

FLIPPED LEARNING APPROACH IN DIFFERENT ACADEMIC COURSES IN CIVIL ENGINEERING, TRAFFIC AND TRANSPORTATION ENGINEERING AND ARCHITECTURE

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Abstract

Flipped classroom approach is the educational method which was lately encouraged and supported by the University of Maribor and therefore implemented in certain courses at the Faculty of Civil Engineering, Transportation Engineering and Architecture. As in any other novelty, only practical usage can show its real value. The teachers of discussed courses introduced flipped learning after they had experienced online teaching and returned to face-to-face lectures. The combination of both allows them to use already prepared online study materials and interact with students in the lecture room. Flipped learning encourages students to be involved in active learning activities, they can study at their own pace at any time that is suitable for them, through Moodle and MS Teams they always have access to literature and instructions. However, they should be mature, disciplined, and motivated for the individual work. Even though mastering learning management system and be available for students in the lecture room results in more obligations for teachers, face-to-face lectures prove higher engagement of students and easier educational process for all.

Keywords: *flipped learning, Moodle, MS Teams, online lectures, face-to-face lectures*

1. INTRODUCTION

Contrary to the traditional classroom learning approach with lectures, delivered by teachers, and students, provided with the study materials in the lecture room, the flipped classroom approach is the method of distributing the study materials before participating classes, therefore students read and assimilate the learning contents prior to meeting the lecturer. The contents are then discussed with the lecturer and the peers in the lecture room. Further learning activities are done thereafter, again outside the lecture room, for students to check and verify their understanding. Moreover, evaluation of student skills and knowledge demands an understanding of alternative methods which comprise the changed role of students, different relations with their peers, lecturer, and study contents. In order to prepare such lessons, teachers should be familiar with blended learning which is an approach that includes both face-to-face and online learning components by using digital teaching tools. However, Rasheed, Kamsin and Abdullah [1] admit that the creation of the online component has made students, teachers and educational institutions worried about their IT skills. First, students should possess self-regulation skills and technological competence. Second, teachers should master teaching technology, and third, institutions should provide teacher trainings and IT support for both students and teachers. As for the University of Maribor, decision in 2020 was made to install and use MS Teams for all lectures and meetings, whereas Moodle was introduced 20 years before and therefore already well-known to teachers and students alike. Teacher trainings in Moodle take place each year multiple times to improve its usage and get acquainted with its novelties and/or upgrades. In addition, many teacher trainings were provided to introduce MS Teams functions and possibilities which enabled easier avenue and employment in the studying process. By means of Moodle, the flipped learning workshop was available for teachers including online materials and tasks so that they could learn the new instructional strategy, prepare lessons, and evaluate the outcomes for their subjects. Later, seminars and workshops were offered for all university pedagogical staff. They suggested that teachers start with a single course or a part of it and that they do not need to use flipped approach all the time. It should be used in a way that it meets the needs of the contents and is effective. Also, the role of the teacher is changed into a facilitator of active learning activities during the class time. What's more, students can suggest additional tasks to be done

and therefore contribute to the ever-changing process, tailored for students. At the same time, students and a teacher have overview of the educational process, students get support, and individual recommendations. The evaluation of the students' work is ongoing and encourages development and improvement of knowledge which means that the final grade considers all phases, not only the final examination, seminar paper or final contribution. After the end of semester, the evaluation of a flipped learning approach was done by teachers in order to estimate the efficiency of the method and possible future modifications.

2. LMS TOOLS

2.1. MS Teams

Online lectures, seminars and tutorials should follow the same objectives, competences, and outcomes as face-to-face sessions; however, the methods and tools differ. In 2017, MS Teams appeared as a component of the Microsoft Office 365 suite of work tools to support shared projects. Later it was also used for online lectures and tutorials. Hai-Jew [2] finds MS Teams a relatively complex tool including channels, files, a notebook, global navigation with many possibilities and connections to numerous apps. It should be learner-oriented, should enable learning and permit constructive sociality. Despite its versatility, it cannot replace the learning management system. She also suggests that the success in learning largely depends on the learners and the instructor. Krašna and Pesek [3] add another point in favour of MS Teams, namely the phone usage is important for students, the mobile phone client runs well, and what is more, a computer and a mobile phone can be used simultaneously without problems.

2.2. Moodle

Modular Object-Oriented Developmental Learning Environment or Moodle in short was developed for the higher education environment by using pedagogical principles. It is a well-established, continuously upgraded learning management system (LMS) which can be used for sharing contents, assignments and other workload, questionnaires, marks, evaluation, and communication (Krašna and Pesek, [3]). Furthermore, it is verified as a useful learning tool for blended learning (Acar and Kayaoglu, [4]). The study by Handayanto, Supandi, and Ariyanto [5] shows that the usage of Moodle improved students' results in their final exam. Moreover, students are more engaged in the learning process and more interested in activities since they are personalized and take into account student learning background and objectives. Students can develop critical thinking and problem-solving skills. Therefore, teachers need to think about study materials very carefully, so that the chosen activity is understandable, accessible, and feasible. In tertiary education students can read scientific papers or technical articles, study e-transparencies, mind-maps, watch simulations or educational videos.

In addition, Krašna and Pesek [3] compare both MS Teams and Moodle in their study and conclude that MS Teams still cannot be a complete substitute for Moodle due to its explicit course design, assignment uploading and tradition. However, its dated appearance, area of communications and notification make MS Teams more attractive tool to use. Also, the research of Cabero-Almenara, Arancibia, and Del Prete [6] shows that Moodle is mostly used as a platform for exchange of materials and information, neglecting educational implementation. Also, it allows students to access learning materials at any given time. Another important point is made by Kerimbayev et.al. [9] who recognize the value of distance education in lifelong learning and realization of social constructivism by LSM teaching if a close system of 'common objects and senses' is established by all participant (Amineh, Asl, [10]). Social constructivism claims that knowledge and understandings of the world are gained through interaction with other educated people and near surrounding (Amineh, Asl, [10]). Indeed, studies by Wongsavat, Thanananuphapphaisan [7] and Olszewski [11] illustrate that online students miss communication with both teachers and peers. Students are less motivated, committed, and inattentive outside the social environment of the lecture room (Olszewski, [11]). As a result, blended learning is the combination of both, so advantages of face-to-face learning as well as online learning components can be used successfully. In addition, the research results by Katić, Šafranč and Zivlak [12] show that MS Teams best contribute to development of cognitive skills and collaboration, Moodle enhances progress in learning inventiveness and autonomy, while traditional learning functions as understanding of complex

materials and improvement through socialization. Students develop communication skills, collaboration, and teamwork skills.

2.3. E-mailing

The third communication channel used for contacts and material exchange is e-mailing. The reason for its application is pragmatic, everyday usage of the e-mail assures accessibility and accurate correspondence in contrast to MS Teams or Moodle that are mostly used for educational purposes. In fact, study on the most helpful communication channels for students during online learning (Wongsavat, Thanananuphapphaisan, [7]) proves the importance of e-mails since 49.6% students at their college find them convenient for receiving information. Yu and Yu [8] even go further in their research by studying the influence of including e-mails into learning process. The students' academic results were better because they received an e-mail with weekly class outlines before the next class session which improves teachers' instructions and communication between students and teachers. Furthermore, e-mails are personal, and they do not expose timid students.

3. MATERIALS AND METHODS

The study introduces academic courses in civil engineering, traffic and transportation engineering and architecture that use flipped learning approach and looks at variety, structure, and modus of delivery of the study materials. It includes semi-structured interviews with teachers who use the method of flipped learning in their courses, and analysis of their study materials offered to students. Teachers were asked why they decided for this instructional strategy, how and when they introduce it to students, how they deliver study materials and what experience they gained. The courses comprise Geodesy (bachelor's in civil engineering), Special chapters in geodesy/GIS (bachelor's in architecture and traffic and transportation engineering), Modern surveying methods in civil engineering (master's in civil engineering), Technical English – Advanced (master's in civil engineering and industrial engineering), Technical German – Advanced (master's in civil engineering and industrial engineering), Theory of systems and transport economics (master's in traffic and transportation engineering), Transport infrastructure management (bachelor's in traffic and transportation engineering), Introduction to civil engineering (bachelor's in civil engineering), Structural analysis 2 (bachelor's in civil engineering), Concrete structures (bachelor's in civil engineering) and, Foundation engineering (bachelor's in civil engineering).

4. RESULTS

4.1. Introduction of flipped learning

In general, teachers started to search for alternatives to face-to-face lessons when they began to deliver on-line lectures, as the whole teaching process was moved to MS Teams in 2020. After almost two years of lessons in completely different environment, they already prepared their study materials for the on-line usage and could use MS Teams well. Moreover, they wanted their students to be better included in the studies, be active and engaged. They realized that the literature could be studied in many different ways and could include variety of study materials from videos, online lectures, short or longer texts to books or textbooks, scientific and technical articles. In addition, the flexible study enables possibility to approach the literature at any given time, which completely individualizes the study outside the lecture room. So, teachers wondered how to combine these with face-to-face lectures and found flipped classroom approach very useful.

The method of flipped learning in courses Geodesy, Special chapters in geodesy/GIS, Modern surveying methods in civil engineering provides easier work for all participants, including a lecturer. Students study new contents by themselves, and when in the lecture room, they ask much more questions than before the introduction of this instructional strategy. The system is also suitable for tutorials where the exercises are done by all students together. In addition, students are given a quiz during each meeting, which proves their knowledge and makes fun. Obviously, this provides a good stimulation for self-

directed learning and the result of the quiz shows exactly which contents need further explanation. The teacher of Transport infrastructure management already knew students from the previous course and decided to take a different approach by introducing flipped learning so that students studied literature by themselves via links on Moodle or a book. The courses Technical English – Advanced, Technical German – Advanced and Theory of systems and transport economics, Transport infrastructure management are electives, so the number of contact hours depends on the number of students which means that the acquisition of the whole syllabus is only possible if students learn individually. Therefore, flipped learning is a good solution for the lack of face-to-face lectures.

In all courses, the flipped classroom system is explained at the very beginning of the semester, instructions are given before each task, so students understand the method of study and know exactly what their tasks are, what they should read, watch, or study. Teachers who introduced similar study approach before implementation of flipped learning did not need to adopt much to new blended methods. They already prepared study materials with the help of digital teaching tools and can use them for flipped learning.

4.2. Study materials

Teachers use different communication channels to deliver study materials. Moodle proved to be the best means for sending materials, links, textbooks, videos and receiving seminar papers and other work from students, however the students of Technical English – Advanced and Technical German – Advanced send their work via e-mail and students of Introduction to civil engineering, Theory of systems and transport economics, Structural analysis 2 and Concrete structures prefer MS Teams because the system informs them about new contents.

Obviously, discussed courses offer completely different contents. Geodesy [13] and Special chapters in geodesy/GIS [14] include contents on geodesy as science, introduce units, maps, calculations, and measurements, whereas Modern surveying methods in civil engineering [15] builds upon these contents and deals with engineering approaches to find geodetic solutions in terms of variety of geodetic methods. Technical English – Advanced [16] and Technical German – Advanced [17] involve academic writing and communication in both languages, adequate grammar and vocabulary support, while Theory of systems and transport economics [18] determines system theory, cybernetics, the transport system and its economic efficiency. The course Transport infrastructure management [19] is concerned with planning, construction, maintenance, strategies, programmes and projects in transport infrastructure, Introduction to civil engineering [20] is about history of civil engineering, construction sites, architecture, loads, forces, principles, and behaviour of structural materials. Structural analysis 2 [21] includes definitions, concepts, methods, and computer programmes, Concrete structures [22] comprise analysis and design of concrete elements and structures, the course Foundation engineering [23] determines foundations and geotechnical design.

As a result, methods of delivering lectures and literature meet the requirements of specific courses and differ considerably in prerequisites, syllabus, objectives, competences, learning outcomes and methods of assessing students' activities and acquired knowledge. However, in all courses student are given various texts up to 10 pages which can also include pictures, calculations, and diagrams for better understanding. Videos with lectures proved to be a useful tool for students to reflect upon a certain topic and can be later involved in the fruitful debate. What is more, links to certain literature are provided only in two ways: by using Moodle or MS Teams which shows the unified utilization of LMS despite the differences in course contents.

4.3. Advantages of flipped learning

Flipped learning should enable students to understand materials better because they participate in active learning activities, get teacher's attention individually, can self-manage their time and speed of studying, can access the literature at any given time repeatedly and from any premises with internet connection (Isajanovna, A. S., Asfandiyarovich, D. T., Shayusupova [24]). As the research shows, the individual work results in variety of topics because students are encouraged to choose their own themes, make research, and write about them, mostly in the form of a seminar paper or a technical article (Theory of systems and transport economics, Technical English – Advanced, Technical German – Advanced,

Transport infrastructure management). The improvement of their work is encouraged by teachers who help them to correct the mistakes. Next, the flipped learning approach simplifies the study process (Modern surveying methods in civil engineering, Special chapters in geodesy/GIS, and Geodesy) because the students are already prepared for the discussed topic, they mostly understand the content, and the same method is not only used for lectures, but also for tutorials. The students' engagement is better, their reflection on topics is deeper, the study activities are dynamic, and discussions are relevant and long (Theory of systems and transport economics). If texts, videos, or other materials meet the level of students' proficiency in language, they do not have any problems to acquire new learning matter (Technical English – Advanced, Technical German – Advance). They check unknown vocabulary and learn new words which is very important because some students do not want to expose their lack of vocabulary in front of their peers. They are better motivated to ask questions, do tasks and communicate in foreign language. Additionally, it is very important that students can study whenever they want (Introduction to civil engineering, Structural analysis 2, Concrete structures) and flipped learning is especially useful for Erasmus students since lots of literature can be found in English.

Importantly, the support of the University of Maribor plays a crucial role and is of great help since it offers online teacher trainings, face-to-face seminars, and materials which guide teachers through the process of flipped learning, Moodle and MS Teams updates and thus enhance their motivation. The evaluation at the end of the semester analyses the flipped learning method in terms of contents, tasks, assessment and future development.

4.4. On the flip side

First, flipped learning demands a mature, disciplined, and motivated students, otherwise they skip lectures or come to the lecture room unprepared. This provides many difficulties for teachers because they cannot realize the aims of a particular lesson. The course Foundation engineering was such an example; therefore, the teacher decided not to follow this instructional strategy and return to conventional lectures. In addition, the same study materials do not always result in the same outcomes, sometimes they even lead to demotivation, so teachers cannot predict in advance the outcomes of students' self-studies. Second, preparing materials and assessing students' work is more time-consuming than delivering lectures. The latter refers to the courses Theory of systems and transport economics, Technical German – Advanced, Transport infrastructure management and Technical English – Advanced because the students do not prove their knowledge by the exam but by their practical written contributions which need to be evaluated already during the process of formation so that the students can improve their writing before their final assignment. As already mentioned, these courses are electives and demand more individual work of students as well as of teachers, especially with unmotivated students. Third, it is hard to study individually if the students do not have adequate pre-knowledge. Moreover, they cannot always estimate the essential elements of the content, they focus on components of minor importance or acquire new topics superficially.

5. DISCUSSION

The use of technology and Internet is changing education constantly, so new methods and virtual environments are introduced in learning and teaching. However, to what extent they are implemented in the educational process, depends largely on teachers' know-how and their willingness to learn about new tools. The university and faculty can only recommend new means and offer support with seminars, teacher training and appropriate technology. Even though discussed courses vary in their prerequisites, syllabus, objectives, competences, learning outcomes and methods of assessing students' activities and acquired knowledge, many common points are found. First, adoption of flipped learning: in 2020, teachers were forced to use LMS and prepare materials for online teaching which led them to reflect on their educational process. They realized that other didactic concepts were possible and started to search for new methods. Also, they have already invested their time and energy in new approach to teaching, so they wanted to incorporate their work into face-to-face lectures. Since flipped learning combines both methods, it seemed the appropriate approach. Second, the introduction of flipped learning to students: in all courses students are given information about the method of studying at the very beginning of the

new semester when the course starts. Teachers explain the flipped learning approach, the means of communication, material access, IT, and all methods of evaluation (tests, oral exam, written exam, seminar paper, quizzes, ongoing assessment) and evaluation criteria. Third, sharing the study materials through LMS: in all courses MS Teams and/or Moodle are used, which would not be the case if the University of Maribor did not introduce both and offer teacher trainings. In terms of study literature, links are provided to the materials which vary from shorter to longer texts, technical textbooks, journal articles, and videos to recorded online lectures. Only in two courses students should use email to submit the written papers, and in three courses also 'Kahoot!' is used for fun quizzes, so that students can each time evaluate their knowledge. This shows that some teachers have developed a complex methodology of the flipped learning approach while others are still testing and improving it.

Students' individual work shows their maturity, discipline, and motivation. If all of them are present, the objectives, competences and outcomes of the course can be fulfilled. Therefore, teacher – student and peer collaboration have a significant value in the flipped learning approach. All teachers agree that LMS combined with face-to-face lectures requires more work for the teacher, especially in deliberate planning and preparation of study materials to adequately support and guide students. The reduction of the scope of contact hours in elective courses due to the lower number of participants means more individual work not only for teachers but also for students. The study by Doo [25] shows that it is important for students to understand benefits of flipped learning, and that rational grading system or appropriate class policies should be used. More than 55% students claimed that 'they spend more time on flipped learning classes than regular classes'. Furthermore, teachers complain that insufficient pre-knowledge provides problems for students in acquiring new contents, therefore it is difficult to meet all aims of the educational process.

6. CONCLUSION

As teachers constantly search for new methods to address students, the flipped classroom approach offers more flexible, up-to-date, and constant way of acquiring knowledge. The mode of distribution of the study materials before participating classes is very important, therefore, the online approach can be too complicated if many communication channels are used. To focus on as less as possible is essential so that students are not confused when searching for the study materials and contacting teachers. It is also important that flipped learning is stimulated by the university, otherwise the needed IT support for both students and teachers and sufficient teacher expertise are not available. Constant upgrade is not necessary only for Moodle and MS Teams but also for teacher training.

Flipped learning approach demands more efforts to prepare lessons, because teachers should use digital teaching tools and hold face-to-face lectures. The role of the teachers is changed especially during the class time since they function as facilitators rather than lecturers. However, all these encourage their professional development and personalize learning. Teachers expect students to be more responsible about achieving their learning results since they are involved into active learning activities, the face-to-face classes are tailored to their needs, individual work is encouraged, and they can actively participate in the educational process. In addition, development and improvement of their knowledge is constantly monitored which contributes to their final grade. However, if they are not willing to study material before coming to the class, participate in discussion, interact with their peers, self-practice and improve their understanding of the contents, the flipped learning approach might not be the best option.

To conclude, the flipped learning approach is an ongoing, still developing teaching method and it is not yet proven that it leads to better results at the end of the studies, so further research is needed. Also, the new approach is yet not the part of the syllabi, so it should be included in the modernized curriculum in the future.

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