to thank all the authors who submitted papers to ICTERI 2017 and thus demonstrated their interest in the research problems within our scope. We are very grateful to the members of our Program Committee for providing timely and thorough reviews and, also, for being cooperative in doing additional review work. We would like to thank the local organizers of the conference whose devotion and efficiency made this instance of ICTERI a very interesting and effective scientific forum.

May, 2017

Vadim Ermolayev
Nick Bassiliades
Hans-Georg Fill
Vitaliy Yakovyna
Heinrich C. Mayr
Vyacheslav Kharchenko
Vladimir Peschanenko
Mariya Shyshkina
Mykola Nikitchenko
Aleksander Spivakovsky

Workshop 3L-Person

Planning and Implementation of the Project "Cloud Services to Each School"

Vasyl Oleksiuk[1], Olessia Oleksiuk[2], Mykola Berezitskyi[3]

[1] associate professor of the department of informatics and methods of its teaching,
Volodymyr Hnatiuk Ternopil National Pedagogical University
oleksyuk@fizmat.tnpu.edu.ua

[2] teacher of the department of contents and methods of subjects,
Ternopil Regional Municipal Institute of Postgraduate Education
o.oleksyuk@ippo.edu.te.ua

[3] postgraduate Institute of Information Technologies and Learning Tools of NAES of Ukraine
m.berezitskyi@gmail.com

Abstract. This article raises up the issue of creating the cloud-based learning environment through the collaboration of several age groups. Authors of the article share the experience of designing, deploying, configuring and maintenance of G Suite and Microsoft Office 365 cloud services at schools of the Ternopil region (Ukraine). Authors offer to use public cloud technologies to support the teaching process. The project "Cloud Services to each school" was defined as a method of obtaining the practical results and forming the cooperation between scientists, teachers and students. Authors believe that deployment of cloud services is possible at any secondary school.

Keywords: Cloud computing, e-learning, project, public clouds, G Suite, Microsoft Office 365.

Key Terms. InformationCommunicationTechnology, ICTEnvironment, TeachingProcess.

1 Introduction

The development of E-learning provides the conditions for creating new teaching tools. Today society requires the assurance of openness and universality of training. These requirements can be met if the mentioned above teaching tools will be designed by cloud approach [2; 12]. As it is known, it provides remote access to a specific set of computing resources. The data processing is performed at the cloud provider's facilities (servers, clusters). These resources ensure functioning of cloud services, platforms and infrastructures.

Cloud computing services usually provide the access to any application via Internet and the only software that is needed is a web browser. In terms of training, it is important to work with resources despite the clients' hardware and software, as well as its geographical position.

According to many studies, the problem of using cloud technologies in educational institutions is still relevant. Scientific works of V. Bykov, O. Glazunova, N. Morse, O. Spirin, M. Shishkina, B. Hirsch, A. Labus, M. Mircea, W. Roy, H. Wong S. and others are dedicated to the establishment of cloud technologies in education.

Authors offer the model at service layer of cloud computing for educational institutions [4]. Maury Elizabeth Brown researches the problems of usability of study of Google Apps for Education. The results of her study demonstrate that Google Apps for Education are relatively easy to use for most users, even those unfamiliar with Google Apps services [1]. Cory Robertson [8] described the experience of using a cloud-based environment to support teacher training.

Article's goal is a summary of the main theoretical basics of designing cloud-based environment in educational institutions. The article contains the analysis of the experience of implementing and deploying of G Suite and Microsoft Office 365 cloud services at schools in Ternopil region (Ukraine).

2 The presentation of main results

2.1 The cloud-based learning environment of educational institution

A cloud-based environment of the institution is the environment of the participants of the educational process, which uses a virtual corporate or hybrid IT-infrastructure for the implementation of content, technology, information and communication functions [9]. Unfortunately, nowadays the deployment of corporate information infrastructure at schools is a very challenging. The reasons are: a legal base remains unresolved and therefore it remains uncertain who is responsible for the organization and deployment of technological and scientific-methodological support of IT infrastructure, lack of appropriate material base, absence of teachers' motivation and others.

There are two components in the cloud-based model of learning environment: organizational-methodological and technological. They define the components of the environment and the requirements for its functionality. The following tasks of the educational environment in the learning process are among the main ones: the development of learning resources, support of the educational process organization, providing access to learning materials, training students both in the classroom and remotely, system-based control of learning process, monitoring and analysis of learning process, presentation of the institution in Internet [3].

Among the main functional requirements, the next ones may be highlighted: unified access to resources via the Internet, support desktop and mobile platforms, reliability and security data storage. The deployment of cloud technologies is possible due to such service models private, public and hybrid [2].

2.2 Project implementation stages

Our research performed in Joint laboratory of the Institute of Information Technologies and Learning Tools of NAES of Ukraine (IITLT), Ternopil Volodymyr Hnatiuk National Pedagogical University (TNPU) and Ternopil regional municipal institute of postgraduate education (TRMIPE) [7]. Its purpose is to implement the project "Cloud Services to Each School". TRMIPE provides the coordination and maintenance of deployed systems. Organizational aspects are built on collaboration between scientists from the Academy of Sciences and institutions of postgraduate education, teachers of secondary schools and students of universities. This approach is justified in terms of mutual organization of all participants. A student having an appropriate level of fundamental preparation in computer sciences, holding knowledge about different approaches to studying computer science at school during his activity in project, gets skills to bring them into future professional activity. The computer science teachers have to teach how to use different programs that makes their professional activities more difficult under the conditions of rapid technology changes and varied computer resources in secondary schools. The objective of the project "Cloud services to each school» is to bring together scientists, teachers and students and makes them collaborate to create the cloud-based learning environment. Deployment of the cloud-based learning environment appropriate to carry out during the following stages: [5].

- problematic stage involves determining the basic educational and training problems, which should be solved using cloud services;
- concept-based stage during which bases of functioning of cloud-based learning environment should be found out;
- assessment stage provides analysis and selection of cloud technology and evaluation of its application in the educational process;
- modeling stage covers the design of the environment, the activities of its members, instructional design and methodological components;
- experimental stage carries out verification of the operation, correction of deployed services, training of students and teachers;
- summarizing stage provides analysis, summary of the results of design, and making decisions on the usage.

The main problem, the solution of which directed the project is to provide a universal access of students and teachers to the information resources of the school.

The basic foundations of the concept of a cloud-based environment of the school are the following: the absence of any server hardware in the school, lack or minimum of material costs to deploy cloud services support, voluntary nature of the project due to the initiative and motivated teachers.

The leaders in cloud-based services are the well-known software development companies: Google Inc. and Microsoft. Each of them has developed and implements public model of cloud-based platform G Suite (Google Apps) and Microsoft Office 365. An important advantage of the platform G Suite is free of cloud services for education. Like the vast majority of software, company Microsoft Office 365 platform is distributed commercially. However, educational institutions can get a free subscription and use cloud services, in particular, "Office 365 Education for Faculty and Staff" and "Office 365 Education for Students". Given the proposed concept deployment of cloud-based environment, we use only free subscription "Office 365 Education for Faculty and Staff " and "Office 365 Education for Students."

2.3 Implementation and Evaluation

For the deployment of cloud services in secondary school, cooperation between computer science teachers, English teachers and school administration is required. The assistance of experts in the field of information technology, including system administrators is desired. In this cooperation, the development of cloud-based environment of the institution will be successful.

We consider appropriate the organization and functioning of cloud-based learning environments in schools using both cloud services – G Suite and Microsoft Office 365. Students of the last year of study majoring in “Pedagogical education. ICT” participated in the project "Cloud Services to Each School". At the beginning (pilot project), we have deployed clouds for eight schools.

In collaboration with teachers, students determine which services, as components of the work environment, are to be configured or migrated to cloud. An important task of this project is registration and configuration of Internet Domain of educational institution. We consider appropriate to use in a domain (subdomain) «edu» within the regional domains. For example, we registered domains "edu.te.ua" for schools of Ternopil region. Given the concept of cloud-based environment, we tried to minimize the material costs of registration and renewal delegation of domain names. In particular, some Internet service providers has delegated, for free, to educational institutions the subdomains «edu.ua». Two name servers – master and slave – must provide the functioning of domains. We have configured the main server, containing domains of all schools, we have configured on a separate Internet server of TRMIPE. We did not have to install the reserve server, because we used the Ukrainian free Internet service secondary.net.ua.

During modeling stage of the project, there was a task to create a school account on cloud services – G Suite and Microsoft Office 365. Primarily, the ownership of the domain had to be verified. The students, who created appropriate records for the domain name server, performed this procedure. All application forms were filled carefully and answers to Google and Microsoft were given. To this end, the participants of the project were organized into small groups of two students and a computer science teacher of the respective school. They all had access to the school account. To obtain academic licenses G Suite and Microsoft Office 365, a detailed description in English of the educational institution with the aims to use cloud services in it was prepared.

As it is know, the major cloud service G Suite and Microsoft Office 365 is an e-mail. Domain names servers provide processing e-mail by e-mail servers Google and Microsoft. We were unable to set up a full synchronization of e-mail services both platforms. It means that educational institutions need to decide which e-mail service will be the main one. You can further customize an other e-mail service and forward copies of incoming messages between services, for example, from Gmail to Outlook.

In this case, the letters coming through service Gmail service to user pupil@school.edu.te.ua, will be further sent to the service Outlook service (if account pupil@school.edu.te.ua was created on Office 365). However, mailboxes will not be synchronized. It means that emails that are read in Gmail, will not be reflected in Office 365 accordingly.

Both platforms have quite functional administrative interface. The principal objectives are to create user and group of user accounts. G Suite and Microsoft Office 365 support the following methods for creating accounts: manual account parameters data entry, importing of user accounts from a spreadsheet, synchronization user accounts with local base. Both systems support mechanism for groups of users: a letter sent to group e-mail will be delivered to all of the participants, all participants can work with a folder or document with group access, all of the invited participants will receive access to events calendar. For structuring G Suite accounts administrator can use the organizational units. Deployed cloud services need maintenance and support. In part, the teachers have questions about the administration, configuration, monitoring of cloud services. Such problems can be resolved throw organization of trainings, seminars and workshops or remote maintenance of qualified specialists.

We received positive feedback on the project from teachers and students. The reports on the use of cloud services at all schools within last 6 months confirm success of the pilot project (fig. 1).

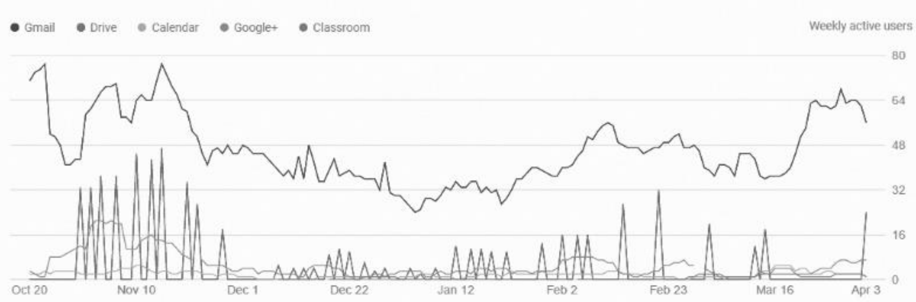

Fig. 1. Common report of using cloud services

Analysis of the diagrams shows that teachers and pupils regularly work with Gmail, Google Drive and Calendar. A small amount of Classroom service users is attributable to the fact that most of the teachers do not have their own electronic courses.

For continuous implementing of the project in the future, we conducted a study of the factors that hinder the implementation of cloud technologies. The study was conducted in TRMIPE from September 2016 to December 2016. In the study, we used the method of L.Y. Muilenburg and Z.L. Berge [6]. Forty-eight computer science teachers of Ternopil region were the respondents. They were asked to rate each of 24 barriers according to the five-point scale choices: 1 – not a barrier, 2 – somewhat of a barrier, 3 – a barrier, 4 – a strong barrier, 5 – a very strong barrier.

After the survey, we verified an internal consistency of questions. We computed Cronbach’s alpha for all 24 items. The alpha coefficient for 24 items is 0,793 and is considered "acceptable".

Investigated barriers we combined into 4 groups:

- Academics. Teachers do not have sufficient scientific and methodological support or do not want to change the style of teaching;
- Administrative. Teachers do not have enough support and encouragement from school management;
- Motivation. This grouping has to do with the psychological processes that cause teachers to persist in meeting professional (innovational) goals.
- Technical – poor material support of schools and the lack of technical support.

For each of them were calculated the averages values (Table 2-5).

Table 1. Investigated barriers

Code	Issues	Mean	Description
AC1	I have no experience of using cloud technology	3,44	A barrier
AC2	I don't have anyone to consult on the implementation of cloud technology	3	A barrier
AC3	Lack of qualitative e-learning materials	3,27	A barrier
AC4	I do not consider appropriate to spend my time for retraining	1,69	Somewhat of a barrier
AC5	I don't want to change my own teaching style	2	Somewhat of a barrier
AC6	I can't orientate myself in the information flow, I don't know where to start	1,83	Somewhat of a barrier
AC	Overall Mean	2,54	A barrier
AD1	Insufficient attention to these problems of the school management	3,65	A strong barrier
AD2	No leaders, innovators in teaching staff	2,96	A barrier
AD3	No development strategy of the institution on the use of cloud technologies	3,06	A barrier
AD4	Lack of support and assistance in this matter by management of school	2,9	A barrier
AD5	Lack of moral and material incentives	4,33	A strong barrier
AD6	I do not have a positive example of implementing of cloud technology	2,24	Somewhat of a barrier
AD	Overall Mean	3,14	A barrier
M1	Lack of interest in innovation	1,96	Somewhat of a barrier
M2	I don't want to take more responsibility	1,9	Somewhat of a barrier

M3	Lack of time	3,21	A barrier
M4	Fear of failure	2,44	Somewhat of a barrier
M5	I don't know what will be the consequences of changes	2,67	A barrier
M6	I think any innovations is a temporary thing	2,27	Somewhat of a barrier
M	Overall Mean	2,41	Somewhat of a barrier
T1	The lack of a good access to the Internet	3,04	A barrier
T2	Lack of theoretical knowledge about the cloud technology	2,98	A barrier
T3	Lack of practical skills and abilities in the field networking	2,71	A barrier
T4	Outdated material and technical base of schools	4,25	A strong barrier
T5	Lack of technical assistance	3,85	A strong barrier
T6	Incompatibility of platforms and browsers creates technical problems	3,42	A barrier
T	Overall Mean	3,38	A barrier

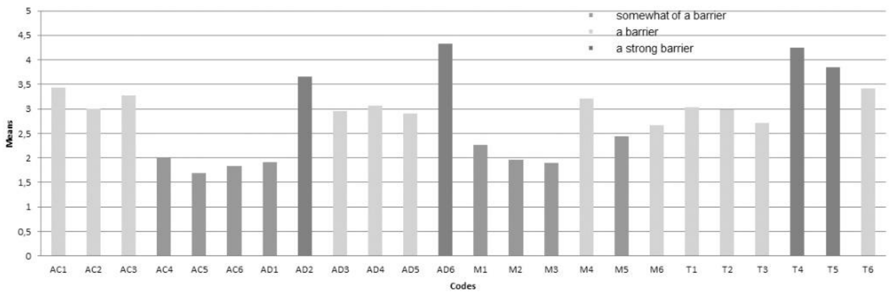

Fig. 2. Results of teachers' survey

The analysis of the results of the survey (fig. 3) shows that teachers are sufficiently motivated for the implementation of innovations. The main barriers of using cloud technology by teachers are administrative and technical. It can be argued that academic barriers decrease as experience with using clouds. The projects such as ours can be useful in overcoming technical and academic barriers. Also, the problem of implementation of cloud technology in education can be solved at the state level. In this case, it is hoped that there will be maximum efficiency of innovations and overcoming of all barriers.

3 Conclusions

Students' participation in this project has the following benefits in the short, medium and long term for the future teachers of computer science:

1. In the short term development of ICT-competence, fundamental in higher education; participation in the project contributes to the students' abilities to work with the cloud technology independently and responsibly;
2. Medium term: recognizing yourself as a teacher, focusing on results.
3. Long term: awareness of the need and willingness to work as a teacher, creating a positive image of the teacher, the desire to use cloud-based applications.

Teachers' participation in the project has the following positive effects: applicability of modern ICTs in the learning process, development of teachers' ICT-competencies, and consequently professional growth as organizer and consultant ICT implementation in the educational process of school; interconnection between secondary and higher schools. The purposes of project takes into account the participants' needs and interests. We hope that participation in the creation cloud-based learning environment will stimulate their life-long learning skills.

Prospects for further research we see in designing tools to perform specific tasks of the learning process (tests, statistics, monitoring), its integration with existing cloud services, and in developing of appropriate methods of application.

References.

1. Brown, M., Hocutt, D.: Learning to Use Useful for Learning: A Usability Study of Google Apps for Education. Journal of Usability Studies, 10(4), 160-181, http://uxpajournal.org/usability-study-google-apps-education/ (2015)
2. Bykov, V.: Cloud computer-technology platform of open education and appropriate development of organizational and technological structure of it departments of educational establishments, http://lib.iitta.gov.ua/1184/ (2013) (in Ukrainian)
3. Glazunova, O., Voloshyna, T.: Hybrid Cloud-Oriented Educational Environment for Training Future IT Specialists. Proc. 12-th Int. Conf. ICTERI 2016, http://ceur-ws.org/Vol-1614/paper_64.pdf (2016).
4. Jabbar, S., Naseer, K., Gohar, M.: Trust model at service layer of cloud computing for educational institutes. The Journal of Supercomputing. 72(1), 58–83 (2016).
5. Lytvynova, S., Melnyk, O.: Professional Development of Teachers Using Cloud Services During Non-formal Education. Proc. 12-th Int. Conf. ICTERI 2016, http://ceur-ws.org/Vol-1614/paper_51.pdf (2016)
6. Muilenburg, L., Berge, Z.: Student barriers to online learning: A factor analytic study. Distance education. 16(3) (2005)
7. Nosenko, Yu, Shyshkina, M., Oleksiuk, V.: Collaboration between Research Institutions and University Sector Using Cloud-based Environment. Proc. 12-th Int. Conf. ICTERI 2016, http://ceur-ws.org/Vol-1614/paper_84.pdf (2016)
8. Robertson, C.: Using a Cloud-based Computing Environment to Support Teacher Training on Common Core Implementation. Techtrends, 57(6), 57–60 (2013)
9. Shyshkina, M.: The Hybrid Cloud-based Service Model of Learning Resources Access and its Evaluation. Proc. 12-th Int. conf. ICTERI 2016, http://ceur-ws.org/Vol-1614/paper_57.pdf (2016)