E-learning and STEM Education
Scientific Editor Eugenia Smyrnova-Trybulska
"E-learning", 11, Katowice-Cieszyn 2019, pp. 139-160
DOI: 10.34916/el.2019.11.10

HOW TO CREATE AN EFFECTIVE FLIPPED LEARNING SEQUENCE IN HIGHER EDUCATION

Nataliia Morze[1], Viktoriia Vember[2], Liliia Varchenko-Trotsenko[3]
Borys Grinchenko Kyiv University,
18/2 Bulvarno-Kudriavska Str, Kyiv, Ukraine,
[1]n.morze@kubg.edu.ua, [2]v.vember@kubg.edu.ua,
[3]l.varchenko@kubg.edu.ua

Abstract: *This article shows peculiarities and tendencies of flipped learning implementation in the educational process of higher educational institutions, describes the model of flipped learning implementation using e-learning courses. The authors present the results of the survey conducted within the framework of the international project Erasmus + MoPED on flipped learning, participated by bachelor's and master's degree students of the Borys Grinchenko Kyiv University. The article includes an example of a flipped learning sequence based on intended learning outcomes and Bloom's taxonomy. The example provides a list of students' activities, including assessment, and their distribution among the phases of flipped learning sequence: Pre-Phase, Face-To-Face Phase and Post Phase.*

Keywords: flipped learning; educational video; Bloom's taxonomy; intended learning outcomes (ILOs); higher education.

INTRODUCTION

Transformation of society under the influence of digital technologies, change of the labour market requirements to specialists and their competences, peculiarities of modern students' needs in knowledge acquisition sources and methods, practice-oriented learning, dual education system, combining study and field experience require immediate changes in higher education, including changes of educational process organizing and utilization of innovative pedagogical technologies. One of the ways to provide those changes is the implementation of e-learning and distant learning technologies; the development of e-learning courses and other types of e-learning content; standardization in e-learning content and electronic educational environments development and a global shift from Learning Management System (LMS)

to Training Management System (TMS) (Morze, Buinytska, Varchenko-Trotsenko 2016).

Today many educational resources in electronic format placed in the public domain can be divided into two groups: developed learning content and services for content development. Designed scenarios for educational videos, visualizations and presentations sets of questions and tasks can be included to content. Services allow using models for content design, that is a service is a "wrapping" which "wraps" some content for an end user; e-learning courses can be included there. There are open questions left: for which services do we need to create content, which technologies should be used in the process to increase students' positive motivation for learning and ensure quality of their learning?

Recently, the concept of teaching in higher educational institution has been changing from teaching aimed at theoretical materials exploration where a teacher is the main source of information to practice-oriented teaching, students' active involvement in educational process where their needs and peculiarities of teaching z-generation students are considered, which manifests itself in the use of digital technologies and devices as well as different cognitive learning styles. The present labour market sets for higher education the task to train a modern, creative, mobile graduate who has a complex of occupational key competences and is ready to effectively perform their professional activities in the conditions of globalization and informatization of all spheres of the society. The educational process in a modern higher educational institution has to be built on the basis of the use of innovative pedagogical technologies, in particular ICT. These technologies include flipped learning, blended learning, gamification, adaptive learning, microlearning, etc. (NMC Horizon Report, 2018).

That is why in the Borys Grinchenko Kyiv University a lot of attention is paid to e-learning implementation based on the use of electronic content (e-content) including e-learning courses (ELC) and electronic collaboration (e-collaboration) technologies on the basis of the University's designed electronic informational learning environment. The problem that arises is integration of innovative pedagogical technologies with e-learning courses. One of the above-mentioned technologies is flipped learning based on using video materials of new format.

Flipped learning technology has become one of the innovative educational strategies in recent years. It "turns around" direct teaching of disciplines and helps to focus on attracting students' interest to applying gained knowledge and high level of thinking skills formation (Bloom, 1994).

The purpose of the article is to develop a model of flipped learning technologies implementation on the basis of e-learning course utilization.

Methods

To achieve the goal, a number of methods were used, in particular theoretical ones: methods of systematic and comparative analysis of scientific sources,

methodological literature, and special literature to find out the elaboration of the problem of implementing flipped learning in the educational process of higher educational institutions; synthesis and generalization for the formulation of the main provisions of the study; empirical – a survey and interviews with students of pedagogical specialties. In particular, at the Borys Grinchenko Kyiv University, in July 2019 a survey was conducted, in which 76 participants took part, including 12 bachelor's degree students and 64 master's degree students. The survey was passed by students of 5 specialties of pedagogical direction from the Faculty of Information Technologies and Management and Pedagogical Institute (Figure 1). The survey was conducted (https://docs.google.com/spreadsheets/d/1KT2m6MUs8vX9cSIAy5J1HYHGuKe2amRDLisTxEieO7A/edit?usp=sharing), where questions about the fields of study were raised.

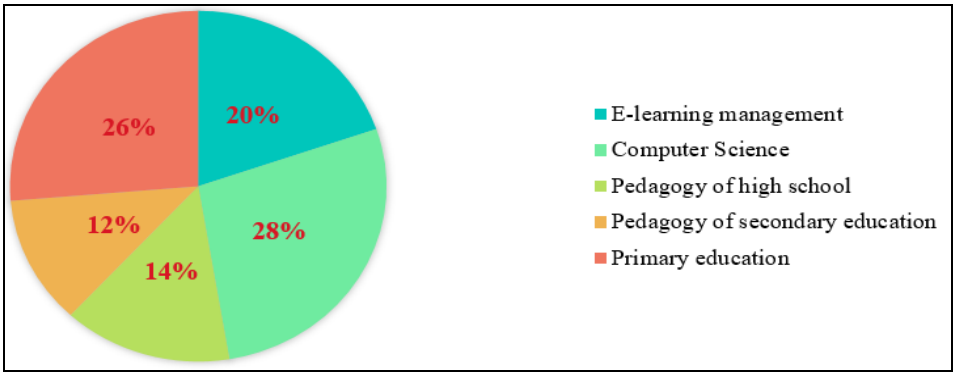

Figure 1. Fields of study of the students who took part in the survey

Source: Own work

1. THEORETICAL PECULIARITIES OF FLIPPED LEARNING

1.1. What is "flipped learning"?

Although there is no single model (Tucker 2012), the flipped learning is characterized in terms of course structure: instructional content (e.g., pre-recorded class lectures) is assigned as homework before coming to the class. In-class time is then spent working on problems, advancing concepts and engaging in collaborative learning (Findlay-Thompson and Mombourquette 2014). Removing the instructional content from in-class time allows the instructor to spend more time on personal engagement of every individual student (Roehl et al. 2013), but perhaps equally important, the flipped classroom model is student-centered (McLaughlin et al. 2014), which means that students are responsible for watching lectures on their own and coming to class prepared for in-class activities and discussion. Little direct evidence currently exists regarding student learning outcomes or academic

performance in a flipped versus traditional (lecture-based) classroom (for reviews, see O'Flaherty and Phillips 2015).

The concept of flipped learning was offered by Bergmann and Sams (Bergmann, Sams 2012). They recorded classroom lectures and placed the videos in the Internet for students to watch and revise the learning content easily. This technology provided significant learning results which inspired the authors to use it further before in-class lessons (for example, in the form of online video instructions). This way students could get ready for the lessons watching video materials and could acquire knowledge on a definite topic before the beginning of in-class lessons. Thus, such approach provided more time for active learning in the classroom which allowed to involve students in deeper study of a discipline and discover and correct possible mistakes and problems (Bergmann, Sams 2012). Various scientific sources can give different definitions of the notion of flipped learning. That is why we offered our students to choose one or several definitions of the notion whereas there was one which did not correspond the sense of the notion. It helped to define the most relevant definitions of flipped learning from those offered by several scientists and also to find out that 10% of students who took part in the survey had a wrong idea of flipped learning technologies.

According to the results of the survey different definitions of flipped learning can be ranked:

- Flipped Learning is a pedagogical approach in which direct instruction moves from the group learning space to the individual learning space, and the resulting group space is transformed into a dynamic, interactive learning environment where the educator guides students as they apply concepts and engage creatively in the subject matter (FLN 2014) – 61%.
- Flipped learning is a pedagogical approach in which the conventional notion of classroom-based learning is inverted, so that students are introduced to the learning material before class, with classroom time then being used to deepen understanding through discussion with peers and problem-solving activities facilitated by teachers (HE Academy 2015) – 46,8%.
- Inverting the classroom means that events that have traditionally taken place inside the classroom now take place outside the classroom and vice versa (Lage et al. 2000) – 35,1%.

Analysis of scientific studies shows that a considerable part of teachers all over the world have already been using flipped learning (Hwang 2015) as:

- Teachers use multimedia technologies to provide students with learning materials which allow them to learn regardless of time and location. Students are taught to search and choose required information and data for in-class lessons, and it is expected that they will be more active and responsible for their study.

- Learning video allows students to watch learning content several times if needed for acquiring deep basic knowledge.
- Digital multimedia learning materials are easy to store, watch, change and transfer.
- In the process of preparation to implementation of flipped learning teachers can check and give all the students access to a curriculum, tasks and requirements for learning results and their assessment, constantly improving pedagogical design of students' activities and learning content.
- When students have sufficient basic knowledge on the learned topic, they get more time for active learning, own questions formulation and discussion, defining practice-oriented problems and their collaborative solution. Under the circumstances teachers are able to give individual consultations which help students to overcome difficulties in study.
- Active involvement and discussion in a classroom can increase the level of collaboration between students and teachers. Active atmosphere might increase students' learning motivation, and thanks to collaboration with co-learners learning effect will grow.
- Additional learning strategies such as project-based learning, inquiry-based learning and problem-based learning can be used for in-class lessons to facilitate development of higher level thinking skills according to Bloom's taxonomy which would be more important for formation of professional and key competences.

We will consider ways of flipped learning technology utilization in the educational process of a university. We will focus our attention on the fact that flipped learning is also a pedagogical concept as z-generation representatives where modern students belong can percept learning material better through visualization of the content (Morze, Smyrnova-Trybulska, Umryk, 2015). That is why it is advisable that a teacher provided students with new material in the format of video lectures or other types of digital learning materials which they could study at home, especially considering that most students have their own mobile smart gadgets. According to statistics, 92% of students use their own digital devices in educational process (Payne 2019). Conducting lessons can be flipped with the help of digital media materials which are placed on a university educational platform. Such educational content is provided with the help of an e-learning course in LMS which allows swapping traditional types of students' in-class activities with the out-of-class ones, that means transformation of in-class (giving new materials) and self-study phases happens.

Flipped learning has 3 phases:

- *Pre-Phase* – which takes place before in-class lesson,

– *F2F (face-to-face)* – active in-class learning,

– *Post-Phase* – following out-of-class learning, reflection.

On the stage of Pre-Phase design, it is advisable to use microlearning technology. Charles Weber formulated a concept of microlearning technology regarding "quick learning in changeable environment" (Weber 2003), which means learning a relatively small amount of learning material and short-term learning, micro-modules. This term is used the most frequently in the sphere of e-learning where it is the easiest to divide learning materials to components. Therewith, every such module has to provide all the aspects of an educational process - brainwork, fulfilment and assessment (reflection) (Zimmerman, Dale 2001). In addition, z-generation students are learning in higher educational institutions now – these are young people born after 1996 for whom it is typical to switch their attention quickly, and who are characterized by online existence, absence of unquestioned authority, etc. (Vember, Buchynska 2018); and flipped learning will help to consider peculiarities of such students.

Let us analyze how the above-mentioned phases of flipped learning are implemented in the process of design and utilization of an e-learning course (Figure 2). Out-of-class activities of Pre-Phase could include classical lectures, individual tasks that contain formative assessment instruments, in particular rubrics, check-lists, assessment forms, K-W-L charts, etc. Active learning (F2F phase) will take place in the classroom during seminars, laboratory and practical sessions using different innovative pedagogical technologies. The end of work, additional tasks and self-study are transferred into Post-Phase (Morze, Varchenko-Trotsenko 2019). The structure of flipped learning using an e-learning course can be presented in Figure 2.

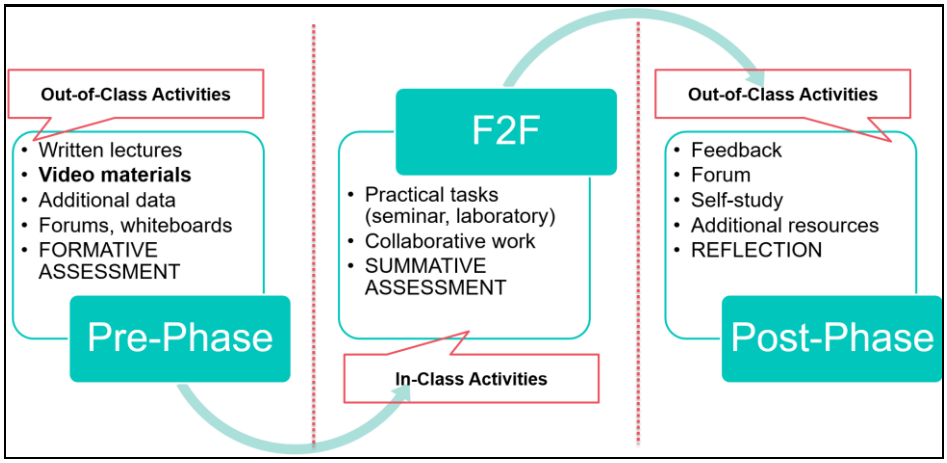

Figure 2. Scheme of materials division in the phases of flipped learning
Source: Own work

The level of acquiring knowledge by students depends on the form of educational work (Figure 3). Therefore, in order to ensure the effectiveness of learning, it is envisaged to apply different forms, methods and technologies, in particular practice through action and training in cooperation. That is why while using flipped learning it is rational to leave the activities in the process of which students acquire less learning material (lecture, reading, video-audio materials, demonstrations) for self-study and to use discussion in groups, practice through action, teaching others etc. during in-class activities.

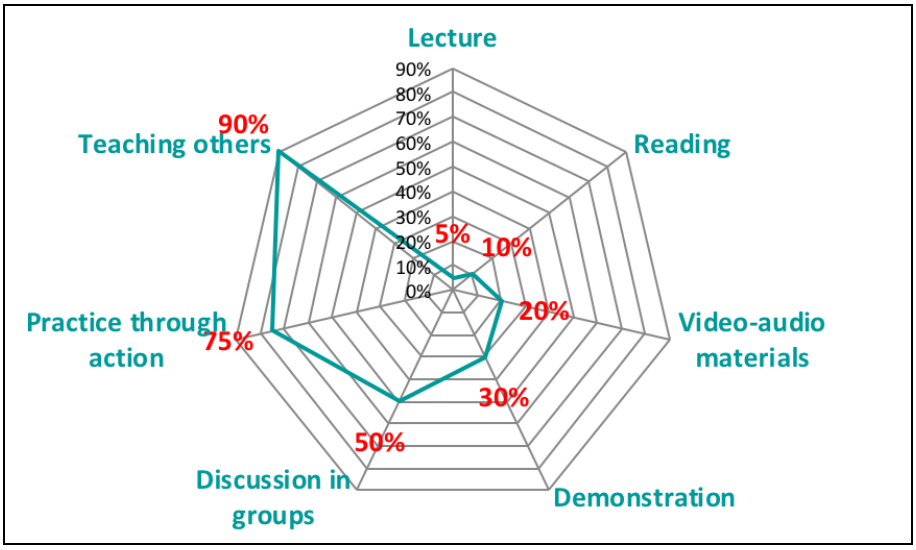

Figure 3. Dependence of the level of students' acquisition of knowledge on the form of educational work.
Source: Morze, 2003

1.2. The model of flipped learning implementation using e-learning course

For implementation of flipped learning technology we designed a model (Figure 4) which takes into account utilization of an e-learning course and peculiarities of learning materials acquisition by different students.

One of the most important stages of the model implementation is identifying **intended learning outcomes** (ILOs) which can be based on Bloom's taxonomy (Bloom, 1994) modified by Anderson and Krathwohl (Anderson, Krathwohl 2001). According to this taxonomy there are six levels of cognitive skills: remembering, understanding, applying, analyzing, evaluating and creating. In flipped learning the tasks students perform out of class belong to remembering and understanding, i.e. to the lowest levels of cognitive learning as materials are used to acquaint students with basic data. During in-class activities higher levels of cognitive thinking skills are formed such as analyzing, evaluating

and creating (Hwang et al. 2015). Teacher's role in the classroom is being changed - they become facilitators, use discussions, organize collaborative learning activities, group work, projects, furthers development of students' ability of self-reflection.

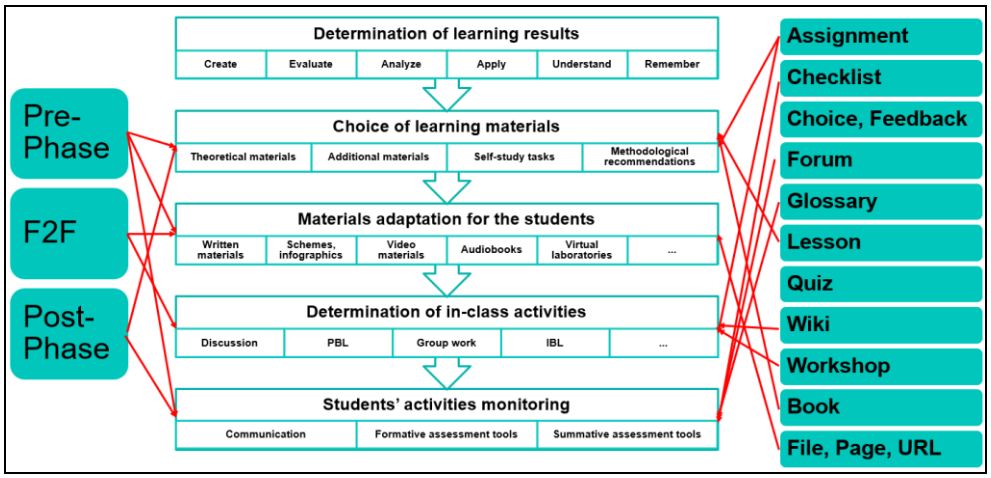

Figure 4. The model of flipped learning implementation using e-learning course

Source: Own work

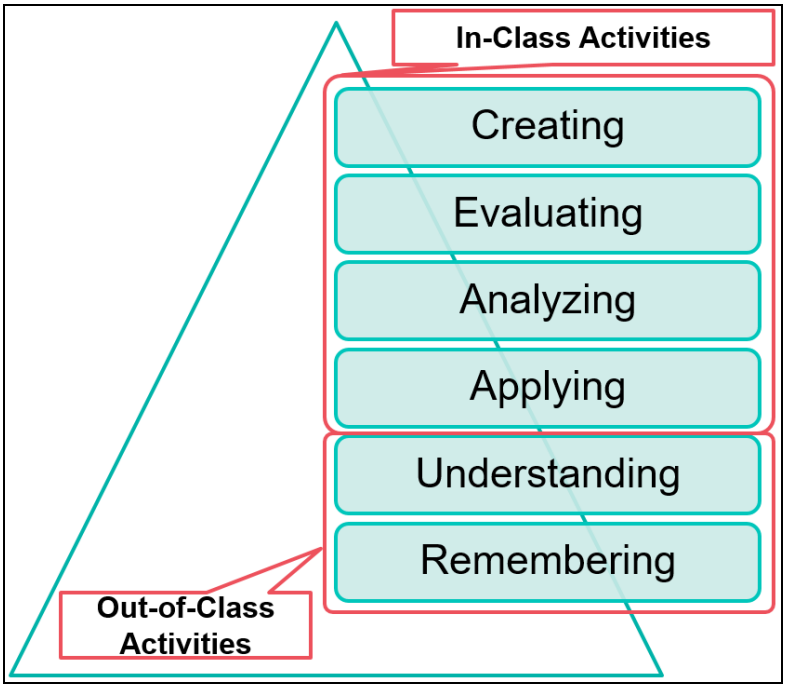

Figure 5. Utilization of flipped learning and Bloom's taxonomy

Source: Own work based on Bloom's taxonomy

On the second stage a teacher prepares learning materials according to intended learning outcomes.

In the process of adaptation of learning materials which will be used in Pre-Phase a teacher should consider that every person prefers different learning styles and methods. Among the classification of learning styles VARK has become the most popular model. In VARK model (Fleming, 1995) which is based on the idea of different type of information perception the following styles are defined:

1. *Visual* - people with a strong visual preference for learning like: different formats, space, graphs, charts, diagrams, maps and plans.
2. *Aural* - people with a strong aural preference for learning like: discussions, stories, guest speakers, chat.
3. *Read/write* - people with a strong read/write preference for learning like: lists, notes and text in all its formats and whether in print or online.
4. *Kinesthetic* - people with a strong kinesthetic preference for learning like: senses, practical exercises, examples, cases, trial and error.

There is an example of VARK model questionnaire available online (http://vark-learn.com). It also contains explanations for every style and recommendations for educational activities optimizing using a correspondent type of information perception and learning style and presented in the way that is appropriate for a respondent. A survey taken by Grinchenko University students has shown that such styles of learning as visual and kinesthetic (Figure 6) are the most widespread, though there are also students with different learning styles even if they presented in minority. That means that teachers should present learning materials in different ways.

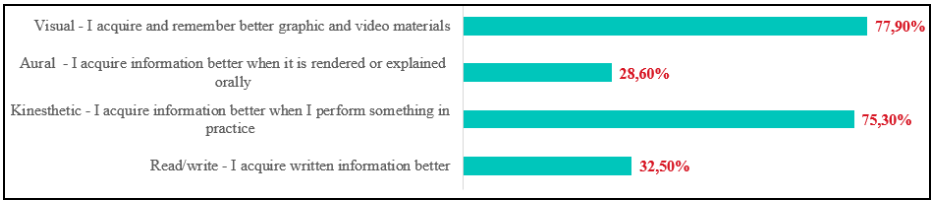

Figure 6. Respondents' answers about learning styles
Source: Own work

Particularly, a clarifying question about the form of presenting materials for acquisition has shown that students prefer such forms as learning videos and presentations (Figure 7):

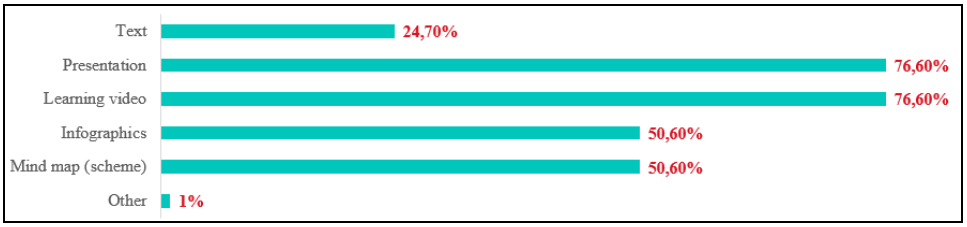

Figure 7. Respondents' answers about Pre-Phase learning materials types
Source: Own work

Therefore, an important aspect for providing Pre-Phase with learning materials is creation of high-quality video materials by teachers. Video materials are an effective instrument as learners receive data through two channels – auditory and visual. Important factors are video content (completed part of learning material), duration (optimal for perception) and type (text data, infographics, speaker recording etc.).

Let us define components of a qualitative video: a duration up to 6-15 minutes, a completed educational idea that corresponds to the learning goals, a natural pace of speech, an interesting content delivery based on an outlined problem with the help of inquiry-based questions formulation. After each video with completed idea students are offered to answer several questions. The questions support all three stages of educational process: they serve as a guideline at the beginning, as a self-check method in the studying process and as a possibility of assessing own results at the end.

At the stage of identifying **in-class students' activities** it is necessary to pay attention to achieving learning objectives aimed at developing higher levels cognitive skills.

Students noted that during in-class lessons they are more interested in such activities as discussions, group and pair work, IBL (Figure 8).

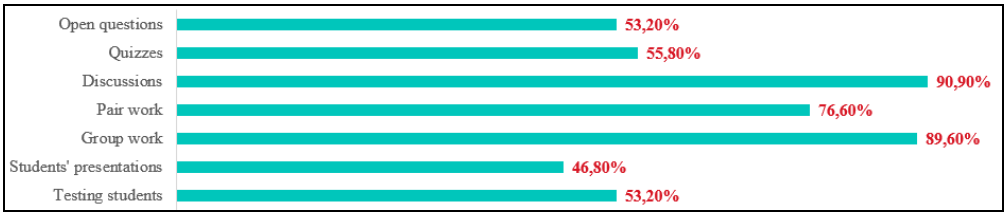

Figure 8. Respondents' answers about learning materials types in the classroom environment
Source: Own work

While choosing instruments for **students' activities monitoring** a teacher defines the ways different communication options will be applied considering both communication among students and with the teacher. It is important to understand formative and summative assessment differences as well.

The peculiarities of formative assessment (Morze, Vember, Varchenko-Trotsenko 2017) include:

- assessment of the learning process itself not limited to the products of educational activities;
- assessment criteria design based on set learning goals;
- students' participation in the assessment process;
- process character of assessment;
- utilization of digital instruments for assessment;
- absence of open comparison of different students' results.

The following methods belong to formative assessment (Figure 9):

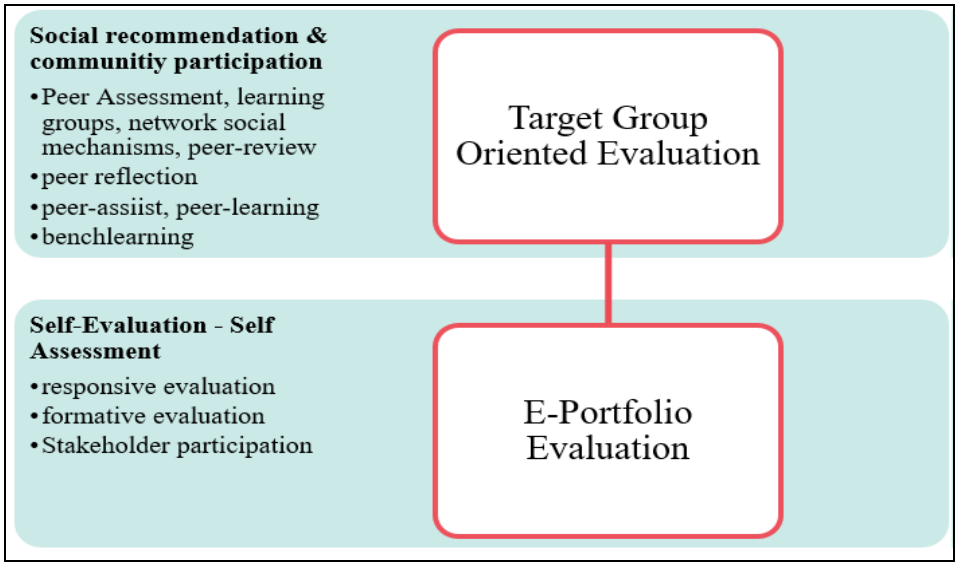

Figure 9. Formative assessment methods
Source: Own work based on Intel

For implementation of summative assessment, a teacher can use traditional or peer assessment.

The peculiarities of peer assessment include:

- strictly defined assessment criteria;
- assessing each other by students;
- receiving a note not only for performed work but also for objectiveness of assessment;
- high efficiency of activities.

Let us specify the stages of implementation of the offered model using the defined resources of an **e-learning course**.

The assignment activity module allows teachers to form tasks, collect assignments, assess them and leave feedback on the assignments. That means this resource can be used for storage and traditional assessment of students' activities results at any stage of learning.

Students can send any digital content (files) such as text documents, spreadsheets, pictures, audio and video files. Moreover, it is possible to allow students to type answers in the body of word-processor in the course. Also, tasks can serve for students as reminders of what they are required to do in the "real world", for example, some creative task which cannot be performed in digital form.

Checklist module allows teachers to create checklists or lists of tasks that have to be done by students. This resource is very useful for formative assessment implementation or tracking students' activities.

Feedback module allows teachers to create own survey to collect students' opinions using different types of questions including multiple choice, yes/no questions or short answers. Feedback can be anonymous if needed; the results can be shown for all participants or for teachers only. Any feedback can be organized on the home page of the website for unregistered users as well.

Forum module allows participants to conduct asynchronous discussions, that is those which take place within long time boundaries. A teacher can use forum both for communication and assessment of students' activities. There are some types of forums to choose from. For example, there is a standard forum where anyone can start a discussion at any time; a forum where one student can create only one discussion; a Q&A forum where students have to send their own message prior to commenting on other students' messages. A teacher can allow attaching files to messages in a forum. Attached files are displayed in the messages of the forum. Messages in a forum can be assessed by teachers or students (independent assessment). Those assessments can be summed up to form a final mark which will be transferred to grader report.

Glossary module allows participants to create and support lists of definitions in the form of a dictionary or collect and arrange resources or information. A teacher can use a glossary both for presenting definitions and for assessment of students' activities.

Lesson module allows teachers to present theoretical materials in a convenient interactive form. Teachers can use a lesson to create single-level web-pages or for learning activities where different ways and options are offered.

Quiz module can be used for conducting traditional assessment.

Wiki module allows participants to add and edit a set of web-pages. Wiki can be joint with access to editing by all the members or individual where

everyone has own wiki-page with private access to editing. History of previous versions of every page is stored with the list of changes being done by every member.

Workshop module is designed to collect and analyze students' assignments with collective assessment. Students can present their work in the form of any digital content (files) such as text documents, spreadsheets, presentations and also they can type answers in the input field with the help of word-processor (a link on a blog, a document or wiki-resource, etc.).

Materials are assessed with the help of some criteria defined by a teacher. A process of collective assessment and understanding the form of such assessment can be trained in advance using examples of assignments provided by a teacher with a link on an assessment example. Students are given possibility of assessing one or several assignments performed by co-learners. Materials and reviewers

can be anonymous if required.

Students get two marks for the seminar - the first one is for their own prepared assignments and the second one is for evaluating their colleagues. Both marks are transferred to the grader report.

To present different additional materials there is a possibility of using resources **Book, File, Page, URL**.

2. CREATING THE FLIPPED LEARNING SEQUENCE

Within the framework of the project "Modernization of Pedagogical Higher Education by Innovative Teaching Instruments" (MoPED) of the EU programme Erasmus + KA2 – Development of Higher Education Capacity, the University of Deusto organized and conducted the course "Flipped Learning and Moodle - Assessing Learning Outcomes" which was built on the principles of blended learning: an online course was offered in LMS Moodle, a set of webinars was conducted as well as one-week face-to-face training meetings with the participants of the course.

According to the course assignments we designed flipped lesson sequences with respect to defined requirements.

Let us consider an example of planning a flipped lesson sequence based on Intended Learning Outcomes according to Bloom's taxonomy for the flipped lesson on the topic «Inquiry Based Learning Technique». The following ILOs were formulated (Table 1):

Table 1.

ILOs according to Bloom's taxonomy for a flipped lesson

Bloom's taxonomy	ILO1 – O9
Remembering	ILO1: to define Inquiry Based Learning (IBL) technique,
	ILO2: to list main phases of Inquiry Learning Cycle,
	ILO3: to name ICT tools, which can be used to organize IBL
Understanding	ILO4: to explain each phase and sub-phase of Inquiry Learning Cycle
Applying	ILO5: to use Go-Lab portal to find Inquiry Learning Spaces (ILS),
Analyzing	ILO6: to compare different models of Inquiry Learning Cycle and some ILS on Go-Lab portal and their structure
Evaluating	ILO7: to verify if one of the ILS on Go-Lab portal matches the model of Inquiry Learning Cycle
Creating	ILO8: to create ILS as a duplicate of one of the ILS on Go-Lab portal,
	ILO9: to make some changes to this ILS

Source: Own work

According to identified ILOs a flipped lesson sequence was formulated setting out performance of several types of activities with three phases: preparation phase before the beginning of an in-class lesson – PRE-Phase, an in-class lesson – Face-To-Face (F2F), and completing out-of-class phase - POST-phase.

Activities

1. PRE-Phase

A1 – students individually get acquainted with the materials provided by the teacher (watch the video, read texts) and search more information about IBL on the Internet (ILO1-4).

A2 – task for each student to publish on a forum (type of forum – "Q and A") definition of IBL (ILO1), main phases of Inquiry Learning Cycle (ILO2) and to compare different models of Inquiry Learning Cycle to determine if they have a common and different characteristics (ILO6).

FA1: self-assessment; using another forum - if students have questions, they can write a message on the forum and the teacher or other students will answer it.

A9 – task for students to register on the Graasp environment (graasp.eu).

2. F2F

A3 – discussion with students about IBL, they need to define Inquiry Based Learning (IBL) technique and name ICT tools, which can be used to organize IBL (ILO1,3).

A4 – task for students using Padlet: students in teams (the group of students should be divided into 5 teams) need to write main phases of Inquiry Learning Cycle - one phase per team (ILO2), then in comment to other team's message explain one phase per team (ILO4).

A5 - work in pairs: 1) one participant gives an example of what students will do, and the other determines whether it relates to the IBL technique (ILO 1); 2) each pair of students receives a handout where the student's actions are indicated during each phase of inquiry learning cycle, they need to make up the inquiry learning cycle correctly and define the names of the phases of the cycle (ILO2, 4).

SA1: assessment by teacher (for ILO1-4).

A6 – acquaintance with criteria for searching ILS on Go-Lab portal, task for students to find at least two ILS for primary school (ILO5).

FA2: self-assessment or peer assessment in pair.

SA2: observing the activities of students, assessment by teacher (ILO5).

A7 – task for students (in pairs): 1) to compare two found ILS and their structure: how many phases they contain, what are the names of these phases and discuss in pairs (ILO6); 2) to verify if one of the found ILS matches the model of Inquiry Learning Cycle: if it contains 5 phases, if the phases of the sequence correspond to Inquiry learning cycle and discuss in pairs (ILO7).

FA3: peer assessment in pairs.

A10 – task for students to create ILS as a duplicate of one of the ILS on Go-Lab portal (ILO8).

FA4: self-assessment, the teacher is observing the activities of students.

3. POST-phase

A8 – task for students to create document describing the implementation of task A7 (ILO6-7).

SA3: peer assessment using criteria, given by teacher (ILO6-7).

A11 – task for students to make some changes to ILS created in task A10 ((ILO9).

SA4: students provide their results to the teacher, assessment by teacher (ILO8-9).

The represented consequence can be presented in the form of the scheme (Figure 10):

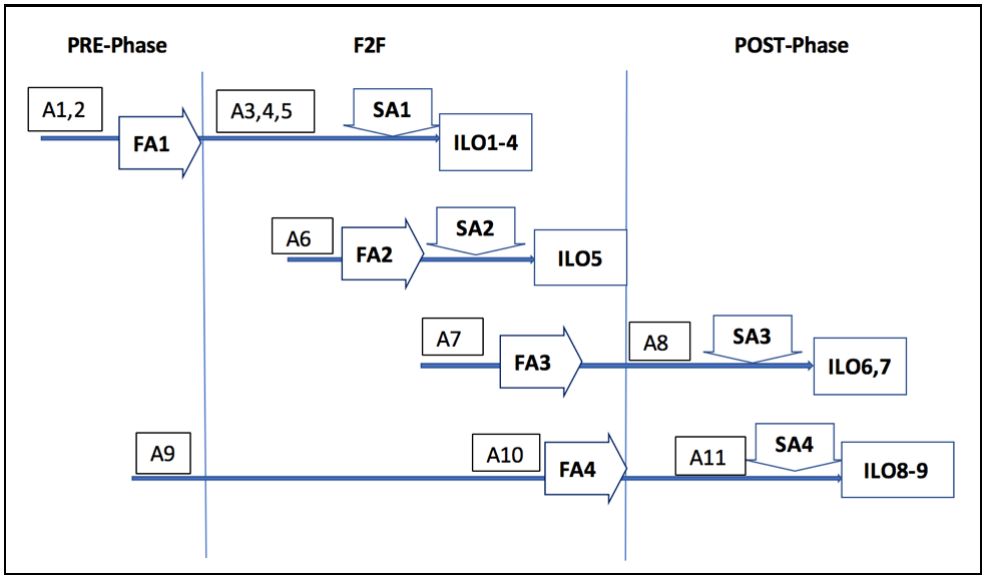

Figure 10. Sequence of flipped lesson activities

Source: Own work

To provide preparative PRE-Phase, give access to necessary materials for students as well as required support the structure of the part of flipped classroom was planned and implemented in Moodle LMS (Figure 11). An example of a page which contains learning videos is presented in Figure 12.

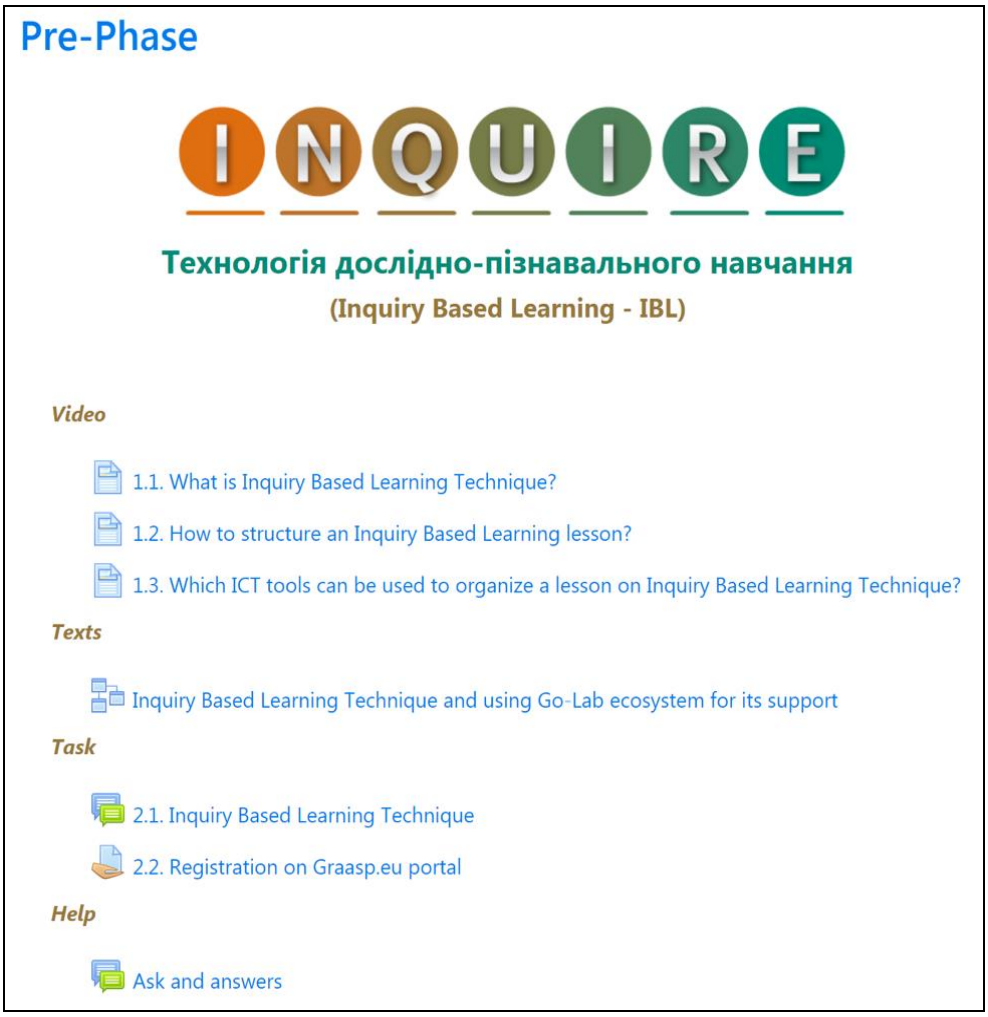

Figure 11. Pre-Phase structuring example for a flipped lesson on LMS Moodle

Source: Own work

Materials can also be given in the form of a text that contains pictures, schemes, infographics and can be divided into units which can be toggled with the help of navigation elements.

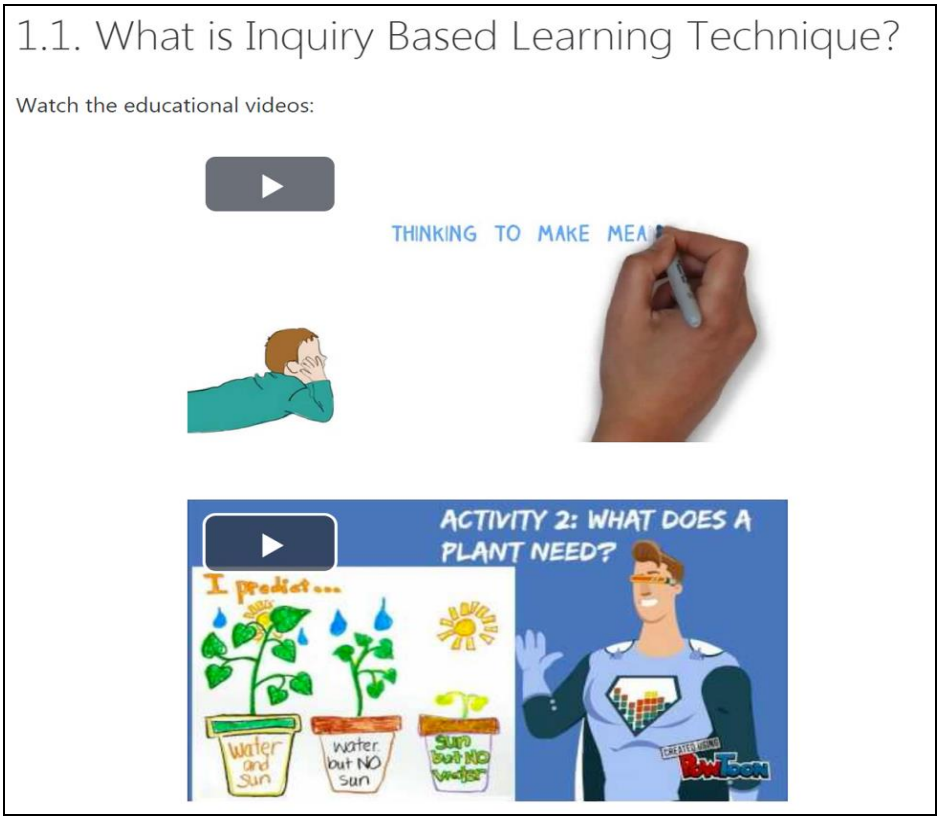

Figure 12. Page with an educational video in Pre-Phase materials

Source: Own work, YouTube

CONCLUSION

A modern higher educational institution requires changes and utilization of innovative pedagogical technologies including digital ones in the educational process. Flipped Learning is a pedagogical approach which increasingly used by the educational community of higher educational institutions. However, a range of requirements must be considered to design an effective flipped learning sequence. All the kinds of activities provided for students to perform have to be planned on the basis of Intended Learning Outcomes taking into consideration Bloom's taxonomy.

It is reasonable to plan the activities which are aimed at lower level Bloom's taxonomy skills formation - Remembering and Understanding - to be done by students before the lesson in Pre-Phase of a flipped lesson. During Face-to-Face Phase students work on problems, advance concepts, and engage in collaborative learning, through this process higher level cognitive skills are being developed.

To finish formation of every planned ILO it is important to provide assessment – both formative assessment in the process of tasks preparation and summative assessment – at the end of all kinds of students' activities sequence that has to lead to the corresponding ILO. Students can finish tasks performance, make peer assessment, accomplish reflection in the Post-Phase.

It is possible to implement the designed flipped learning sequence effectively using an e-learning course, particularly in Moodle LMS. On different stages of flipped learning different resources can be used to provide students with learning materials considering learning styles typical for different students, to organize group work peer-to-peer interaction and peer assessment etc.

Prospects for future research are aimed at implementing and improving the created flipped learning model using e-learning courses.

Acknowledgements

The research leading to these results received within the framework of the Modernization of Pedagogical Higher Education by Innovative Teaching Instruments. MoPED – KA2 CBHE – 586098-EPP-1-2017-1-UA-EPPKA2-CBHE-JP. This publication reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

REFERENCES

Anderson, W., & Krathwohl, D. R. (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's educational objectives*. New York: Longman

Bergmann, J., & Sams, A. (2012). *Flip your classroom: Reach every student in every class every day*. Washington DC: International Society for Technology in Education. ISBN: 978-1-56484-315-9. Retrieved from http://i-lib.imu.edu.my/NewPortal/images/NewPortal/CompE-Books/Flip-Your-Classroom.pdf (accessed on 20 July 2019)

Bloom, B. S. (1994). Reflections on the development and use of the taxonomy. In K.J. Rehage, L.W. Anderson & L.A. Sosniak (ed.) *Bloom's taxonomy: A forty-year retrospective* (pp. 1–8). Chicago, IL: Yearbook of the National Society for the Study of Education.

Butt, A. (2014). Student views on the use of a flipped classroom approach: evidence from Australia. *Business Education and Accreditation*, 6, 33–43.

Davies, R. S., Dean, D. L., & Ball, N. (2013). Flipping the classroom and instructional technology integration in a college-level systems spreadsheet course. *Educational Technology Research & Development*, 61, 563–580.

Findlay-Thompson, S., & Mombourquette, P. (2014). Evaluation of a flipped classroom in an undergraduate business course. *Business Education and Accreditation*, 6, 63–71.

Fleming, N. D. (1995). I'm different; not dumb. Modes of presentation (VARK) in the tertiary classroom. In A. Zelmer (ed.) *Research and development in higher education, Proceedings of the 1995 Annual Conference of the Higher Education and Research Development Society of Australasia (HERDSA)*. 18. (pp. 308-313). Auckland: HERDSA.

Flipped Learning Network (FLN), (2014). *The Four Pillars of F-L-I-P*. – Retrieved from https://flippedlearning.org/definition-of-flipped-learning/ (accessed on 20 July 2019)

Gilboy, M. B., Heinerichs, S., & Pazzaglia, G. (2015). Enhancing student engagement using the flipped classroom. *Journal of Nutrition Education and Behavior*, 47, 109–114.

HE Academy. (2015). *Flipped learning.* - Retrieved from https://www.heacademy.ac.uk/knowledge-hub/flipped-learning-0 (accessed on 20 July 2019)

Hoffman, E. S. (2014). Beyond the flipped classroom: redesigning a research methods course for e3 instruction. *Contemporary Issues in Education Research*, 7, 51–62.

Hung, H. (2015). Flipping the classroom for English language learners to foster active learning. *Computer Assisted Language Learning*, 28, 81–96.

Hwang, G.J., Lai, C.L. & Wang, S.Y. (2015) Seamless flipped learning: Amobile technology-enhanced flipped classroom with effective learning strategies. *Journal of Computers in Education*, 2(4), 449-473. https://doi.org/10.1007/s40692-015-0043-0

Intel® Teach Elements Collaboration in the Digital Classroom Retrieved from https://educate.intel.com/download/K12/elements/Collaborate_html/index.htm (accessed on 20 July 2019)

Jamaludin, R., & Osman, S. Z. M. (2014). The use of a flipped classroom to enhance engagement and promote active learning. *Journal of Education and Practice, 5*, 124–131.

Lage, M.J., Platt, G.J., and Treglia, M. (2000) Inverting the classroom: A gateway to creating an inclusive learning environment. *The Journal of Economic Education, 31*(1):30–43.

Mason, G. S., Shuman, T. R., & Cook, K. E. (2013). Comparing the effectiveness of an inverted classroom to a traditional classroom in an upper-division engineering course. *IEEE Transactions on Education, 56,* 430–435.

McLaughlin, J. E., Roth, M. T., Glatt, D. M., Gharkholonarehe, N., Davidson, C. A., Griffin, L. M., & Mumper, R. J. (2014). The flipped classroom: a course redesign to foster learning and engagement in a health professions school. *Academic Medicine, 89,* 236–243.

Missildine, K., Fountain, R., Summers, L., & Gosselin, K. (2013). Flipping the classroom to improve student performance and satisfaction. *Journal of Nursing Education, 52,* 597–599.

Morze. N., Smyrnova-Trybulska. E., & Umryk. M. (2015) Designing an e-university environment based on the needs of net-generation students. *International Journal of Continuing Engineering Education and Life-Long Learning, 25 (4).* 466-486. ISSN 1741-5055

Morze, N. (2003) *System of methodical preparation of future teachers of informatics in pedagogical high schools*: diss. Doctor Pedagogical Sciences 13.00.02 / Nataliia Morze. Kyiv, 2003. 531 pp. [In Ukrainian]

Morze, N., Varchenko-Trotsenko, L. (2019) Use of flipped learning technologies based on video. Scientific journal of the Dragomanov National Pedagogical University. Series No 2. *Computer-oriented learning systems.* 21(28). 9-17. [In Ukrainian]

Morze, N., Buinytska, O., & Varchenko-Trotsenko, L. (2016) Creation of a modern electronic training course in MOODLE: Tutorial. Kamenets-Podilsky: Private entrepreneur O.A. Buinitsky. ISBN 978-617-608-064-0 [In Ukrainian]

Morze, N., Vember, V., & Varchenko-Trotsenko, L. (2017) Formative and peer assessment in higher education. In E. Smyrnova-Trybulska. *Effective Development of Teachers' Skills in the Area of ICT and E-learning*. "E-Learning". 9, (pp.159-180). Katowice-Cieszyn: Studio Noa for University of Silesia.

NMC Horizon Report (2018) Retrieved from https://library.educause.edu/resources/2018/8/2018-nmc-horizon-report (accessed on 20 July 2019)

O'Flaherty, J., & Phillips, C. (2015). The use of flipped classrooms in higher education: a scoping review. *The Internet and Higher Education,* 25, 85–95.

Payne Jonatan (2019). *Smartphone Use By College Students* Retrieved from https://smallbusiness.yahoo.com/advisor/smartphone-college-students-infographic-153840365.html (accessed on 20 July 2019)

Roehl, A., Reddy, S. L., & Shannon, G. J. (2013). The flipped classroom: an opportunity to engage millennial students through active learning strategies. *Journal of Family and Consumer Sciences,* 105, 44–49.

Tucker, B. (2012). The flipped classroom. *Education Next,* 12, 82–83.

Vember, V., Buchynska, D. (2018) Centennials: a generation that needs new approaches to learning. In Y. Tryus (Ed.). *Conference proceedings of III International Scientific-Practical Conference "Information Technologies in Education, Science and Technology" (ITEST-2018)* (pp. 187-189). Cherkasy: ChSTU. Retrieved from http://elibrary.kubg.edu.ua/id/eprint/24063/1/V_Vember_D_Buchunska_ITONT_2018.pdf (accessed on 20 July 2019) [In Ukrainian]

Weber, Ch.M. (2003) *Rapid Learning in High Velocity Environment*: Dissertation to the Degree of Doctor of Philosophy In Management of Technological Innovation and Entrepreneurship / Weber, Ch.M. – Massachusetts Institute of Technology. 569 p.

Zimmerman, Barry J., and Dale H. Schunk, (Eds.) (2001). Self-regulated learning and academic achievement: Theoretical perspectives. Abingdon: Routledge, 2001.