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Flipped Learning Model: Tools and Experience of Its Implementation in Higher Education

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Abstract

The introduction of information and communication technologies constitutes one of the conditions for higher education development as well as a catalyst for enhancing ICT competences of all those involved in the educational process in order to form their 21st century skills. The article presents experience in the implementation of flipped learning in Ukraine and Poland. It also describes scenarios and collaboration tools for students' practical activity, provides examples of learning objects representing resources for independent study and research, and criteria for assessing the effectiveness of the proposed model.

Keywords: *information and educational environment, experience, flipped learning model, electronic resources*

Introduction

Analysis of the impact of macro-, mezzo- and micro-trends and design of educational environments and models are the subject of research of scientists and educators. Observations show (Riel Miller, Hanne Shapiro, Knud Erik Hilding-Hamann, 2008) that the global context in which learning takes place varies in a systematic way and is influenced by many factors.

Higher education differs by the fact that within its system new knowledge in society's cultural, social and economic spheres is created and used. Since the creation of new knowledge and technologies requires a high level of motivation

and training, teaching students should take into account educational trends (Blake Beus, 2017) and pedagogical technologies.

Research Problem

The demands of the modern knowledge society determine the policies of universities whose tasks include: creation, dissemination of knowledge, training graduates and teachers and renewal of knowledge (UNESCO world report, 2005). In addition, increasing the role of learning in the global knowledge society is creating new economic opportunities, particularly for the provision of non-profit educational services, which, in turn, requires quality and efficiency (ISO Standard, 2010).

To achieve these objectives, it is necessary both to reduce the "digital divide" and the real "knowledge gap".

Learning new information and communication technologies and their integration into the educational processes require learner training. The dynamics of such processes requires flexibility of modern universities to ensure the implementation of the demands of society through innovative teaching and IC-technologies.

Research Focus

Research Methodology

To develop 21st century skills, creation of a personal learning environment (PLE) for students is preferred. This assumes that a learning platform can be combined with independent and web-based applications, such as Web 2.0 tools (Facebook, electronic journals etc.) and group interaction tools (social networks, Google Apps). Consequently, an open architecture that can include and/or can be easily compatible with web resources is needed for learning platforms (UNESCO Policy Brief, 2011).

PLE is a result of the evolution of Web 2.0 and its impact on education. Access to education is access to resources and services allowing for both using educational resources and creating them.

Research General Background. Flipped Learning Model

The quality of higher education instruction is increasingly dependent on ICT skills. The application of these technologies requires not only the creation of open information environments (Morze, Kuzminska and Protsenko, 2013), but also changes in the educational process. However, the institutional environment

is lagging behind when it comes to solving technological problems, as ICT themselves do not increase productivity, but offer opportunities to create new technologies.

Partial reduction of this gap is possible in the case of flipped learning (Figure 1).

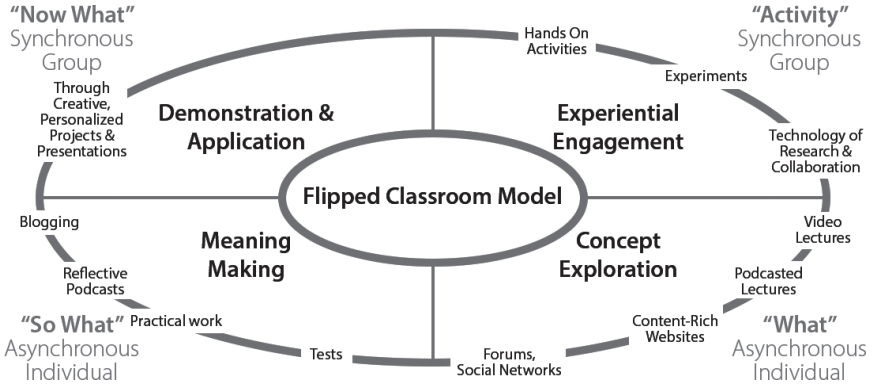

Figure 1. Flipped learning model
Source: Own work based on https://usergeneratededucation.wordpress.com/2011/06/13/the-flipped-classroom-model-a-full-picture/

Authors and researchers have attempted to analyze flipped classrooms. M.J.D. Souza and P. Rodrigues (2015) conducted research on investigating the effectiveness of the flipped classroom in an introductory programming course. Flipped classrooms for legal education were studied by L.M. Rosen (2017); J. Jovanovic, D. Gasevic, S. Dawson, A. Pardo, N. Mirriahi conducted learning analytics to reveal learning strategies in a flipped classroom (2017); the effectiveness of a technology-enhanced flipped science classroom was in the focus of the research conducted by B. Sezer (2017). J. Chih-Yuan Sun, Yu-Ting Wu, Wei-I Lee studied the effect of the flipped classroom approach to Open Course Ware instruction on students' self-regulation (2017).

Research Sample

Higher education programs are increasingly using flipped learning. There is no single model of flipped learning - a term widely used to describe all activities based on the viewing of pre-recorded lectures followed by discussion in the classroom. Above all, learning is not an end in itself, it is a starting point.

Research purpose and questions

The purpose of this study was to examine flipped learning effectiveness at universities. To study the possibility of scaling the approaches proposed by the authors, students of different specialties of Polish and Ukrainian universities took part in the study.

The questions of the study considered the students' perception of flipped teaching vs. the traditional approach: a) whether training with the use of the flipped model affects the quality of teaching; b) what value do they attribute to the use of the teaching learning method for the implementation of collective projects; c) did the proposed course influence their attitude to learning and developing skills of a successful specialist? The motivation for conducting this research was to demonstrate that reverse instruction in the classroom would be useful for teaching – student learning.

Participants

The participants in this study were students with roughly the same level of basic skills in MS Office in the Polish University of Silesia in Katowice and two Ukrainian universities: Borys Grinchenko Kiyv University and National University of Life and Environmental Sciences of Ukraine. A student requirements analysis was carried out and a module "Information technology" was designed for the students for studying with the use of flipped training. The group that completed the elective module comprised 152 students (70 Polish, 82 Ukrainian).

Research results

Data Analysis and analysis of requirements and pedagogical design

A survey conducted among the students of Ukrainian universities: NUBiP of Ukraine and Borys Grinchenko Kyiv University (https://goo.gl/forms/wcOC9Xoc4eQxlDK02) and the University of Silesia in Katowice (https://goo.gl/forms/6oEBJjwXEYxwLGTM2) found that:

- the students consider their experience and needs (53% of Ukrainian students and 50% of Polish students) and labor market requirements (50% of Polish students and 39.4% Ukrainian students) as the basis for studying;
- combining theory with practical training motivates for a deeper self-study of the topic (50% of the students from the Polish University, and 51.5% Ukrainian students);

- students use online tools for collaborative product and knowledge development (56.1% of Ukrainian students and 50% of Polish students); discussion and consultation (55.3% of Ukrainian students and 28% of Polish students).

Analysis of the survey determines differences in the Ukrainian and Polish students' attitudes to the organization of the university educational process. For instance, the Polish students are more oriented to labor market requirements in determining the selection criteria of the profession, whereas the Ukrainian students need more consultation during the learning process. Yet, these differences are not fundamental, so today's students are customers and active participants in the educational process. In addition, they are representatives of Generation Y and Z (McCrindle, 2014). They have certain technical skills, while their teachers need ICT support.

That is why one of the objectives of the university is the development of professional and ICT competences of students and teachers.

Flipped learning is based on such ideas as active learning and student involvement. The value of flipped learning lies in using class time for study group sessions, with students discussing lectures or interacting with each other.

Design activity to organize flipped learning should be based on the TOTE model (Chris Delaney, 2013). One should define students' default orientations (motivation, willingness to use ICT), on designing a learning environment to meet modern educational resources (e.g., Top 200 Tools for Learning 2016, http://c4lpt.co.uk/top100tools/) and students' learning styles, designing activities and ICT support, e.g., according to Bloom's Taxonomy, setting activities and ICT-support and A Revision of Bloom's Taxonomy of Educational Objectives (Anderson, Krathwohl, 2001).

Although this model is attractive in its simplicity, effective "flipping" requires careful preparation and new skills from teachers (Bergmann and Sams, 2014).

Discussion

Methodology for introducing the model of flipped learning and student achievement

Let us examine examples of the implementation of flipped learning in the Ukrainian and Polish Universities in the teaching of disciplines of the Information Technology cycle or during introduction to the module "Information technology".

We propose to use the term "learning object" when referring to the flipped classroom.

The tasks for organizing the first stage were selected according to the requirements relating to the application of Internet technologies in professional activity (Geoffrey C. Fox, 1999). Because LMS Moodle is used in the Polish and Ukrainian universities, this platform was used to create an e-course. The purpose of this stage (2–4 weeks of each module study) is to systematize the knowledge acquired earlier and evaluate the benefits of using the flipped training modules.

The selection of tools and forms of the presentation of material in the e-course should be based on learning styles. This design should be flexible. However, there are general guidelines, e.g., to present theoretical information as video resources or as text formats.

As a result, apart from the evaluation of academic achievement, students gain experience in using electronic resources and independent work (Table 1).

Table 1. Implementation of flipped learning based on an e-learning course at university

Resources (LMS Moodle)	Compliance with the flipped learning model
INPUT KNOWLEDGE AND RECOMMENDED RESOURCES	
Forum (discussion, question-answer)	Realizing the result
Text (identification of the level of students' input knowledge)	Realizing the result
Hyperlink to an external resource (self-education)	Concept exploration
Theoretical materials and practical work	
Lesson (studying and verification by testing)	Concept exploration
File, hyperlink (visualization for teaching theory to discuss)	Experiential engagement
Tasks (processing of theoretical material)	Experiential engagement
Quality control and reflection	
Test (control of mastering)	Realizing the result
Seminar (design template, evaluation criteria, and self-evaluation)	Experiential engagement
Forum (video presentations and discussion)	Demonstration and application,

In response to the question "Rate the effectiveness of the course materials and learning activities" (Table 2), the mean was 8.7 for flipped treatment and 7.0 for regular treatment (1 represents extremely ineffective, 10 - extremely effective). Because the survey data have a normal distribution, the Student's T distribution was used to assess the significance of various mean values.

Table 2. Average weekly results of the question: How valuable were the learning activities and materials?

	Poland		Ukraine		
	University of Silesia (n=70)	Borys Grinchenko University (n=42)	University of Life and Environmental Sciences (n=40)	Total (n=82)	TOTAL (n=152)
Regular classroom (Previous experience)					
Form for submitting materials (LMS Moodle)	7.5±0.21	7.5±0.3	7.3±0.22	7.4±0.26	7.4±0.26
Getting help	7.0±0.24	6.5±0.25	6.5±0.22	6.5±0.24	6.7±0.23
Study (in classroom)	8.0±0.22	8.2±0.22	8.3±0.24	8.3±0.24	8.2±0.24
Homework	6.5±0.28	6.5±0.24	6.3±0.28	6.4±0.22	6.4±0.25
Practical experience	6,0±0.26	6.5±0.12	6.0±0.22	6.3±0.28	6.2±0.26
Total	7.0±0.28	7.0±0.25	6,9±0,22	7,0±0.26	7.0±0.25
Flipped classroom (experiment)					
Form for submitting materials (LMS Moodle)	8.2±0.18	8.5±0.22	8.6±0.24	8.6±0.22	8.4±0.25
Getting help	9.0±0.22	8.6±0.24	8.5±0.22	8.6±0.28	8.7±0.28
Study (in classroom)	8.2±0.22	8.5±0.24	8.5±0.25	8.5±0.26	8.4±0.26
Homework	8.5±0.28	8.2±0.3	8.3±0.22	8.3±0.25	8.3±0.25
Practical experience	9.5±0.16	9.5±0.24	9.4±0.18	9.5±0.22	9.5±0.22
Total	8.7±0.22	8.7±0.25	8.7±0.26	8.7±0.28	8.7±0.28

Calculation of the Student's T distribution values for assessing the experience of traditional training of the Ukrainian students $T = 0.30$, $Tcr = 1.99$ at the significance level $\alpha = 0.05$ ($f = 80$) shows that the differences are not statistically significant ($p > 0.05$). Similar results show a comparison of the assessments of the Polish and Ukrainian students both from the experience of traditional training and from the flipped classroom. A statistical analysis of survey data shows that the survey results relating to the Ukrainian and Polish students were not significantly different. However, there are differences in respect of traditional teaching and flipped teaching. The latter method achieved higher score and, taking into account the fact that the opinions were not country-dependent, we can assume that this was an objective result: $T=4.53$, $Tcr_{=} 1.972$ at the significance level of **$\alpha = 0.05$ ($f = 302$)**.

At the second stage, the teacher's task is to organize team work for students to solve a particular assignment (Table 3). These tasks can be considered as integrating students' educational, scientific and social needs into real life or career.

For instance, the following tasks for IT students and future teachers specializing in *Management of e-learning* were suggested: to create proposals for the establishment and equipping of a computer class.

The proposal in this context is a set of documents and resources, including the selection of appropriate software and hardware, creating a layout of the audience, a SWOT analysis and presentation of ideas.

Table 3. Implementation of flipped learning by implementing learning teamwork and creating student PLE

Tasks	PLE resources examples
Experiential engagement	
Organization of group work	Google Apps, Microsoft Office 365
Communication of participants	Facebook,
Selection of resources and tools	MS Office, Google Apps
Creating resources and their integration	Google Sites, YouTube
Concept exploration	
Theoretical materials and embodiments	Moodle, Google Classroom,
Learning videos	YouTube
Instructions for the organization of work, presentation of results	Wiki, Google Docx,
Forms of assessment	Google Forms
Realizing the result	
Tests	Kahoot, Survey
Questionnaires and checklists	Google Apps
Project blog	Google Sites
Demonstration and application	
Project presentation	Prezi, Slideshark
Video Essays	YouTube
Electronic assessment	Google Apps

To determine the effectiveness of flipped learning, forms of the assessment of teamwork and student creativity were used (Intel, 2010). Assessments of the degree of developing information literacy skills and 21st century skills were carried out according to the UNESCO recommendations (Catts & Lau, 2008).

At the end of the 2nd stage, an expert evaluation of the students' solutions was made. Two categories of experts were appointed: students and teachers from among the experiment participants. The criteria used included proposal development quality, the quality of the e-materials, the prospects for practical implementation.

One of the final evaluation methods that was used as an experiment to implement the flipped learning model was the self-evaluation method. The questionnaire method was chosen for self-evaluation. The questions were combined into two groups: those that are measured quantitatively and qualitatively. The questions chosen for the students and teachers were the same. Considering some of the features of studying at universities in these countries, only the results of the survey questions evaluated qualitatively can be offered (Figure 3). These questions are divided into 3 categories: the implementation of flipped learning based on an e-learning course (Table 1), the implementation of flipped learning by learning teamwork and creating of student PLE (Table 3), forming 21st century skills.

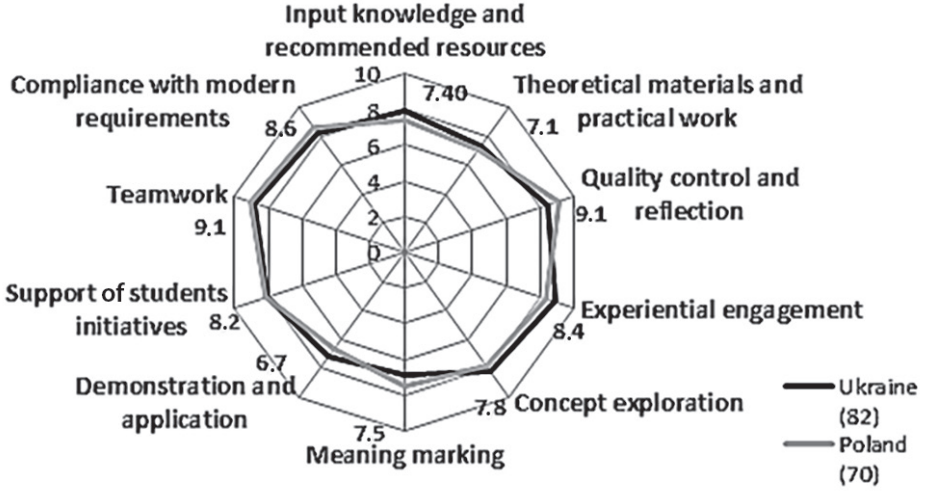

Figure 3. Self-efficacy of student flipped classroom model
Source: Own work

On the basis of statistical data processing (Table 4), it can be assumed that the proposed case of using the flipped learning model received a positive assessment, regardless of the students' country and specialty. For degrees of freedom f = 150,

the critical value of the Student's T distribution is Tcr = 1.977, with the significance level α = 0.05. Differences are statistically significant (p> 0.05) only in the case of Meaning marking, which can be explained by different approaches in the implementation of decision making by the Ukrainian and Polish students.

Table 4. Results of self-efficacy of student flipped classroom model

Indexes	Ukraine (82)	Poland (70)	Student's T distribution value (T)	Difference (T_{cr}-T)
Input knowledge and recommended resources	7.92±0.22	7.40±0.2	1.75	0.2
Theoretical materials and practical work	7.4±0.22	7.1±0.12	1.2	0.8
Quality control and reflection	8.5±0.24	9.1±0.22	1.84	0.2
Experiential engagement	8.9±0.17	8.4±0.25	1.65	0.3
Concept exploration	8.2±0.24	7.8±0.18	1.33	0.7
Meaning marking	6.9±0.13	7.5±0.22	2.56	-0.6
Demonstration and application	7.2±0.24	6.7±0.18	1.67	0.3
Support of students initiatives	8.1±0.22	8.2±0.25	0.3	1.7
Teamwork	8.8±0.24	9.1±0.19	0.98	1.0
Compliance with modern requirements	8.2±0.18	8.6±0.22	1.41	0.6

Source: Own work

The strengths and weaknesses of flipped learning were identified. The results of the experiment, carried out in the two countries, are the basis for the confirmation of the hypothesis of the effectiveness of this model.

The positive feedback of our students on what makes flipped learning attractive is also important:

- Contemporary students show a high familiarity with flipped learning, as they use the Internet and social networks in everyday life.

The final questionnaires also allowed for expressing suggestions regarding the introduction of flipped learning in specialist training. These included:

- improving the quality of education, applying the method of flipped learning in the study of all disciplines;
- completing the training of each subject with collective project work;
- involving specialists in the evaluation of the results of the implementation of projects that will both increase the motivation of students, as well as opportunities for internships and academic mobility;

Conclusions

On the basis of these results, we can draw the following conclusions:

1. Development of students' 21st century skills and information literacy in the implementation of the flipped learning model is provided in the implementation of the following pedagogical requirements:
   - students' involvement in independent cognitive and practical activities;
   - use of modern information technology and services
   - parity of research positions 'teacher-student', 'student-student'
2. The leading characteristics of students' activity in the proposed model is the individual's capability of system and divergent thinking, independent learning, self-awareness and decision-making.
3. When adopting flipped learning, universities may have to pay close attention to space in the classroom to ensure the possibility of maintaining active and collaborative activities.

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