

TEACHING ACTIVITIES IN FLIPPED CLASSROOM STUDY DESIGN

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ABSTRACT

In recent years, the flipped classroom (FC) methodology – contact learning preceded by individual learning and the creation of prior knowledge in the learner – has become increasingly common in university teaching. However, the design of the FC has been applied differently in teaching. The aim of our research was to map the teaching activities used in various FC designs and to compare the use of the methods for study groups of different sizes. In order to map the teaching activities of the FC design, we compared 10 different study designs as well as the teaching activities used in study groups with different numbers of students. The study groups were divided into large groups including more than 30 students and small study groups with less than 30 students. As a result of the comparison of the different study designs, we mapped teaching activities conducting teaching by FC methodology. The different teaching activities of the FC suited equally well to the dissimilar study groups.

Keywords: *university teaching; flipped classroom; study design; individual learning*

INTRODUCTION

The reasons for using new teaching models in university teaching are mostly connected to the decreased hours of contact learning in classrooms and the need and possibility of using new technologies in both teaching and learning [3, 7, 13, 18]. In recent years, the flipped classroom method has become widely used as a teaching approach at universities [4, 9, 10]. The flipped classroom is a teaching approach in which students first learn about a new topic at home, usually online [17]. After that, the new knowledge is applied in classroom for solving problems or cases individually or in groups [12]. After contact learning, follow-up learning activities can be adopted individually or in small groups. This cycle is repeated by weeks or topics.

This teaching approach has gained importance especially due to the Covid-19 pandemic when the need and amount of individual preparation of students increased drastically in the conditions of distance learning [1, 6, 8].

Since various teaching activities can be used for FC [12, 16] the aim of our research was to map the teaching activities used in FC designs and to compare the activities used for large and small study groups.

MATERIAL AND METHODS

Our research on teaching activities during FC method was based on comparison of 10 literature sources describing the use of the teaching models [Table 1, Literature resources (LR)]. The FC designs were analysed, and the teaching activities used in study groups of different sizes were compared. The teaching activities were observed in three main phases of FC: preparation for contact teaching, contact teaching-learning and follow-ups to extend learning after the scheduled class session. The study groups were divided into large groups including more than 30 students (7 groups: LR 2, 3, 4, 6, 7, 8, 10) and small study groups with around 30 students (3 groups: LR 1, 5, 9). Most of the teaching activities for the FC design were composed by the university lecturers teaching natural and real sciences (8 cases).

Table 1. Literature resources

Authors and publications	Size of the study group	Division into subgroups	Ordinary lectures	Learner activating activities	Use of videos	Ordinary practical sessions	Quiz-tests	Tests after contact learning
1. Bhavsar V. M. (2020). A Transparent Assignment to Encourage Reading for a Flipped Course. <i>College Teaching</i> , 68(1), 33–44. https://doi.org/10.1080/87567555.2019.1696740	24			+	+	+	+	
2. Castedo R., López L. M., Chiquito M., Navarro J., Cabrera J. D., Ortega M. F. (2019). Flipped classroom—comparative case study in engineering higher education. <i>Comput Appl Eng Educ</i> , 27, 206–216. https://doi.org/10.1002/cae.22069	80	+		+	+	+		+
3. Heiner E. C., Banet I. A., Wieman C. (2014). Preparing students for class: How to get 80% of students reading the textbook before class. <i>American Journal of Physics</i> , 82, 989–996. https://doi.org/10.1119/1.4895008	475		+	+			+	
4. Huang H.-L., Chou C.-P., Leu S., You H.-L., Tiao M.-M., Chen C.-H. (2020). Effects of a quasi-experimental study of using flipped classroom approach to teach evidence-based medicine to medical technology students. <i>BMC Medical Education</i> , 20(31), 1946–1947. https://doi.org/10.1186/s12909-020-1946-7	62	+			+			
5. Krouss P., Lesseig K. (2020). Effects of a Flipped Classroom Model in an Introductory College Mathematics Course. <i>Primus</i> , 30(5), 617–635. https://doi.org/10.1080/10511970.2019.1625471	28	+		+	+	+	+	+
6. Nouri J. (2016). The flipped classroom: for active, effective, and increased learning – especially for low achievers. <i>International Journal of Educational Technology in Higher Education</i> , 13(33). https://doi.org/10.1186/s41239-016-0032-z	240				+			

Authors and publications	Size of the study group	Division into subgroups	Ordinary lectures	Learner activating activities	Use of videos	Ordinary practical sessions	Quiz-tests	Tests after contact learning
7. Pardo A., Gašević, D., Jovanovic J., Dawson S., Mirriahi N. (2019). Exploring Student Interactions with Preparation. Activities in a Flipped Classroom Experience. IEEE Transactions on Learning Technologies, 12, 3. https://doi.org/10.1109/TLT.2018.2858790	290		+		+	+	+	
8. Price C. and Walker M. (2019). Improving the accessibility of foundation statistics for undergraduate business and management students using a flipped classroom. Studies in Higher Education, 46, 2, 245–257. https://doi.org/10.1080/03075079.2019.1628204	500	+			+	+		
9. Ranga J.S. (2020). Factors Influencing Student Learning in Semi-Flipped General Chemistry Courses. J Chem Educ, 97, 2130–2139. https://doi.org/10.1021/acs.jchemed.9b01165	25-42	+			+			+
10. Steen-Utheim A. T. and Foldnes N. (2018). A qualitative investigation of student engagement in a flipped classroom. Teaching in Higher Education, 23(3), 307–324. https://doi.org/10.1080/13562517.2017.1379481	93	+		+	+			+

RESULTS

The teaching activities used for preparation for teaching, contact learning and the follow-ups at the flipped classroom methodology by small and large study groups are summarized in Table 2.

1. Preparation for contact teaching

a) Study materials

In all studied articles, FC designs adopted pre-class reading materials. Mostly the reading materials were online reading materials given according to the topic, only in one case, particular page numbers of a textbook were indicated. From the 10 observed designs, the reading materials were supplemented by videos in 9 cases. For four cases pre-class quiz-tests were adopted to encourage the use of reading materials or the content of videos (LR 1, 3, 5, 7). The pre-class quiz-tests were compulsory in 3 (LR 3, 5, 7) and voluntary in 1 case (LR 1), one of the compulsory quiz-tests was to be carried out by a small study group ($n < 30$), others by a large study group ($n > 30$). Revision questions were given to larger study groups. Students in one small study group had to solve a reading assignment and prepare a presentation before contact learning (LR 1).

b) Lecturers' pre-class activities

The students' pre-class quiz-tests results had to be checked before classes. In the articles, the right answers for online quiz-tests were mostly shown online automatically immediately after the test after every question. In two large study groups, the quiz-tests scores were accounted for the final exam (LR 3, 7).

Online counselling of a large study group before classes was practiced in one case (LR 6), and in one small study group the timely presented reading assignments were counted at the final exam – the students who had timely presented all reading assignments during the whole schoolyear could use the materials at the exam (LR 1).

Finally, the lecturers' pre-class activities also comprised checking the follow-ups from the previous cycle.

Table 2. Teaching activities used for preparation for teaching, contact learning and follow-ups at flipped classroom methodology

Teaching phases	Tasks for teachers to think about before, during and at the end of contact teaching in FC method	
	For large study groups (number of students > 30)	For small study groups (number of students < 30)
1. Preparation for contact teaching:	What kind of study materials to share with students before classes?	
	a) Study materials	<ul style="list-style-type: none"> • reading materials (7) * • videos (6) • quiz-tests (2) • revision questions (1)
		<ul style="list-style-type: none"> • reading materials (3) • videos (3) • quiz-tests (2) • reading assignment (1)
	b) Lecturer's pre-class activities	What kind of student activities can be analysed by lecturers before class?
	<ul style="list-style-type: none"> • test results (2) • group counselling at distance (1) • checking the follow-ups (7) 	<ul style="list-style-type: none"> • test results (2) • timing and quality of reading assignments (1) • checking the follow-ups (3)
2. Contact learning	What are the aims of contact learning for students?	
	<ul style="list-style-type: none"> • analysis of the mistakes that often occurred in pre-class quiz-tests (2) • seminars, practical sessions – solving problems in small groups, compiling a report, presenting the answers (3) • ordinary practical sessions (3) • lectures with learner-activating activities using clickers (3) • ordinary lecture (3) • tests, exams (7) 	<ul style="list-style-type: none"> • analysis of the mistakes that often occurred in pre-class tests (2) • in seminars and practical sessions – solving problems / tasks in groups (groups can be formed randomly, 3–5 learners per group) (2) • ordinary practical sessions (2) • lectures with learner-activating activities using clickers (1) • test at the end of the lesson (the answers will be analysed at the beginning of the next lesson) (3) • tests, exams (3)
3. Follow-ups	What kind of teaching activity to use at the end of the study?	
	<ul style="list-style-type: none"> • registration of participation in studies (7) • feedback survey (2) 	<ul style="list-style-type: none"> • registration of participation in studies (3) • knowledge and skills measurement test (1) • FC-EBM questionnaire (satisfaction survey) and feedback questionnaire (1)

* The number of cases studied

2. Contact learning

In this phase of FC design, active learning and feedback to the students' pre-class learning occurs – for example, analysis of the common mistakes of the pre-class quiz-tests. Practical sessions and seminars are usually given to the

whole group, subdivision of groups into smaller study groups was used in half of the studied cases (LR 2, 4, 5, 8, 9, 10) – during the sessions, the learners in subgroups discussed the topics, solved problems, compiled reports and, at the end of the seminars, presented their reports. Learner-activating activities – clickers – were used during lectures mostly in half of the large study groups (LR 2, 3, 10) but also in one small study group (LR 5).

Tests at the end of the contact lesson / classroom meeting were practiced in small study groups; their answers were analysed at the beginning of the next lesson. In one of the small study groups, only the students who had solved the test 100% correctly could participate in the next class (LR 2). At the end of the lessons, the participation was registered in all study groups.

3. Follow-ups after the contact session

Feedback about reading materials and tests on the topics of the past sessions was carried out in 2 large (LR 2, 10) and 2 small study groups (LR 5, 9). In addition, the FC-EBM questionnaire (satisfaction survey) as well as the knowledge and skills measurement test were compiled for one of the small study groups (LR 4).

DISCUSSION AND CONCLUSION

In traditional learning, the lower level of cognitive work is happening in class, the higher level of learning outside the classroom [12]. In the flipped classroom methodology, learning is flipped – the content is acquired and remembered before classes, and higher cognitive levels of learning are carried out during contact-learning in class [5, 11]. The FC design allows for multiple methods of learning and teaching, increases metacognition, and embeds many evidence-based teaching strategies within the course routine [2].

Due to the pre-class activities and preparation for contact learning in FC design, the pressure of the lecturer to deliver content in a limited time is lifted from the classroom and, instead, students can take more time for hands-on practice and active learning. Therefore, the application of the FC methodology in university teaching has become increasingly important in recent years under the conditions of decreased hours of contact learning. FC supports learning in the conditions of social-distancing, which has been topical in the past years to prevent COVID-19, as it enables the teaching and learning process to continue. While students benefit from the flexible learning environment, the professor can collect important data about the students and their level of understanding of the current material and prior knowledge [15].

The FC design usually consists of three phases: the preparation phase before the scheduled class session, the practice phase during the class and the phase of after-class follow-ups. In our study, the teaching activities during the three phases were observed and compared for larger and smaller study groups.

In the preparation phase the lecturers create and introduce instructional materials and analyse the students' pre-class activities. For instructional videos, students have to be given flexibility to choose when and where they interact with the content, and how they break up their sessions for learning, including reviewing or revising the material. In order to gain a high learning effect, the materials have to be interactive: quizzes, forums, polls embedded within or required after the video, allowing the students automated feedback to help them assess their initial understanding [14]. In our study, all teachers had provided most of the pre-class reading materials with tutorial videos. Still, only half of the groups of both sizes were supplied with quizzes on the subject. However, besides analysing the students' quizzes, one of the larger study groups could receive group counselling at distance.

In the contact-learning phase, active learning activities that require students to apply the content they reviewed before class, analyse, evaluate, create, synthesize, and make connections to other content areas take place. Also, learning in smaller subgroups, solving quizzes or polls in larger groups, discussions, presentations, hands-on tasks are common. For teachers, feedback about students' pre-class activities and mini-lectures are welcome. In our study, the analysis of the mistakes that often occurred in pre-class tests was carried out mainly in small study groups. Solving problems in smaller subgroups was practiced by half of the groups of both sizes and clickers were used mainly in the lectures for large study groups.

In the third phase of the after-class follow-ups, students should review, reflect, and act upon the feedback and experience from the two first phases. By reviewing and reflecting, students boost their metacognition and also increase their knowledge. For teachers, the participation of students in the studies also provides feedback. In our study, the participation of all students in studies was registered. Still, feedback was asked only from the students belonging to two larger and one of the smaller study groups. In one of the small study groups, the knowledge and skills measurement test and the FC-EBM questionnaire was used.

In summary, the teaching activities of different flipped classroom study designs were studied. The main activities used in the observed FC designs contained reading materials, watching tutorial videos and solving quizzes as

the main pre-class activities and solving problems in study subgroups and using clickers in the lectures of large study groups during contact-learning. In general, we conclude, that the different teaching activities of the FC methodology can be equally used in study groups of different sizes.

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