EduAkcja. Magazyn edukacji elektronicznej
nr 1 (15)/2018, str. 14—22

Improving the involvement of students and their performance through the use of flipped classroom technology

Kuzminska Olena

National University of Life and Environmental Sciences of Ukraine

o.kuzminska@nubip.edu.ua

Abstract: Widespread introduction of information and communication technologies (ICT) is one of the conditions of higher education development to the level of international standards. It is also a catalyst of enhancing the ICT competences of all involved in the educational process, in order to form their XXI century skills. The article presents the experience gained in implementation of a flipped learning model in the National University of Life and Environmental Sciences of Ukraine. The article describes scenarios and collaboration tools for practical activity of students, provides examples of learning objects representing resources for independent study and research, and criteria for assessing the effectiveness of the proposed model.

Keywords: information environment, experience, flipped classroom

1. Tasks of modern higher education

Higher education differs from primary and secondary education not only by the age and level of students' knowledge, but also by the fact that within its system a new knowledge in the cultural, social and economic spheres of society are created and used.

Universities are, in a certain sense, the "mirror" of society. At the same time, the demands of the modern knowledge society determine the policies of university education, the main tasks of which include: the creation, dissemination and use of knowledge, training competitive graduates, training for teachers, transfer of knowledge to the broadest range of people, provision of the renewal of knowledge in areas prone to constant changes (UNESCO world report, 2005). This primarily concerns the integration of ICT in the educational process and scientific activities. In addition, increasing the role of learning in the global knowledge society creates new economic opportunities, in particular for the provision of non-profit educational services, which, in turn, requires the provision of quality and efficiency (ISO Standard, 2010).

To achieve these objectives it is not enough to reduce the "digital divide", it is also necessary to reduce the "cognitive gap", real "knowledge gap", which can get an exponential scale.

For learning of new information and communication technologies and their integration into the educational, economic and political processes, a high level of training of their members is required. The dynamic of processes described requires flexibility of modern universities to ensure the implementation of the demands of society (and sometimes – their prediction) through the introduction of innovative teaching and IC-technologies to the educational process and scientific activities.

2. Informational and educational environment of an university

According to the theory of connectionism, learning is a process of creating a network with nodes which can include people, institutions, libraries, Internet resources, books, databases, etc. The

learning process consists of creation of an external network of nodes used as data and knowledge sources of information and educational environment. Considering the learning process from the perspective of networking, we can distinguish its following features:

- learning cannot be fully controlled by personality – it needs external support, which in conjunction with the resources (informational, methodological, organizational, etc.) will help to reach a higher level of understanding of educational materials and production of new knowledge;
- learning requires a variety of technologies and optimal choice, mobility and flexibility in the choice of resources, methods and means that is more important than existing knowledge;
- teaching and learning – is always a process, where the ability to make connections across disciplines, concepts and ideas is the key;
- learning is a continuous process of decision making.

The features described above complement the concept of information literacy, and their understanding and implementation (Catts and Lau, 2008) are in line with students' XXI century skills, which include: citizenship, life and career personal and social responsibility, creativity, critical thinking, problem-solving, decision-making, information and communications technology (ICT) and information literacy, communication and collaboration (Binkley et al., 2012).

The digital content of a new type, which is composed of digital multimedia archives of learning objects, combining information resources from different scientific disciplines (that are built on the principles of knowledge management systems) is the basis for the electronic informational and educational environment of the university (Morze, Kuzminska and Protsenko, 2013) in terms of its content.

However, it should be noted that the observed emergence of a large number of different Web-based applications in recent years, promotes more widespread use of electronic educational resources: various types of educational applications and platforms, including social networking services (SNS), wikis, blogs, user-created content (UCC), data warehouse, etc. This electronic content definitely gets key role in supporting learning activities and consists of the resources derived from a variety of sources via multiple learning platforms, as well as from the Internet.

Nevertheless, in order to make an optimal use of new educational applications and platforms and to develop learning process, access and the results should be coordinated through such learning platforms as a centralized learning management system (eg. LMS Moodle) and PLE (personal learning environment – personalized learning environment for teachers and students), which helps to manage the learning process (Weller, 2010).

The main indicator of the successful use of the resources of open informational and educational environment is their quality and creation of a comfortable and open service for collaboration of all stakeholders: students, teachers, and administrators.

However, this does not mean that all connections for collaboration and communication should be provided by a single learning platform. To develop the XXI century skills a creation of personal learning environment (PLE) for students is preferred. This leads to a conclusion that a learning platform can be combined with a variety of independent and web-based applications, such as Web 2.0 tools (Facebook, Twitter, Flicker, YouTube, Wiki-environment, electronic journals, institutional repositories, etc.), group interaction tools (social networks, Google Apps) and evaluation of activities, simulation tools, etc. 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).

3. Flipped learning model

The quality of training in any higher education institution is increasingly dependent on ICT skills, particularly on how to obtain the necessary knowledge and how to share it. An effective application of these technologies requires not only the creation of open information environments of higher education institutions as catalysts for improving ICT competencies of their subjects, but also changes in the educational process and scientific research in order to form the XXI century skills. However, lag of institutional environment from proper solutions of technological problems is naturally considerable – ICT by themselves do not increase productivity, but offer opportunities to create a large number of new technologies.

Partial reduction of this gap is possible in a case of the flipped learning model usage (Fig.1).

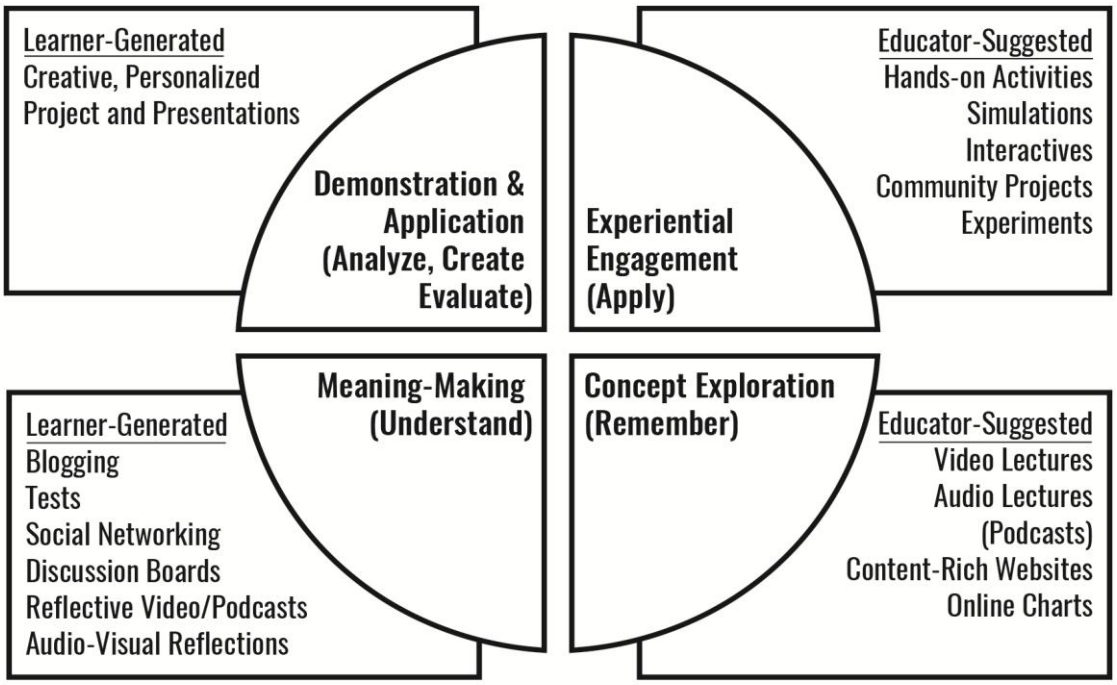

Figure 1. Flipped learning model

The popularity of using the Flipped learning model is confirmed by a graph obtained with Google Trends. Key terms are Flipped Class and Flipped Learning (Fig.2).

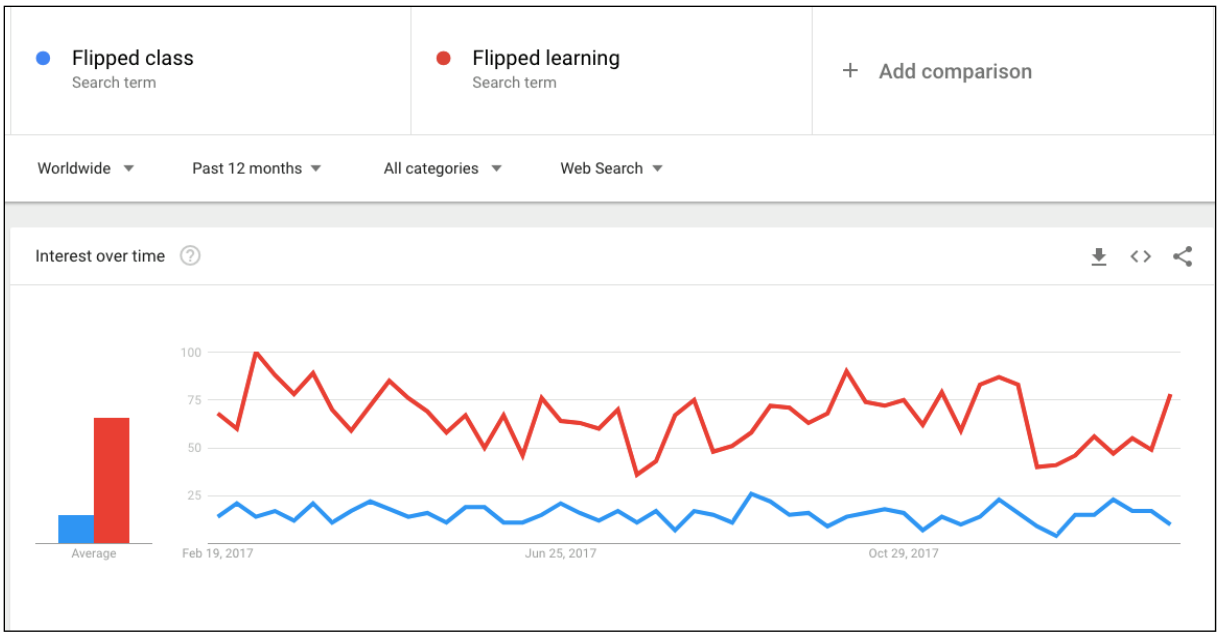

Figure 2. The popularity of the Flipped learning model

An increasing number of higher education programs use flipped learning models. However, despite the effectiveness of this educational technology (https://www.pinterest.com/pin/445012006900136123/), there is no single model of an flipped learning – a term widely used to describe the structure of virtually all activities that are based on the viewing of pre-recorded lectures followed by discussion directly in the classroom. Above all, the learning is not an end in itself, and becomes a starting point. Emphasis is put on the process of cognitive activity in which the student, discovers new knowledge within the content.

For example, at the University of Algonquin lessons with video lectures were used to explain the principles of editing software, which is notoriously difficult to explain in terms of standard lectures. Short educational video lectures allow students to move on to the topic at their own pace, rewinding record for review of important points and skipping those parts of the material which they are already familiar with. All this helps to ensure that students come to class prepared to use the software and are able to do creative projects with other students. There are also other examples of the use of flipped learning technology at the University of Pennsylvania – in the field of accounting, the study of physics at Harvard University, etc. (EDUCAUSE, 2012).

The concept of a flipped learning is based on such ideas as an active learning, involvement of students in the overall operations, technologies of blended learning and, of course, podcast. The value of a flipped classroom is in the possibility to use class time for study group sessions where students can discuss the content of the lecture, test their knowledge and interact with each other in practice. The elements of the class and school learning should be integrated, so that students can understand the principle of this model and have been motivated to prepare for lessons in the classroom. During the learning sessions teacher's role changes – he becomes a coach or consultant, encouraging students to independent research and teamwork. As experts in the field, teachers also offer a variety of approaches, clarify the content and monitor progress with training support for independent research of students.

To apply effectively the flipped learning model, it is important to understand what requirements the participants in the educational process must meet – both those who teach and those who learn. Examples of such requirements are the standards of the International Society for Technology in Education (ISTE, 2016) for students. Some of them are listed below:

- Students should use technological tools in the learning process, as well as "personalize the learning space to deepen knowledge".
- Students should understand the specifics of training in the digital world and act only by safe and legal methods.
- When studying the material, students should think critically.
- It is important not only to study existing materials, but also be able to "solve problems by creating new solutions".

It should be noted that although this model is attractive in its simplicity, the effective "flipping" requires careful preparation and new skills from teacher (Bergmann and Sams, 2014). We are talking about information literacy and ICT competence.

4. Implementation of the model in nules of Ukraine

We often talk about the use of video as an instructional tool, but in fact much of the dialogue about flipped learning has been about videos, which students can view outside the classroom. One of the big mistakes is to focus too much on video. It is proposed to use the term “learning object” when we talk about the flipped classroom in the study of Information Technologies course. A learning objects can include videos, but they also can be resources such as online simulations, books and periodicals, rich content web-sites, courses on CLMS platform, etc.

Implementation of the model of flipped learning was carried out by the author in the process of teaching at the Information Technologies courses in 2014/2016 year. This specialization is elective for masters of 1 year of study.

The motivation for conducting this research was to demonstrate that flipped learning in the classroom would be useful for teaching of student learning.

Problem tasks proposed to students in order to implement the model of Flipped Learning (described in the article as an example) were– to write a proposal on modern computer equipment for an active audience activities and teamwork, common for flipped classes. This proposal and the related documents are to be presented to the University’s Start-Up contest.

The activity is carried out in two stages. The specificity of discipline that is Information Technology involves identifying ICT competencies, both substantive and key (the ability to effectively use ICT in teaching, research, professional and day-to-day activities). The level of acquisition of subject competence is determined by testing students and performing laboratory work in accordance with the curriculum (first stage: individual work). At the second stage, the students implementeducational projects (group work) for acquiring a key ICT competence.

At the first stage (preparatory) the teacher has the leading role of organizing the work of students – the material is studied according to curriculum, using e-learning resources, created on the basis of LMS Moodle (http://elearn.nubip.edu.ua/course/view.php?id=252), and other resources of the digital learning environment of the NULES of Ukraine (http://www.nubip.edu.ua/node/2984).

As a result, besides the evaluation results of the educational achievements on selected topics of the course, students gain experience to use the electronic resources in the educational environment of the University’s independent work on educational materials (Table 1) and a willingness to a group work as a part of the flipped learning model, and hence – the creation of PLE.

Table 1. Implementation of the flipped learning model based on e-learning course, as part of the educational environment of the University

Resources (LMS Moodle) and short annotation	Compliance with flipped learning model
Input knowledge and recommended resources	
Forum (discussion, question-answer)	Meaning marking
Text (identification of the level of students' input knowledge)	Meaning marking
Hyperlink to an external resource (self-education)	Concept exploration
Page (a list of useful resources for learning)	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)	Meaning marking
Seminar (design template, evaluation criteria, and self-evaluation)	Experiential engagement
Forum (video presentations and discussion)	Demonstration and application, Meaning marking

At the second stage the role of the teacher is to assign students to solve a particular problem –that is the creation of proposals for the establishment and equipping of a computer class (implementation of the educational purpose). It is important to assess adequately the input of each student. It is important that not only the leader of the students' group, but each member of the group, gains the necessary research experience.

The proposal contains a set of documents and resources, including the selection of appropriate software and hardware, creating a layout of the audience, financial calculations and SWOT analysis, presentation of ideas, web-resource for discussion and evaluation of proposals.

Table 2. Implementation of the flipped learning model by implementing learning teamwork and creating of students PLE

Tasks	PLE resources examples
Experiential engagement	
Organization of group work	Google Apps
Communication of participants	VKontakte, Facebook
Selection of resources and tools	MS Office, Prezi, Google Apps, ThinkLink …
Creating resources and their integration	Google Sites, Blog, YouTube, Mind Mapping
Concept exploration	
Theoretical materials and embodiments	http://it.nubip.edu.ua/course/view.php?id=147 http://agrowiki.nubip.edu.ua http://video.nubip.edu.ua/
Learning videos	YouTube, http://video.nubip.edu.ua/
Instructions for the organization of work, use of services and present the results of work	http://agrowiki.nubip.edu.ua
Forms of assessment	http://www.intel.com/content/www/us/en/education/k1

	2/assessing-projects/strategies.html
Meaning marking	
Tests	http://it.nubip.edu.ua/course/view.php?id=147
Questionnaires and check-lists	Google Apps
Project blog	Google Sites, Blog
Demonstration and application	
Project presentation	Prezi, http://video.nubip.edu.ua/
Video Essays	YouTube
Electronic assessment	Google Apps, Forums

When implementing the project, the most of responsibility rests on students, giving them an incentive to experiment. Activities may be headed by the students, and communication between students can become the driving force determining process focused on learning through practical skills.

The students are divided into groups of 3-4 persons to implement the project. It's desirable to form the group consisting of students with different level of educational achievements on selected topics of the course. To extend their PLE and raise the level of ICT competencies students are not limited to use the tools offered by professor. The criteria and methods of evaluation are identified and students are notified in advance about them. It is also important to comply the parity of students' self-evaluation, faculty and external experts: IT-specialists, dean and others.

5. Research outcomes

When assessing the effectiveness of the application of the flipped learning model in the study of Information Technology, in addition to assessing students' laboratory work and testing students' knowledge, evaluation strategies (Intel, 2010) were used; in particular, forms for evaluating the teamwork and creativity. Assessments of the degree of developing information literacy skills and XXI century skills were carried out according to the UNESCO recommendations (Catts and Lau, 2008). Informal conversations with students and the reflection of all participants also play an important role in the evaluation system.

Subjects in this study were students with roughly the same level of basic skills in MS Office (the data was obtained from the results of online testing before starting the course) in the National University of Life and Environmental Sciences of Ukraine. From student groups, who completed the Information Technologies course, two groups were formed each year: the control one, in which students were trained by the traditional methodology, and the experimental one– that was taughed by the flipped learning model (Tabl. 3). In total 209 students took part in the experiment.

The research on students' achievements, who studied using flipped learning technology showed more successful results than those students who studied by traditional methods (Tabl. 3).

Table 3. Evaluation results (evaluation ECTS) of the students of experimental group (flipped learning is used) and control group

	N	A (%)	B(%)	C(%)	D(%)	E(%)
2014						
Control group	20	7	15	22	37	19
Experimental group	20	15	22	23	19	21
2015						
Control group	43	43	10	10	24	40

Experimental group	44	44	12	25	26	25
2016						
Control group	41	8	16	20	34	22
Experimental group	40	17	25	25	18	15

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

- this leads to a significant shift in priorities from a simple feed to the work to its improvement;
- flipped learning are close to contemporary students, who use Internet, social networks and various means of communication in their everyday life.

6. Conclusions

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

1. Development of XXI century skills and information literacy of students in the implementation of the flipped learning model is provided in the implementation of the following pedagogical conditions:

- involvement of students in independent cognitive and practical activities;
- creation of the students objective at mastering complex skills of self-education, experimental and scientific creativity;
- the use of modern information technology and services;
- parity of research positions 'teacher-student', 'student-student', willingness to work together to achieve common goal;
- freedom of choice, that is, the implementation of the student's subject position.

2. Leading characteristics of students' activity in the proposed model is the ability of the individual to the system and divergent thinking, independent learning and its use practice, self-organization, self-awareness and reflection, responsible decision-making, cooperation and tolerance.

3. At some level, adopting the flipped learning model, colleges and universities may have to pay close attention to the space in the classroom to ensure the possibility of maintaining active and collaborative activities, prevalent in flipped classes.

4. The need for developing information literacy in teaching at the university by solving problematic tasks (projects) is becoming a major in the teaching process. To find new ways to reach global markets and create new products, successful graduates are needed to be able to create and evaluate creative ideas addressing the real set of requirements and conditions.

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Poprawa zaangażowania studentów i ich osiągów poprzez zastosowanie technologii klasyfikowanej

Słowa kluczowe:środowisko informacyjne, uniwersytet, doświadczenie, klasa odwrócona

Streszczenie: Powszechne wprowadzenie technologii informacyjno-komunikacyjnych (TIK) jest to jeden z warunków podniesienia poziomu wykształcenia wyższego do standardów międzynarodowych.To katalizator podwyszenia kompetencji TIK czestników procesu kształcenia, aby wykształcić u nich umiejętności niezbędne w XXI wieku. Artykuł przedstawia doświadczenie w wprowadzaniu modelu odwróconej klasy na Uniwersytecie Narodowym Biozasobów i Wykorzystanie przyrody Ukrainy: przedstawione są scenariusze i wspólne praktyki studentów, przykłady zasobów obiektów szkoleniowych dla samodzielnego badania, kryteria oceny wydajności zaproponowanego modelu.