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ORIGINAL ARTICLE

FLIPPED CLASSROOM: THE NOVEL LEARNING ENVIRONMENT FOR MEDICAL STUDENTS

IZOKRENUTA UČIONICA: NOVI PRISTUP UČENJU ZA STUDENTE MEDICINE

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Abstract

Introduction: The ongoing pandemic caused by Coronavirus has strongly initiated digital developments and closed in-person classes in higher education. In order to achieve remote high-quality online delivery, the learning method "flipped classroom" has been introduced to both students and teachers. The flipped classroom represents a type of blended learning aiming to increase students' engagement by preparing materials for learning at home and having face- to-face problem-solving during class time.
Aim: To assess attitudes and perceptions of medical undergraduate students toward flipped classroom method of learning.
Material and methods: This was a cross-sectional study conducted among undergraduate students attending Faculty of Medicine University of Belgrade during January 2022, using online questionnaire. The questionnaire used in this study consisted of 34 questions and was divided among six main sections: demographics, overall attitudes, communication, independence in learning, preparedness and motivation, and creative thinking and collaborative work.
Results: A total of 60 medical students were included in the study. Two thirds of the students were female (75,0 %), with the mean age of 23,48 ± 1,53 years. Most of the respondents were fifth- and sixth-year students. The results of this study revealed that significant differences in perceptions of the students toward flipped classroom method of learning between gender and age group were found. Female and younger students had more positive attitudes toward flipped classroom than male and older students.
Conclusion: Flipped classroom method of learning suits the demands of medical students at a university level, advancing their problem-solving skills and higher-order thinking. Bearing in mind that younger students had positive perceptions and attitudes toward flipped classroom method of learning, curriculum designers and educators should adjust the lessons and teaching methods strategies to students' preferences in order to help them to gain their full academic potential.

Keywords:
flipped classroom,
students,
medicine

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Sažetak

Uvod: Pandemija izazvana koronavirusom inicirala je razvoj i implementaciju digitalnih tehnologija u obrazovnom procesu svih nivoa edukacije. S obzirom na to da je nastava u vanrednim uslovima bila neprihvatljiva, obrazovne institucije bile su prinuđene da uvedu kombinovani sistem nastave ili isključivo digitalnu komunikaciju sa studentima. U cilju postizanja visokokvalitetne edukacije „na daljinu", uveden je metod „izokrenute učionice", kako za studente, tako i za nastavni kadar. „Izokrenuta učionica" predstavlja tip kombinovanog učenja koji ima za cilj da poveća angažovanje učenika na dva načina, najpre pripremom materijala za proces učenja kod kuće i rešavanjem problema uživo tokom časa.
Cilj: Cilj rada je procena aktuelnih stavova i percepcije studenata medicine o novouvedenom metodu učenja - „izokrenutoj učionici".
Materijal i metode: Sprovedena je studija preseka među studentima na Medicinskom fakultetu Univerziteta u Beogradu tokom januara 2022. godine korišćenjem onlajn upitnika. Upitnik korišćen u ovoj studiji sastojao se od 34 pitanja i bio je podeljen na šest glavnih sekcija: demografske podatke, opšte stavove, komunikaciju, nezavisnost u učenju, pripremljenost i motivaciju, kreativno razmišljanje i timski rad.
Rezultati: U istraživanje je uključeno ukupno 60 studenata Medicinskog fakulteta Univerziteta u Beogradu. Više od polovine učenika bilo je ženskog pola (75,0 %), prosečne starosti 23,48 ± 1,53 godine. Većina ispitanika su bili studenti pete i šeste godine. Rezultati ove studije pokazuju da postoje značajne razlike u percepciji studenata prema izokrenutoj učionici kao novom metodu učenja prema polu i starosti. Učenici ženskog pola i mlađi učenici imali su pozitivnije stavove prema izokrenutoj učionici od učenika muškog pola i starijih učenika.
Zaključak: Metod učenja po tipu izokrenute učionice odgovara zahtevima studenata medicine, razvijajući njihove veštine rešavanja problema i apstraktno razmišljanje. Imajući u vidu da su mlađi učenici imali pozitivne percepcije i stavove prema metodi učenja po tipu izokrenute učionice, kreatori kurikuluma i nastavni kadar trebalo bi da prilagode nastavu i strategije nastavnih metoda kako bi pomogli studentima da ostvare svoj puni akademski potencijal.

Ključne reči:
izokrenuta učionica,
student,
medicina

Introduction

The ongoing pandemic caused by Coronavirus has strongly initiated digital developments and closed in-person classes in higher education. On a short notice, complete curricula had to be in line with social distancing mandates. Many universities had to achieve in 6 weeks what has been discussed for years, when it comes to incorporating blended learning method in curricula. Therefore, online learning methods were brought in as an appropriate and new educational strategy, necessitated by COVID-19 (1-4). However, such a rapid change from traditional to online learning created some difficulties because of the insufficient opportunity for educators to design and prepare virtual classes. Academics had to learn new ways of teaching and new skills. In addition, students had to adapt to learning online and have become more immersed (2,5,6).

In order to achieve remote high-quality online delivery, the flipped classroom method has been introduced to both students and teachers. The concept of flipped classroom as a learning method was first practiced by Aaron Sams and Jonathan Bergmann, who created and developed a lot of videos of educational content, in order to assist their students in comprehending the main concepts of lessons and to interpret the uncertantiy of topics, advancing learning of students throughout simulation of real-life situations (7). The flipped classroom represents a type of blended learning aiming to increase students' engagement by preparing materials for learning at home and having face-to-face problem-solving during class time. This remote delivery pedagogy transfers activities, traditionally considered homework, into the classroom. In the flipped classroom method of learning, opportunities for evaluating application of the concepts, comprehension of material and deep learning of the course content in a team setting, with a mentor's guidance, is provided (8-11).

With the pandemic emergency online learning, consequential compromise was made in order to improve the quality of the learning process. Therefore, the purpose of the current cross- sectional study is to assess students' attitudes about distance online education, i.e the flipped classroom method of learning.

Materials and methods

This was a cross-sectional study conducted among undergraduate students who attended Faculty of Medicine University of Belgrade in a period between January 20th and February 5th 2022, using an online questionnaire. Participation in research was voluntary and complete confidentiality was maintained for the respondents

The online survey was designed by faculty members using the literature review and it was administered to students (12,13). The questionnaire consisted of 34

questions and divided among six main sections: demographics, overall attitudes, communication, independence in learning, preparedness and motivation, and creative thinking and collaborative work. Demographics included questions related to students' gender, age, study year and current grade point average (GPA). Questions regarding attitudes toward flipped classroom were evaluated using a 5-point Likert scale, with categories from 1 to 5, where 1 refers to strongly disagree and 5 refers to strongly agree. Overall attitude section referred to the students' perceptions about flipped classroom as a method of learning, as well as attitudes on using a flipped versus traditional instructional method. Communication part consisted of questions related to interaction of students with instructors, as well as interaction with each other while using a flipped classroom method of learning. Independence in learning section referred to the students' attitudes toward independent, self-paced learning. Fifth- and sixth- sections of the questionnaire consisted of questions concerning Preparedness and motivation of students, as well as Creative thinking and collaborative work when applying the content learned pre-class.

Statistical analysis

Mean values with standard deviation (SD) and absolute numbers with percentages were used to present numerical variables and categorical variables, respectively. Differences between genders on attitudes toward flipped classroom were compared by Students' test for independent samples and Hi-square test. Correlation between age and questions concerning attitudes toward flipped classroom were examined by Pearson correlation coefficient. Significance was set at 0.05 in all analyses. Statistical analysis was performed using IBM SPSS statistical software (SPSS for Windows, release 25.0, SPSS, Chicago, IL).

Results

A total of 60 medical students were included in the study. Two thirds of the students were female (75,0 %) with the mean age of 23,48 ± 1,53 years. Most of the respondents were fifth- and sixth-year students (76,7 %), while 23,3 % of students were from first to fourth year medical students (**table 1**).

In the **figure 1**, GPA of the students is presented. The majority of the students (43,3 %) had GPA between 8,01 and 9,00. GPA between 9,01 and 10,00 was present in 30 % of the study population, while 26,7 % had GPA between 6,0 and 8,00.

Almost sixty two percent of the students stated that they were not acquainted with the term "flipped classroom", whereas 38,3 % of the students was familiar with the same term. When asked "Did you ever attend online course in a form of flipped classroom?", 36, 7% had negative answer, 33,3 % did not know if they had, and 30,0 % had positive answer.

Female students more often agree with the statements regarding Overall attitudes: "The flipped classroom cut down the number of frustrating sessions" (p = 0.046), "I wish more instructors use the flipped or inverted classroom model" (p = 0.015) and "I believe that I am able to learn material with flipped classroom instruction better than with traditional lecture-based instruction" (p = 0.023) than male students (**table 2**). Younger students agreed more that flipped classroom is an instructional method appropriate for their education (r = -0.310, p = 0.016), that flipped classroom cut down the number of frustrating sessions (r = -0.310, p = 0.016), that the flipped classroom allows students have more time for family, friends, play, and extracurricular activities (r = -0.281, p = 0.030), that flipped classroom is more engaging than the traditional classroom (r = -0.424, p = 0.001), wished more instructors use the flipped or inverted classroom model (r = -0.279, p = 0.031), and believed more that they are able to learn material with flipped classroom instruction better than with traditional lecture-based instruction than older students (r = -0.311, p = 0.016) (**table 2**).

When it comes to the statements regarding Communication, female students more often agree that flipped courses did not limit their interaction with instructors than male students (p = 0.001). In addition, younger students agreed more that the flipped classroom gives students more opportunities to communicate with each other (r = -0.323, p = 0.012), as well as that the flipped classroom helps students to ask questions and get immediate targeted answers to difficult concepts (r = -0.251, p = 0.053) (**table 3**).

Table 1. Demographic characteristics of the study population

Variable	
Age, mean ± sd	23.48 ± 1.53
Gender, n (%)	
Male	15 (25.0)
Female	45 (75.0)
Study year, n (%)	
I-IV	14 (23.3)
V-VI	46 (76.7)

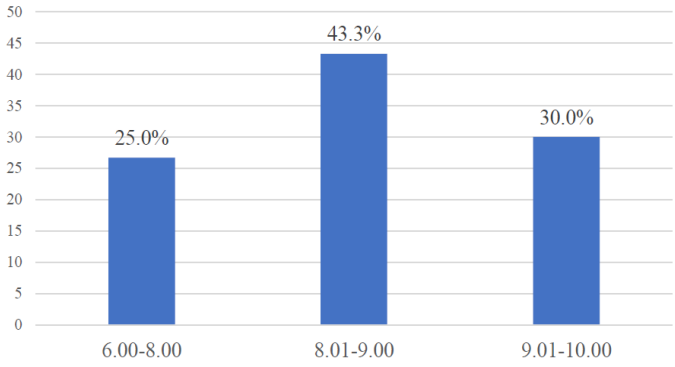

Figure 1. Current GPA of the study population

Table 2. Students gender and age according to overall attitudes toward flipped classroom

Overall attitudes	Gender			Age	
	Male (n=15)	Female (n=45)	p	r	p
Flipped classroom, along with delivery of content outside class and problem solving in class, is an instructional method appropriate for my education.	3.3 ± 1.2	3.6 ± 1.0	0.309	-0.310	0.016
Students would rather watch a traditional teacher lead lesson than a lesson video.	3.1 ± 1.3	2.8 ± 1.0	0.347	-0.021	0.873
The flipped classroom reduces the number of frustrating sessions.	3.2 ± 1.1	3.8 ± 0.9	0.046	-0.310	0.016
The flipped classroom allow sstudents have more time for family, friends, play, and extracurricular activities.	3.7 ± 1.0	3.8 ± 0.8	0.666	-0.281	0.030
I wish more instructors use the flipped or inverted classroommodel.	3.1 ± 1.2	3.7 ± 0.7	0.015	-0.279	0.031
Flipped classroom is more engaging than the traditional classroom.	3.2 ± 0.9	3.6 ± 0.9	0.166	-0.424	0.001
I believe that I am able to learnmaterial with flipped classroom instruction better than with traditional lecture-based instruction.	2.9 ± 1.1	3.6 ± 0.9	0.023	-0.311	0.016
Flipped classroom matches my learning style.	3.1 ± 1.1	3.5 ± 0.9	0.247	-0.243	0.061

*Variables are presented as mean±sd
** r- Pearsons correlation coefficient

Table 3. Students gender and age according to the statements regarding Communication

Communication	Gender			Age	
	Male (n=15)	Female (n=45)	p	r	p
The flipped classroom gives students more opportunities to communicate with each other.	2.8 ± 1.1	3.4 ± 1.0	0.059	-0.323	0.012
Flipped courses did not limit my interaction with instructors.	2.5 ± 0.9	3.5 ± 0.9	0.001	-0.241	0.064
Flipped classroom gives me the opportunity to ask more questions inside the classroom.	3.1 ± 1.3	3.7 ± 1.0	0.089	-0.201	0.123
The flipped classroom helps students to ask questions and get immediate targeted answers to difficult concepts.	3.2 ± 1.1	3.6 ± 1.0	0.150	-0.251	0.053
Teachers are available for more one-on-one interaction with students in a flipped classroom.	3.2 ± 1.1	3.4 ± 1.0	0.550	-0.176	0.180

**Variables are presented as mean±sd
** r- Pearsons correlation coefficient

Female students more often agree with the following statements regarding Independence in learning: "Flipped classroom learning has reduced my dependency on the instructor" (p = 0.013), "The flipped classroom allows students to have access to the lectures at any time easily" (p = 0.047), "I got the ability to self-pace my learning with flipped courses" (p = 0.041), "The flipped classroom supports students in becoming self-directed learners" (p = 0.003), and "I feel that watching videos and taking notes contribute efficiently to my learning" (p = 0.039) than male students. A positive correlation was found between age and the statement "Flipped classroom gives me less class time to practice the concepts of course" (r = 0.350, p = 0.006) (**table 4**).

Male students more often disagree with the statements regarding Preparedness and motivation: "With flipped classroom model, I feel more prepared for my exam" (p = 0.002), "I feel that mastering learning through flipped classroom improved my course understanding" (p = 0.002), "Flipped classroom can improve interest in class" (p = 0.064) and "I am more motivated to learn the concepts of course via the flipped classroom" (p = 0.022) than female students. Younger students agreed more with the statements "I feel that mastering learning through flipped classroom improved my course understanding" (r = -0.258, p = 0.046) (**table 5**).

Table 4. Students gender and age according to the statements regarding Independence in learning

Independence in learning	Gender			Age	
	Male (n=45)	Female (n=45)	p	r	p
Flipped classroom learning has reduced my dependency onthe instructor.	2.8 ± 0.6	3.4 ± 0.8	0.013	-0.164	0.211
The flipped classroom allow s students to have access to the lectures at any time easily.	3.7 ± 0.9	4.2 ± 0.8	0.047	-0.056	0.671
I got the ability to self-pace my learning with flipped courses.	3.4 ± 1.0	3.9 ± 0.8	0.041	0.111	0.400
The flipped classroom supports students in becoming self-directed learners.	3.1 ± 1.0	3.9 ± 0.8	0.003	-0.055	0.679
I feel that watching videosand taking notes contribute efficiently to my learning.	3.3 ± 1.2	3.9 ± 1.0	0.039	-0.018	0.889
With flipped classroom, we have to do more work out of theclassroom.	3.1 ± 1.1	3.4 ± 1.0	0.348	0.045	0.734
Flipped classroom gives me less class time to practice the concepts of course.	3.2 ± 0.8	3.0 ± 0.9	0.553	0.350	0.006

**Variables are presented as mean±sd

** r- Pearsons correlation coefficient

Table 5. Students gender and age according to the statements regarding Preparedness and motivation

Preparedness and motivation	Gender			Age	
	Male (n=15)	Female (n=45)	p	r	p
With flipped classroom model, I feel more prepared for my exam.	2.7 ± 1.0	3.6 ± 0.9	0.002	-0.209	0.109
I feel that mastering learningthrough flipped classroom improved my course understanding.	2.6 ± 1.0	3.5 ± 0.9	0.002	-0.258	0.046
Flipped classroom can improve interest in class.	3.0 ± 0.9	3.6 ± 1.1	0.064	0.057	0.664
Flipped classroom reduces the effort to understand the basic knowledge of the subject matter.	3.3 ± 1.0	3.3 ± 0.9	0.938	-0.014	0.914
I am more motivated to learnthe concepts of course via the flipped classroom.	2.9 ± 1.3	3.6 ± 0.9	0.022	-0.131	0.318

*Variables are presented as mean±sd

** r- Pearsons correlation coefficient

Table 6. Students gender and age according to the statements regarding Preparedness and motivation

Creative thinking and collaborative work	Gender			Age	
	Male (n=15)	Female (n=45)	p	r	p
Flipped classroom encourages meto practice critical and creative thinking.	3.1 ± 1.0	3.6 ± 1.0	0.071	-0.128	0.328
The flipped classroom encourages learners to pose inquiries and find quick focused on solutions to troublesome ideas.	3.1 ± 1.0	3.7 ± 0.9	0.032	-0.140	0.287
Flipped classroom improved collaborative learning.	2.8 ± 1.0	3.7 ± 0.9	0.005	-0.276	0.033

*Variables are presented as mean±sd

** r- Pearsons correlation coefficient

When it comes to the statements regarding creative thinking and collaborative work, female students more often agree that flipped classroom encourages learners to pose inquiries and find quick focused on solutions to troublesome ideas (p = 0.032), as well as that flipped classroom improves collaborative learning (p = 0.005) than male students. Younger students agreed more often with the statement: "Flipped classroom improved collaborative

learning" than older students (r = -0.276, p = 0.033) (**table 6**).

Discussion

The results of this study revealed that significant differences in perceptions of students toward flipped classroom method of learning between gender and age group were found. Female and younger students had more positive attitudes toward flipped classroom than male and older students.

In the study conducted in 2019 at Jerash University in Jordan, students' perceptions of flipped classroom were high. In this study, students considered flipped classroom method as a meaningful learning experience, fulfilling students' needs and preferences. The results of our study are similar to the abovementioned study results, where our study population agrees that flipped classroom is an instructional method appropriate for their education. Difference between our study results and results of the study conducted in Jordan is in gender variable; results of their study showed that perceptions of male students toward flipped classroom method were better than female students perceptions, whereas results of our study were contrary. In addition, results of the Jerash University study showed that, with flipped classroom model, students felt very prepared for their exam. This corresponds to our study results, where female students felt more prepared for their exams with flipped classroom model than male students (p = 0.002). When it comes to the statements regarding students' dependence on the instructor, similar results were obtained in Jordan study, as well as in our study. Their study population agreed that student's dependency on instructor has been reduced, whereas results of our study showed that female students more often agreed with this statement than male students (p = 0.013). In addition, Jordan students agreed that they felt less able to learn better with traditional lecture-based instruction material than with flipped classroom instruction material. This is in line with our study results, in favor to younger students compared to older students (p = 0.016) (12).

In the study conducted by Farrah and Qawasmeh in 2018, attitudes of the students at Hebron University toward flipped classroom were investigated (13). Their study results showed that most students agreed that the learning method of flipped classroom helps students in growing into more self-directed learners. This corresponds to our study results, where female students agreed more with this statement than male students (p = 0.002). Results of the Farrah and Qawasmeh study corresponds to our study results when it comes to the statements "The flipped classroom allows students have more time for family, friends, play, and extra-curricular activities" and "Teachers are available for more one-on-one interaction with students in a flipped classroom", where same degree of agreement was obtained. In addition, our study results correspond to the abovementioned study results regarding male and female students' attitudes towards the flipped classroom. In their study, mean scores showed the female students had better attitudes than male students, which is in agreement with our study results, where female students had higher mean scores than male students (13).

When it comes to students' motivation, results obtained from the Farrah and Qawasmeh study (13), as well as Davies, Dean, and Balls study (14), indicate that when applying flipped classroom learning method students' motivation increases. In addition, Davies, Dean, and Ball have found that flipped classroom learning method stimulate students collaborative work. This is in line with our study results, where female students felt more motivated to learn the concepts of course via the flipped classroom than male students (p = 0.022) and younger students thought more often that flipped classroom improved their collaborative learning than older students (p = 0.033).

Conclusion

Flipped classroom represents a relatively recent strategy more frequently used in higher education due to COVID19 pandemic. This study presented positive attitudes of medical students at a university level towards flipped classroom, developing their problem-solving skills and higher-order thinking. Data gathered from future cohorts will help clarify how this new and innovative type of learning environment impacts on students' performance in its all aspects in higher education. Bearing in mind that younger students had positive perceptions and attitudes toward flipped classroom method of learning, curriculum designers and educators should adjust the lessons and teaching methods strategies to younger students' preferences in order to help students gain their full academic potential.

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