Using e-learning tools in biochemistry teaching for undergraduate medical students in multicultural environment in Ukraine during COVID-19 crisis

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Abstract
Through the special situation like the COVID-2019 lockdown, interactive techniques play a prime role in the study process. The strategy of lockdown ways of higher education was provided in Ukraine as well as in other countries since March 2020. Our investigation was performed at the Department of Biochemistry and Medical Chemistry of Dnipro State Medical University during the first lockdown of COVID-19 from March to June 2020. The main aim of the research was the evaluation of the students' attitudes to studying Biochemistry using Google classrooms and Moodle. Four hundred and sixty-three students studying in English, French, and Ukrainian took part in the survey. Our results reveal that majority of the students found Google classrooms and Moodle as useful e-learning tools. However, questions dealing with the technical issues of using the Google classrooms on laptops and mobile phones and submitting the replies to the Google classrooms cause difficulties among the students.

KEYWORDS
COVID-19 lockdown, Google classrooms, Moodle, multicultural environment

1 | INTRODUCTION

Recently e-learning approaches have become an essential part of higher medical education all over the world. They are used as an additional form of students’ preparation in Biochemistry classes in India, China, and other countries. For example, Rain Google classrooms were used in Biochemistry course with the purposes to enhance studying interest and to optimize learning outcomes in 2017 in China. However, before COVID-19 pandemic it was only the additional measures in the studying process. Spreading of corona virus all over the world leads to moderating and enhancing the impact of e-learning in higher education. It becomes the only possible way of providing classes. For teaching Biochemistry to medical students there are several e-learning approaches to be used: Moodle, Google classrooms, video conferences, for example in Google Meet, Zoom, and so forth.

In Ukraine as well as in other countries there was established the strategy of lockdown ways for school and higher education since March 2020. Dnipro State Medical University (DSMU) also provided online learning with Google classrooms, Zoom conferences, and Moodle.

In Ukraine, there are several state medical institutions such as in Kyiv, Odesa, Vinnytsya, and Dnipro which provide medical education to foreign students. At the DSMU there are courses for foreign students studying in English, French, and Ukrainian languages. The
problem of Biochemistry teaching the students from other countries in English and other languages are highlighted by some investigations, for example, in China and Brasil.\(^8\,^9\) However, there is a lack of information of using the e-learning tools to international medical students for studying of Biochemistry course.

That's why the goal of this study was an evaluation of the usefulness and significance of using Google classrooms and Moodle by international and native speaking Ukrainian students as well as to obtain information about using Google classrooms for further improving and correcting the teaching of Biochemistry.

2 | METHODS

Investigation was conducted at the department of Biochemistry and Medical Chemistry of the DSMU, Dnipro, Ukraine during the first lockdown of Covid-19 from March till June 2020. Students took part in the survey at the middle of the semester (April 18–25, 2020).

There were 22 study groups with 655 students in total that were studying for Medicine qualification in English, French, and Ukrainian; 71% (463 students) of students took part in the survey (Table 1). Students who originate from India, Israel, and Algeria studied in English. These students were divided into groups named by A, C, G, and E letters in Latin. French-speaking students who arrived from Morocco, Tunis, Algeria were put into B group. Ukrainian students were also involved into the investigation. We divided them into groups F and D.

The classes were held by six highly-qualified assistants and associate professors of Biochemistry.

The course of Biochemistry which is called Biological and bioorganic chemistry in the DSMU, consists of two modules in the second year students. The present investigation deals with the 2D module that is devoted to the issues: Molecular mechanisms of hormone action on target cells; Fundamentals of molecular biology; Biochemistry of Human Nutrition; Biochemistry of Vitamins as components of nutrition; Functional and clinical biochemistry of organs and tissues. We conducted classes with Google classrooms (GC), Moodle, and Zoom. The survey was taken for assessment of the work in the Moodle and Google classroom platforms. The studying information presented at the platforms can be divided into two groups: a theoretical part—original lectures in PowerPoint, links for the studying videos on YouTube, and a practical part—quizzes and questions as the home tasks, as well as, multiple-choice questions (MCQ) in the Moodle platform as the summarizing assessment test of the obtained knowledge in line with further state exam Krock (Step)1, which is referred to USMLE and the tasks of the practice course in the printed workbooks for each lesson according to the calendar thematic schedule plan (Figure 1). At the end of two thematic blocks (15 classes), feedback was provided in the form of 10 questions using Google forms. The questionnaire was developed on the base of the survey of Dash\(^2\) with using to one question replies proposed by Harvey\(^10\) and Krosnick with collaborators\(^11\): totally agree, somewhat agree, rather disagree, totally disagree, I do not know. All answers were assessed from 5 to 1, according to a Likert scale with the maximum in 5.

Data were analyzed by Shapiro–Wilk test for estimating the data normality. In the case of nonnormal data—Wilcoxon test was used. One-way analysis of variance (ANOVA) between the groups with studying in different languages. All analysis was performed using JASP, version 0.14.1.

3 | RESULTS

During this investigation, it has been revealed that the level of students' responses depends on several factors.

The represented answers can be divided into several grades: 1—high level of responses (100%–81%), 2—medium (80%–61%), 3—low (60%–41%), 4—very low

| Number of the group | Number of respondents | Total number of students | Not answered | Language of study | Country of origin |
|---------------------|-----------------------|-------------------------|--------------|-------------------|------------------|
| A                   | 33                    | 41                      | 8            | English           | Morocco, Algeria |
| B                   | 30                    | 71                      | 41           | French            | Morocco, Algeria |
| C                   | 88                    | 94                      | 6            | English           | India            |
| D                   | 88                    | 100                     | 12           | Ukrainian         | Ukraine          |
| E                   | 80                    | 117                     | 37           | English           | Morocco, Nigeria, Israel |
| F                   | 80                    | 125                     | 45           | Ukrainian         | Ukraine          |
| G                   | 64                    | 107                     | 43           | English           | India, Israel    |
English-speaking students from India showed high level of responses 94% and 88% respectively. All other students revealed an average level of answers from 80% to 64%. Only French and English-speaking students from African countries and Israel showed a lower level of activity 60% and 42%, respectively.

According to our results all students answered generally to questions between 4.81 to 4.03 in the line with Likert scale (Table 2). The maximum score among all groups was put to question number 3 by the students from Group D (native Ukrainian speakers). They totally agreed that it was convenient to answer questions during preparation for the online classes using GC. The highest score was 4.85. The minimum score (3.03) was notified among the replies of the students from group A. They rather disagreed that it was easier to use GC on a laptop than on a mobile phone.

Seventy-three percent of students in both English-speaking groups and groups with other languages found that access to class materials was easier with the use of GC. The same situation with the difference only in 7% was shown for the value of the links to YouTube videos (Figure 2). However, for students of English-speaking groups it was less convenient to reply on questions via GC. They totally agreed with it on 30% less than students from groups studying in other languages.

When submitting the copies of the answers in the printed workbooks, getting quick feedback, and using access to learning material with GC the students had difficulties both in English-speaking groups and in groups

![Diagram](image)

**FIGURE 1** The learning content that was presented in the Google classrooms

**TABLE 2** Replies to the questionnaire of the students from different investigated groups

| Questions                                                                 | Investigated groups |
|---------------------------------------------------------------------------|---------------------|
| 1. Access to class materials was easier with Google Classroom             | A* 4.40 B* 4.64 C** 4.80 D 4.45 E*** 4.49 F 4.56 G* 4.39 |
| 2. The YouTube videos shared in Google Classroom explaining concepts were helpful | 4.20 4.61 4.74 4.53 4.41 4.40 4.38 |
| 3. It was convenient to answer questions conducted using Google Classroom | 4.63 4.18 4.08 4.85 4.56 4.81 4.08 |
| 4. Submitting the answers of the printed workbook questions in Google Classroom was convenient | 4.47 3.97 4.74 3.74 4.49 4.20 4.30 |
| 5. Getting quick feedback (result of questions, etc.) was helpful         | 4.37 4.76 4.70 3.47 4.54 3.04 4.11 |
| 6. It is easy to access the learning material in the Google Classroom app | 4.30 4.61 4.73 3.78 4.46 3.95 4.36 |
| 7. Use of Google Classroom helped in learning outside of class environment | 4.20 4.67 4.58 4.43 4.30 4.44 4.03 |
| 8. Use of Google Classroom overall enhanced my learning experience for the topics covered | 3.93 4.48 4.52 3.76 4.13 3.70 3.95 |
| 9. It was easier to use Google Classroom on laptop than on phone           | 3.03 3.94 3.47 4.40 3.40 4.09 3.13 |
| 10. Answer to the MCQ in Moodle, is it convenient?                        | 4.80 4.79 4.82 4.11 4.61 4.15 4.06 |

Note: Statistical significance, in each group p-value: <0.05 = *; <0.001 = **; <0.0001 = ***.
studying in other languages. From 57.6% to 41.9% of students replied “totally agree” in this case. Thus, 36% of the respondents from groups with no English studying languages almost agreed that submitting the answers on the printed workbooks questions in GC was convenient. As well the difficulties were with the questions about the value of using GC in the study process (question 8). Only 53.1% of English-speaking students answered totally positively. In the case of using a laptop or a mobile phone for access to GC less than a half of English studying groups totally agreed that a laptop is more convenient.

Comparison of the responses of studying groups which were estimated by the Likert scale using ANOVA shows that the students’ answers from groups with English studying language do not significantly distinguish from the answers of the students from groups with other studying languages (Table 3). However, detail comparison of investigated groups reveals that groups B, C, and G, as well as G and E differ at $p < 0.01$. The data in these groups show normal distribution as proved by Shapiro–Wilk test.

TABLE 3 Summary for the distinguished groups

| Groups | Mean | SD  | SE  | $p$   |
|--------|------|-----|-----|-------|
| A–C    | 4.23 | 0.49| 0.15| 0.02  |
|        | 4.55 | 0.43| 0.13|       |
| B–G    | 4.46 | 0.39| 0.10| 0.007 |
|        | 4.08 | 0.37| 0.12|       |
| C–E    | 4.52 | 0.43| 0.13| 0.05  |
|        | 4.34 | 0.36| 0.11|       |
| C–G    | 4.52 | 0.43| 0.13| 0.009 |
|        | 4.08 | 0.37| 0.12|       |
| E–G    | 4.08 | 0.37| 0.12| 0.001 |
|        | 4.33 | 0.36| 0.12|       |
Thus students studying in different languages have different approach to e-learning and studying Biochemistry.

4 | DISCUSSION

Our results show that access to GC was convenient for students which is coincided with the results of the author from Melaka Manipal Medical College (Manipal Campus), where students estimated question 1 as somewhat agree as well. In our case, students from India evaluated this issue highly too. It was less convenient to access (get to) the class materials for French-speaking students, as well as for native Ukrainian speaking students.

Respondents from different investigated groups reveal the various attitudes toward the tasks. English-speaking students were more interested in resolving situational tasks during Zoom conferences online than in replying to the quizzes in GC, which is in accord with the investigation made in Ulm University, Germany. They confirmed that preparing tasks in groups were more convenient than individual learning. This also can be proved by the role of solving of situational tasks in the teaching of Biochemistry.

The issue number 4 (submitting the answers of the printed workbooks in GC) is connected with certain difficulties among some students. This process included several steps. Firstly, students prepared the handwriting answers in the printed workbooks, then took photos and attached them in their GC accounts. It should be noted that not all students made that easily. The English-speaking students from group G (India and Israel) had more difficulties than students from group C (only India). In the same way French-speaking students needed some help from the teachers in attaching the tasks in the GC accounts. Their questionaries’ responses were less than value of 4. The same results were shown by students from Malaysia. Thus, the students may not have had enough experience in the using of e-learning tools. However, when we provided the special instructions in the form of screenshots in GC, this problem was resolved.

The students studying in English (A, C, G) as well as the French speaking students agreed with the usefulness of quick feedback from the teachers. However, the Ukrainian speaking students thought that feedback was not very useful. It can be explained by higher contacts of Ukrainian speaking students with the teachers via Zoom conferences than that for English and French speaking students. The last ones had the feedback from teachers via the emails and letters in the Google classrooms.

The technique issue about the easier way of using GC on laptops than on mobile phones were quite comprehensive. The students noted that on a laptop it was more convenient, but it could be connected with technical problems.

The MCQ is one of the important part of the preparation of the medical students. In DSMU, the Moodle platform has been used for evaluation of the students' results at the end of the studying topics as the part of preparation for the State exam (Krok-1) for several years. According to our results for students of all language speaking studying groups answering to MCQ in the Moodle was convenient. Moodle gives a lot of opportunities for studying, preparation and evaluation, that is why it is used as the major studying tool in DSMU. It allows the students to reply easily on the questions and to perform appropriately the evaluation of knowledge of Biochemistry of the students by the teachers.

Through the special situation like the COVID-2019 lockdown the interactive techniques played the prime role in the studying process. The using of GC made the teaching and studying processes easier for medical students. GC has the three main signs of a successful e-learning tool: firstly, it is free for students and educators, secondly, it has high level of technical quality and finally, both teachers and students are satisfied with this tool. It is also evident from the replies of the respondents from our investigation.

Our experience proves that Google classrooms allow to give theoretical materials to the students, as well as to evaluate the levels of knowledge of biochemistry. This tool also allows to have a quick feedback for students and teachers. However, GC should be combined with other e-learning platforms in order to have live connections between teachers and students that complies with studies of scientists from different countries.

5 | CONCLUSION

It should be noted that e-learning tools can be used in online studying of Biochemistry particularly in special situations like COVID-2019 lockdown. Our results have been revealed that Google classrooms are convenient for access to theoretical and practical learning materials, for answering questions and quizzes to the students studying in different languages. However, in some questions there were difficulties such as submitting the handwriting replies and technical issues of using GC on laptops and mobile phones. The significant difference is found between the replies of the students studying in English and French, but it is not established any difference between the replies of students studying in Ukrainian and English or French. It has been shown that Moodle platform is also very useful e-learning tool for students and teachers. Nevertheless, the Google classrooms and
Moodle can be recommended not only for online studying, but also as additional tool for extra materials for students’ preparation even during offline studying.

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