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This volume represents the proceedings of the Workshops co-located with the 14th International Conference on ICT in Education, Research, and Industrial Applications, held in Kyiv, Ukraine, in May 2018. It comprises 60 contributed papers that were carefully peer-reviewed and selected from 118 submissions for the five co-located workshops: ITER, TheRMIT, 3L-Person, RMSE, and DSEDU. The volume is structured in five parts, each presenting the contributions to a particular workshop. The topical scope of the volume is aligned with the thematic tracks of ICTERI 2018: (I) Advances in ICT Research; (II) Information Systems: Technology and Applications; (III) Academia/Industry ICT Cooperation; and (IV) ICT in Education.

Preface

It is our pleasure to present you the proceedings of the Workshops co-located with ICTERI 2018, the fourteenth edition of the International Conference on Information and Communication Technologies in Education, Research, and Industrial Applications, held in Kyiv (Ukraine) on May 14-17, 2018. 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 remain vibrant for both the academic and industrial communities. Overall, ICTERI 2018, including the Workshops, was focused on the four thematic tracks reflecting these research fields: (I) Advances in ICT Research; (II) Information Systems: Technology and Applications; (III) Academia/Industry ICT Cooperation; and (IV) ICT in Education.

This volume is structured in parts, each presenting the contributions to a particular workshop:

Part I: 6th International Workshop on Information Technologies in Economic Research (ITER 2018). This workshop focused on advancing research and also business/academic applications of information and communication technologies related to solving practical economic problems.

Part II: 3d International Workshop on Professional Retraining and Life-Long Learning, using ICT: Person-oriented Approach (3L-Person 2018). This workshop presented novel research issues and uses of information technology for life-long learning.

Part III: 4th International Workshop on Theory of Reliability and Markov Modelling for Information Technologies (TheRMIT 2018). This workshop addressed long-standing research and development aspects of reliability, security and safety modeling and assessment for modern IT systems.

Part IV: 2nd International Workshop on Rigorous Methods in Software Engineering (RMSE 2018). This workshop focused on the aspects of formal techniques for specification and analysis of distributed software and cyber-physical systems, computer simulation.

Part V: 1st International Workshop on Data Science EDUcation: Challenges, Opportunities and Trends (DSEDU 2018). This workshop discussed several important issues related to Data Science education: synergies with Computer Science curricula; appropriate education level; required entry knowledge; the consequences of data-driven decisions and related ethical issues; trends in Data Science as a profession.

Overall, ICTERI 2018 workshops attracted 118 paper submissions. Out of these submissions, the organizers have accepted 60 high quality and most interesting papers. So, the average acceptance rate was of 50.8 percent

These papers were published in the Volume II of ICTERI 2018 proceedings.

The conference and its co-located events 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 the workshops of ICTERI 2018 and thus demonstrated their interest in the research problems within their scope. We are very grateful to the members of the Program Committees 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 the constellation of ICTERI 2018 workshops a very interesting and effective scientific forum.

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Part I: 6th International Workshop on Information Technologies in Economic Research (ITER 2018)

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The Group Methodology of Using Cloud Technologies in the Training of Future Computer Science Teachers

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Abstract. The development of cloud computing resources and their implementation in university education require an increase in the ICT-competence of future computer science teachers. The article considers the use of project method as an effective tool of encouraging students' cooperation while solving practical problems and as a means of developing their essential professional skills. The following pedagogical approaches and techniques were used: partnership of group members, development of group work skills, heterogeneous grouping, combined use of individual and peer assessment, teacher's monitoring of the students' work, focus on the task and group work skills, chance for every member to be a leader, essential feedback. The authors suggest using private and public cloud technologies to support the implementation of group methodology in the teaching process. One of such technologies is academic cloud based on the Apache CloudStack platform. This cloud environment is deployed in Physics and Mathematics Department of Ternopil V. Hnatiuk National Pedagogical University. The suggested method has been verified experimentally by using Wilcoxon signed-rank test.

Keywords: ICT-competence, project method, cloud computing, e-learning, future computer science teachers.

1 Introduction

The educational reform which is currently under way in Ukraine among its many priorities calls for the urgent implementation of effective modern teaching technologies in the system of training competitive specialists. One of the ways to rise to a new level of the education quality is the use of cloud technologies, development of education clouds in Ukraine’s universities in particular.

According to extensive research in the field, the problem of creating cloud-oriented environment in higher educational institutions is still relevant. The issues relating to the implementation of cloud technologies in education have been explored by V. Bykov, O. Glazunova, N. Morse, S. Lytvinova, O. Spirin, M. Shishkina, A. Alkhansa, A.A. Shakeabubakor, E. Sundararajan, A. Hamdan and others.

Yu. Nosenko’s paper [9] contains an analysis of cloud technology in Open Education Space. M. Shyshkina in her paper [14] analyses the term ‘cloud-based learning environment’ and develops a cloud-based model of access to learning resources. Professional development of teachers using cloud services was researched by S. Lytvinova and O. Melnyk [8]. A model of cloud oriented learning environment for Bachelors of Informatics training is investigated by T. Vakaliuk [16]. The study of A. Stryuk and M. Rassovyts’ka is devoted to analysis of e-Learning development through cloud computing [13].

"Academic cloud" of a university is a cloud-oriented environment of an educational institution which combines hardware, software and information resources and services, functions on the basis of technologies of cloud computing and provides the academic process with the resources of the university local network and Internet access [5]. University academic clouds are aimed, above all, at facilitating personal development of the faculty and students, encouraging their professional self-realization.

The goal of this article is to research effectiveness of group methodology of training future teachers of computer science in university cloud-oriented environment.

2 Presentation of the main results

The cloud-oriented environment [14; 1] defined above was used for the development of component methodology designed for the instruction of prospective computer science teachers. In particular, we focused on the formation of professional and technology components of ICT competencies. These competencies reflect the professional qualifications of the future teacher. For computer science teachers it is necessary to determine those competencies that are directly related to their profession and cover the content of the school ICT syllabus.

The technology competencies of computer science teachers may be subdivided into two groups [12]:

- competence in basic technologies – fundamental professional qualifications which for ICT teachers are considered as educational technologies (general teaching skills and resources of a computer science teacher);
- information technology competence, which determines the required learning outcomes of innovation information technologies and methods of their application in the teaching process.

We used project work as the main method of instruction. A project is a task or problem which commonly engages a group of students and supplements traditional classroom studies. The notion of "project" encompasses different activities characterized by a number of common features [3]:

- focus on achievement of specific purposes, certain results;
- coordination of interrelated actions;
- limited timing with a clearly defined beginning and end.

Project work is aimed at formation of professional qualifications and skills, development of study habits and need for continuous learning, as well as practical application of the acquired knowledge.

The project under study involved first-year students majoring in "Pedagogical education. ICT, Mathematics, Physics". To cope with the tasks, the students were supposed to have basic knowledge of the following disciplines: Operating Systems, Computer Architecture and Software. The students had one week to complete all the tasks. The focus of the study was computer training. The project consisted of several practical tasks, complex in nature. Students worked in groups, each group having the same tasks to do. Our hypothesis was that conditions favorable for the increase in the student motivation can be created in the process of group work. However, interaction of group members does not guarantee the formation of the desired set of educational motives.

The researchers distinguish between three possible levels of relations depending on the type of students' interdependence in the group: weak, medium and strong [15]. Weak interdependence is typical of a group where the most prepared member can perform all the work and score high without the help of other group members. As a rule, in such cases, group members are not willing to cooperate. In the atmosphere of strong interdependence a group gets united by sharing a common purpose and displays high involvement of all group members. Joint activity brings people together and encourages them to collaborate, so that no member of the group is left out. Research accomplished through cooperation appears to be more logical, sound and valid, its results are usually better grounded and supported by thorough argumentation. Cooperative work triggers creativity and encourages group members to think outside the box.

Group work in the classroom may occasionally result in cases of negative interdependence, which in its turn promotes students' competitiveness [6]. It would be a mistake to believe that such experiences should have no place in the learning process. Competition is an intrinsic part of everyday life and people need to adapt to it. Conflicts are real and inevitable, and the ability to win can hardly be overestimated in the modern world.

The study demonstrated that students face problems in cooperative learning when they lack interpersonal skills, personal responsibility and the desire to achieve a common goal. Sometimes it was possible to observe a situation when more efficient students did most of the work, while the others just waited for the result. Therefore, we developed our own assessment strategy which takes into account both the contribution of each member of the group and the collective results.

Working in groups gives students a number of advantages. They do not get easily distracted and are more likely to stay focused on the given task longer than those who study individually. Students adopt a more positive attitude towards the topics they study working together rather than in individual or competitive learning environments. They are more eager to revise, broaden and increase the knowledge they have acquired. Likewise, students develop a positive attitude towards the subject and the entire educational process.

As a result of our project, the students created E-portfolios, which can serve an instrument for measuring the quality of the learning process [7].

Listed below are the basic principles underlying the strategy we designed to ensure the efficient group work:

- students are oriented towards a common goal which serves as an additional source of motivation;
- all members of the group are taught to take responsibility for the achievements of their group mates and the whole group;
- when one succeeds, all are winners; when one fails, all are losers;
- the need for mutual help and support;
- developing mutual feelings of trust and care;
- cultivating the atmosphere of friendly and supportive relationships.

As a result of positive interdependence, team members develop skills necessary for efficient cooperation. Every member of the group is expected to use these skills while working together. The focus on academic tasks, techniques to solve them and ways of cooperation favours the acquisition of skills necessary for interaction in the classroom. As part of the project, the group regularly review their performance outcomes, thus ensuring continuous progress, improving the quality of their work, contributing to the development of their cooperative skills and successful achievement of the learning goals. Effective cooperation of all group members grows into fully-fledged collaboration. All participants relate to each other and work side by side on a joint project. There is sufficient experimental evidence that such groups can cope with the tasks that individual members fail to complete. To ensure the effective work of groups, the following pedagogical approaches and techniques were used:

- partnership of group members;
- development of group work skills;
- heterogeneous grouping;
- combined use of individual and peer assessment;
- teacher's monitoring of the students' work;
- focus on the task and group work skills;
- chance for every member to be a leader;
- essential feedback.

Working on the project, students were asked to divide the responsibilities by taking on specific roles (table 1). By taking a certain role each student is supposed to demonstrate the behavior others can expect from him/her and a certain reaction towards other members' behavior.

Table 1. Functional Roles of Group Members

Title of the role	List of rights and duties	Characteristic personal qualities and positive features
Chairperson	leads the way to achieve the common goal; is able to identify the strengths and weaknesses of the team members	ingenious, self-confident, with good self-control; impartial and unbiased; high ambition to reach success
Idea man	generates new ideas and strategies highlighting the core issues; strives to bring innovation;	individualist, scientifically-minded; smart and imaginative, knowledgeable and gifted
Expert	adopts a pragmatic approach to analyze problems, weighs the ideas for the group members to make a decision;	tolerant, reserved, cautious, reasonable; common sense, rationality, determination;
Implementer	brings plans and concepts into action; makes an objective judgment of feasibility of a decision;	realist, experienced and well-versed in practical matters; self-disciplined, organized; systemic in approach to business;
Promoter	spots and communicates new ideas and updates available outside the group, establishing external contacts;	conservative with a strong sense of duty, great communication skills, sensible, self-disciplined, inquisitive, sociable;
Supervisor	encourages the team members to persist and maintain the purpose, takes effort to eliminate mistakes	capable of completing tasks, scrupulous and demanding; diligent and accurate in carrying out tasks;
Team worker	coordinates the work of group members; offers help in difficulties, keeps up the team spirit	kind, sensitive, ready to meet the needs of the group members, creates friendly atmosphere

Although in many cases the above mentioned roles are conventional, they help teachers and group members to focus on the subject matter and social elements of their work:

- elements related to the subject matter of the task. They are necessary for the effective division of work among team members (for example, the idea man puts forward new ideas and strategies, the implementer weighs pros and cons of the solution, the supervisor strives to eliminate the mistakes);
- social elements help team members to build effective working relationships (the promoter manages cooperation of group members, the chairperson guides the way for the group to achieve success, a team worker coordinates the work and keeps up the morale of the group members).

Our research was performed at the Joint Laboratory of the Institute of Information Technologies and Learning Tools of the National Academy of Educational Sciences of Ukraine, and Ternopil Volodymyr Hnatiuk National Pedagogical University [10].

A systematic use of external academic clouds is significant to form professional skills in a future IT specialist [2]. The public and private platforms are integrated in the academic cloud of Ternopil V. Hnatyuk National Pedagogical University. We have constructed the diagram of the model of using cloud technologies (Fig 1.)

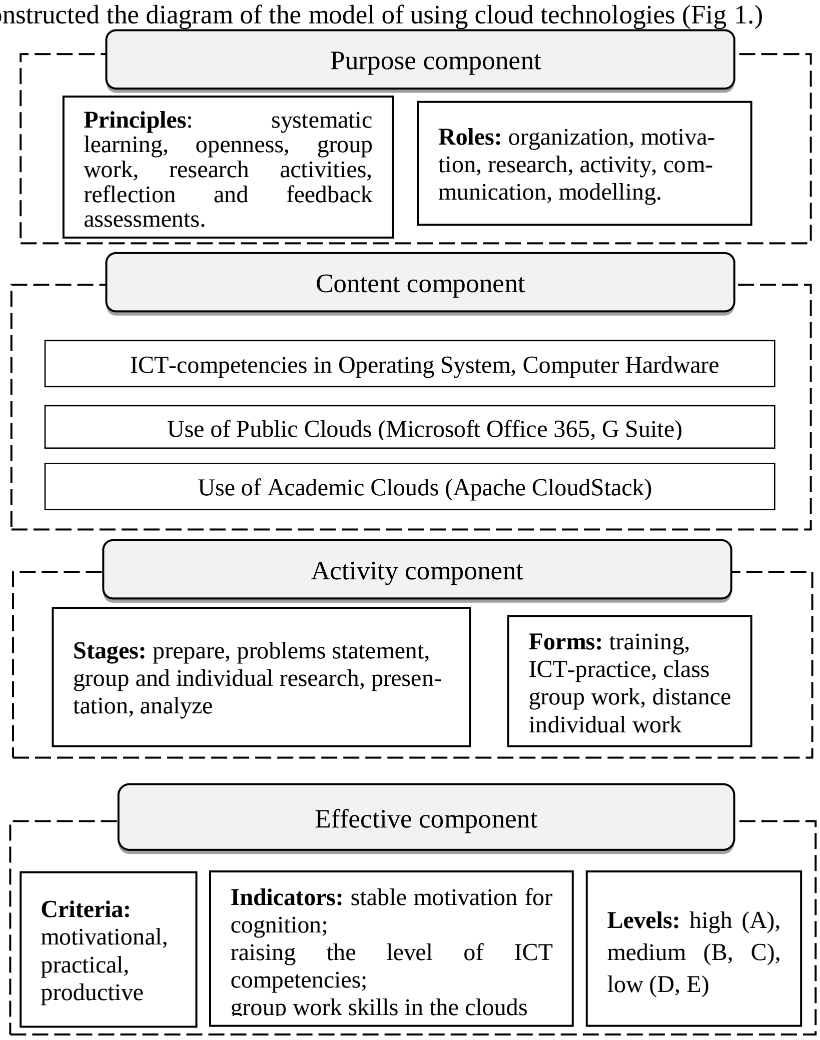

Fig. 1. Functional-structural diagram of the authors' model

Students used the public cloud tools (Google Suite and Microsoft Office 365) to:

- discuss study-related questions in open and private groups;
- plan and coordinate their group work;
- create and edit educational materials of E-portfolios (diagrams, reports, brochures, leaflets, infographics);
- access files;

- post and share videos demonstrating problem-solving procedures;
- give feedback.

To verify the efficiency of our methodology, we conducted an experiment involving 5 basic groups (BG) of 20 students and 5 experimental groups (EG) of 20 students. All the groups were of mixed type, i.e. with students from different departments (ICT, Mathematics, Physics). All the participants had the same task to carry out, namely, to repair computer operational system (real or virtual). Students from experimental groups used the virtual machines from the academic cloud based on CloudStack platform. Students from basic groups used real computers. The validity of the experiment was ensured by meeting the following requirements:

- random grouping;
- classes in basic and experimental groups were delivered by the same teacher;
- standard system of assessment (A (90-100 points), B (85-89 points), C (75-84 points), D (65-74 points), E (60-64 points), F (less than 60 points)).

Working with real or virtual computers, students from basic and experimental groups tried to recover their operating system. They performed the following operations:

- recovery of deleted data;
- migration of operating systems to another hardware;
- performance optimization of VMs and real computers;
- recovery of operating systems after BDOS;
- virus removal.

Taking into consideration the tasks of the project, we had the following requirements to the teaching of the experimental groups:

- the study of information systems on the basis of their educational models – virtual computers;
- virtual objects matching real information systems;
- teachers and students can change the object of study to suit their personal needs;
- unlimited access to cloud services via LAN of the educational institution and the Internet;
- personalized access to computational resources, preferably using single sign-on authentication.

Before the start of the project we got ready 20 virtual and 20 real computers for each student of the above-mentioned groups. It is commonly known that CloudStack platform provides possibilities to reinstall VMs and take their snapshots. So in case students from the experimental groups failed to complete the task, it was possible to start from the very beginning. User authentication was carried out in LDAP directory of Microsoft Active Directory. It allows users to use single sign-on authentication in order to access local and cloud services. Unlimited access was secured by VPN-server which also carried out authentication via LDAP. To divide participants into experimental groups a few Apache CloudStack domains and projects were used. Group leaders were assigned the role of administrators in charge of all the VMs.

Deployed cloud infrastructure contains such elements: 1 zone, 1 pod, 1 cluster, 3 hosts, 3 primary and 1 secondary storages. In our academic cloud, Apache CloudStack provides: running a large number of instances of VMs; connection of VMs through physical and virtual networks; access to VMs through web-interface and standard protocols; distribution of computing resources for VMs; creation of template and snapshot of VMs; integrated authentication based on LDAP-directory.

At the first stage of the experiment we analyzed the final marks received by the students of the both groups in the course "Operating systems". The marks were given on a 100-point scale. To compare the marks, we used nonparametric Mann–Whitney U test for 2 independent samples [4]. Two hypotheses were made:

- H_0 – the differences between marks in BG and EG are random.
- H_1 – the differences between marks in BG and EG are regular.

Marks of both groups were combined in order of increasing. Every mark was assigned a rank. For the same marks an average value of the sum of their ranks was assigned. For both groups we calculated the rank sums (R1 for BG and R2 for EG). As a result, we got the following table:

Table 2. Distribution of students in BG and EG.

Student	Grade in BG	Rank 1	Grade in EG	Rank 2
1	92	40	91	39
…	…	…	…	…
20	45	2	42	1

U_{exp} is then given by:

$$U_{exp} = n_1 \times n_2 + \frac{n_1(n_1+n_2)}{2} - R_x \qquad (1),$$

where n1 – student numbers in BG, n2 – student numbers in EG, Rx – maximum of R1 and R2. Calculated value of Uexp=189, which is more than critical 138 (for α=0.05). Uexp>Ucr. So the null hypothesis H0 that the mark distributions of both groups are equal proved to be true.

Student academic performance was assessed according to such levels of achievement: A (90-100 points), B (85-89 points), C (75-84 points), D (65-74 points), E (60-64 points), F (less than 60 points). The diagram below features the results of the assessment of student performance.

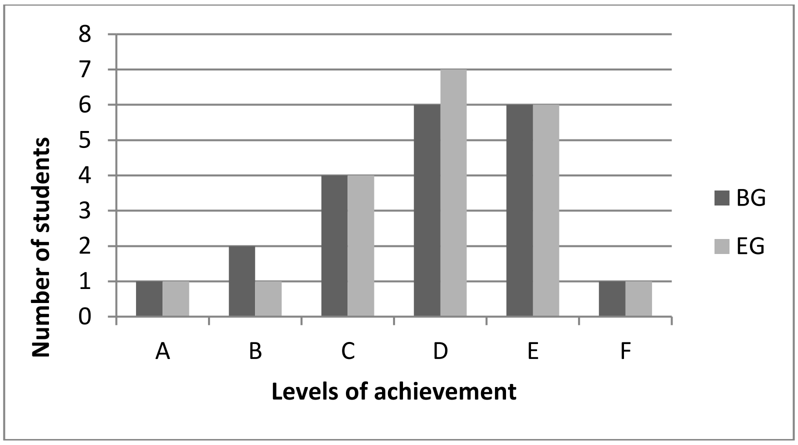

Fig. 2. Student performance results at the first stage

At the second stage students solved practical tasks. They produced their results as group and individual portfolios. We rated works of the students on the same 100-point scale. After that we compared the grades received by students in EG (EG-1 and EG-2) at the first and second stages (fig. 3).

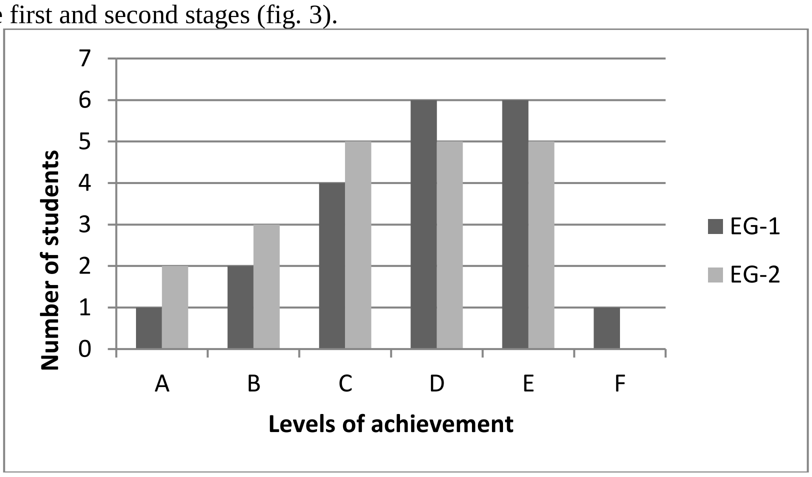

Fig. 3. Student performance results in final testing

To verify regularity of the differences in grades at first and second stages we used the nonparametric Wilcoxon rank sum test for 2 related samples [4]. Two hypotheses were made:

- H_0 – students' marks at the 2nd stage exceed their marks at the 1st stage;
- H_1 – students' marks at the 2nd stage do not exceed their marks at the 1st stage.

For each student we calculated the shift of their marks at the first and second stages (table 3).

Table 3. Distribution of students in EG at the first and second stages.

Student	Grade in 1st stage	Grade in 2nd stage	Difference	Positive rank (Rp)	Negative rank (Rn)
1	91	94	3	6.5	
…	…	…	…	…	
20	42	60	15	20	

W_{exp} is then given by:

$$W_{exp} = \sum_{k=0}^{20} R\,p_i + \sum_{k=0}^{20} N\,p_i \qquad (2)$$

In our research all Npi=0. Calculated value of Wexp=210, which is more than critical 60 (for α=0.05). Wexp>Wcr.. So the null hypothesis H0 proved to be true. Hence, the results of the experiment testify to the efficiency of the developed learning strategy. The higher level of the second group is the result of the students' work in the academic cloud based on our methodology.

3 Conclusions

The conducted research allowed us to make the following conclusions:

1. Traditional system of education too often puts students into the competition conditions, rarely preparing future professionals for work in a team in the environment of positive interdependence.
2. There are objective conditions for using group methodology in training future computer science teachers.
3. The current level of cloud technology development makes the group project training technology open and easily accessible.
4. The applying of the suggested methodology can be an effective tool in solving several problems, organizational, technological, psychological and social.

Our research has experimentally proved the efficiency of the project method in training future computer science teachers. The proposed training technology raises students' cognitive interest, allows them to develop essential professional skills, ability to work in a team and sense of responsibility for their joint effort.

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