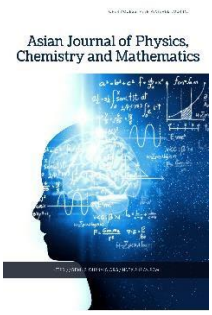

Impact Of Covid-19 On Understanding Organic Chemistry for New Students in Iraqi Universities

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ABSTRACT

COVID-19 has besieged academic institutions worldwide. As countries closed their international borders and imposed lockdowns, tertiary-education institutions have had to move quickly toward online offering to maintain continuation of teaching and learning. Faculty members have encountered enormous obstacles in replacing traditional face-to-face lectures with alternate means of instruction and assessment. This shift appears to have been relatively easy for countries that invested in education and approached e-learning strategically prior to the crisis. Countries that have not created a strategic approach to e-learning cannot provide the necessary assistance, and those that have witnessed lower development in higher education in general have faced considerable challenges. In this study, we show how chemistry instructors dealt with and overcame the challenges of teaching a freshman organic course at a period of stringent safety regulations. We discuss how the assessment mechanisms in our course have changed, as well as the effects of these modifications on our students' academic performance and teacher feedback ratings..

Keywords: COVID-19 Pandemic, Organic chemistry, Students, Iraqi universities

Introduction

The coronavirus disease outbreak of 2019 (COVID-19), which began in Wuhan, China, has expanded throughout the world. COVID-19 has impacted the life of everyone on the planet, some more severely than others (Alon et al., 2020). It comes as governments around the world tighten social restrictions by closing restaurants, bars, movies, banquet halls, and gyms (Nachum et al., 2021). Manufacturing enterprises have ceased operations, and air traffic has plummeted to near-zero levels. According to economic specialists, 20% of the workforce is currently subjected to some type of lockdown. To a certain extent, these workforces encompass academic institutions worldwide (Kniffin et al., 2021). Public transportation has been suspended, educational institutions have been closed, public gatherings and activities such as Church gatherings, Friday and daily prayers, weddings, and funerals have been prohibited. The operation of restaurants, banquets, cinemas, and gyms have been stopped, and suspected cases have been quarantined (Hussain, 2021). During this exceptional situation, faculty members have sought interactive platforms and alternative solutions that enable communication between educators and students, as well as amongst students (Pokhrel & Chhetri, 2021). During this unprecedented crisis, interactive platforms and alternate-communication methods are required to strengthen communication between educators and students. Various previously unheard-of techniques have been developed in Iraq to limit COVID-19 dissemination. Accordingly, the present study aims to

determine the impact of COVID-19 on understanding organic chemistry for new students in Iraqi universities. The university students' their level of knowledge, attitudes, and practices towards understanding organic chemistry in Iraq during the COVID-19 are assessed. Our findings are expected to help universities to organise the necessary educational programs in organic chemistry classes and better plan for educational strategies to provide up-to-date information and deliver the best practice to understanding organic chemistry.

Freshman Organic Chemistry Course: INCH10601

In the following discussion, we utilise the freshman course 'Organic Chemistry I' (course code INCH10601) that we teach at the University of Thi-Qar of Iraq (UTQI) to illustrate how the instructors' efforts have evolved from the first day of teaching to COVID-19 experiences. Students majoring in chemical science in their first year of college will benefit from this course, which is based on the well-known Clayden book. For the preceding eight academic years, it was taught in a flipped classroom (FC) approach. During FC, students undertake lower-level cognitive work (learning and comprehension) outside of class and focus on higher-level cognitive work (application, synthesis, analysis, and/or evaluation) in class with the help of their peers and instructor. In the previous semester, 112 students enrolled in five face-to-face (F2F) classrooms during COVID-19. Students spent one hour at home each week watching filmed lecture videos, doing tutorial assignments, and then attending a two-hour F2F active-learning session. These 112 students met in the lecture hall once every three weeks for a synchronous large-class review session and were provided with asynchronous formative self-assessment worksheets by the course's lead instructor. Each student devoted 3 h per week to self-preparation. In 'Organic Chemistry I', the students learn the fundamentals of organic molecule structure and reactivity in this course, with curriculum emphasis on substitution and elimination reactions, as well as the chemistry of various functional groups in organic chemistry (Supporting Information). Additionally, students are taught how molecules can be produced through the use of molecular-orbital theory in the classroom setting. Other significant subjects explored include the mechanism of reactions, organic transformations, and stereochemistry. INCH10601 serves as a foundation for subsequent organic chemistry courses at UTQI. The learning outcomes (LOs) for this course are as follows.

1. Simple inorganic chemistry reaction transformations, functional-group interconversions, and bond-formation reactions should be applied and evaluated in this course.
2. By depicting the movement of electrons, show the mechanics of inorganic chemistry reactions.
3. Distinguish between and configurations in stereochemistry and identify their lexicons.
4. Explain the requirement of chemicals
5. utilised in reaction pathways.
6. Explain and account for the chemical reactivity of reaction processes.

Background of Covid-19 Events That Affected Teaching

The Chinese Center for Disease Control and Prevention revealed in January 2020 that a coronavirus, SARS-CoV-2, was the primary pathogen in a series of new pneumonia cases in Wuhan, Hubei Province, which the World Health Organization (WHO) later dubbed COVID-19 (Mohan & Nambiar, 2020). COVID-19 was declared as a Public Health Emergency of International Concern by the WHO on January 30, 2020 as the number of new cases and deaths from the virus continued to grow. Many countries implemented measures such as border screening and social separation to combat the virus's spread (World Health Organization, 2020). On February 26, 2020, the Ministry of Higher Education and Scientific Research cancelled all studies and examinations, including Bachelor's, Master's, and PhD courses, due to a government decree that all such procedures be suspended or cancelled (Elameer, 2021). The Iraqi government placed limitations on schools and

universities on February 26th, and Iraq went into full-scale lockdown on March 4th. Despite the lockdown, school and university employees were obliged to continue working to support students via e-learning during this critical period (Hussein et al ., 2020). In light of the continuously changing nature of professional roles and working habits, we are keen to investigate the extent and specific aspects of this virus outbreak that impacted students' level of understanding of organic chemistry. As we continue to be confronted with the prospect of virus pandemics, grasping the consequences of the COVID-19 outbreak for students who will be the vanguard of treating these diseases in the future is critical. Through our findings, we hope to shed light on the impact COVID-19 on new students' understanding of organic chemistry in Iraqi universities within the College of Science, Department of Chemistry whilst emphasising the specific locations that should be considered in the event of future outbreaks.

Sudden Change in Learning Assessment for Students at UTQ

UTQ students face a sudden change in learning assessment. The orders below were issued in the first week of March. On March 3, 2020, Iraqi Prime Minister Haider al-Abadi told the Iraqi people that the administration decided to take even tougher steps to tackle the COVID-19 crisis in the country (Lafta et al., 2021). In schools, institutes, and universities of learning, the country would transition to entirely home-based education. To combat the spread of COVID-19 in the workplace, UTQ adopted telecommunicating for all employees, following a recommendation from Iraq's Ministry of Health (Alsayed et al., 2020). All course assessments must now be performed online. Chemistry professors were also urged to replace examinations with take-home online assignments and reassign the course-evaluation components. As a result, we modified the assessment components in INCH10601. INCH10601 consists of three major evaluation components. It is decided by the number of students who attend class each week in the F2F session and who meet all five LO requirements. The midterm exam is a one-hour F2F closed-book examination encompassing LO1, LO2, and LO3. Initially, the course's percentages were as follows: midterm examination (50%), and final examination (50%). Examinations were introduced by e-assignments, and the department was hesitant to give an open-book e-assignment to such a high percentage of students. This setup may appear to be unfair to those who do not perform well and blame it entirely to the midterm test. Finally, the percentage makeup for INCH10601 was revised to include a midterm test (50%), and an online assignment in lieu of a final exam (50%).

Table 1. Change in Course Assessment Components as a Result of COVID-19

Assessment Component	Before COVID19	After COVID19	Rationale for the Change
Class participation	20%	10%	
Midterm test	30%	30%	To allocate it entirely to the midterm test would appear to be unjust to those who performed poorly.
Final exam	50%	60%	Changes in the Final Exam mode were reported mid-the semi-annual, together with a reduction in the percentage of students not accustomed to a scheduled online job. Examinations were replaced with electronic assignments, so a high level of e-

assignment was not comfortable for the department.

Factors That Influenced Our Decisions to Use Online Assessments

The following factors were evaluated by experts when they decided which modalities of online evaluation to use. These concerns guided the development of the INCH10601 online take-home assignment. First, when deciding on an evaluation method to replace the F2F exam, we selected the tried-and-true method. Google Classroom, the internal learning-management system at our university, was used. It is well-known amongst teachers and students as an online platform where students can use multimedia tools and post and download files. Owing to a lack of experience with Google Classroom, UTQ was able to overcome possible obstacles during the online evaluation. Second, we looked at the degree to which the LO was met for each of the three assessment components (Table 2).

Table 2: Module Assessment Alignment with INCH106011's Learning Objectives

Assessment Component	**Weightings of Final Grade (%)**	**LO1: Apply Organic Reaction Transformations, Functional Group Interconversion, and C-C Bond Formation.**	**LO2: Describe the Mechanisms of Organic Reactions Through the Movement of Electrons**	**LO3: Distinguish R/S and E/Z Configurations in Stereochemistry and Differentiate the Lexicons**	**LO4: Describe and account for a reaction's chemical reactivity**	**LO5: Explain the Need for Chemicals in Reaction Pathways**
			Pre-COVID-19 (before 2020)			
Class Participation	20%	75%	75%	75%	75%	75%
Mid-Term Test	30	75%	75%	25%	50%	
Final Exam	50	75%	75%	75%		50%
			After COVID-19 (2020)			
Class Participation	10%	75%	75%	75%	75%	75%
Mid-Term Test	30	75%	25%	75%	50%	50%
Final Exam	60	75%	50%	75%		

Despite the absence of F2F examinations in favor of take-home online assignments, we were still able to complete more than three out of the five LOs in our course despite the change in assessment method. Considering that INCH106011 is a freshman organic chemistry

course, students were instructed to use a pen and paper to design the skeleton structures of organic compounds and organic reaction pathways through arrow pushing. The teaching team determined that instructing pupils to sketch on Google Classroom with a mouse or an electronic stylus would be unjust because students would need to practice sketching with unfamiliar equipment, and it also has the potential to give an unfair advantage to those who can buy the expensive stylus that simulates the pen and paper mode, amongst other things.

Preparation for Examinations by Using Online Assessments

Given the decision to switch to an electronic platform for our final summative assessment, we ensured that clear instructions were provided to our students ahead of time (Alrefaie, Hassanien & Al-Hayani, 2020). In particular, we emphasised the need for appropriate equipment (e.g., mobile phone with camera, computer with internet access, printer, and scanner). We also prearranged with the department for the loan of such electronic devices in the event that pupils did not have access to a notebook or working computer. In our situation, no requests for hardware assistance were received from students. The prerequisites for wi-fi or mobile-data access were also included to guarantee that students were able to access the assessment whilst away from their home or school. Due to the FC nature of INCH106011, we did not have any issues with Wi-Fi because students were inclined to utilise Google Classroom on a daily basis. Prior to the start of the online assessment, we reminded students of the university's code of student conduct and discussed the concept of cheating, as well as the ramifications of engaging in unethical behavior (Bilen & Matros, 2021).

Taking the Real-Time Take-Home Online Assessment

During the evening of April 1, 2020, the INCH106011 course chief teacher published a Google Classroom document with the e-assignment questions to the course's Google Classroom page. We recommended that students download and print this material. They were required to write their replies in dark ink and draw all buildings. A time limit of one hour was suggested for this e-assignment. Students needed to scan and upload their completed assignment paper into a folder on Google Classroom after they completed the task. The deadline for this folder was 9 p.m. In other words, sufficient buffer time was given to enable real-time downloading, printing, scanning, and uploading of the assignment whilst it was being done. Although the e-assignment had no glitches, some students emailed the primary teacher to ask for clarification regarding some aspects of the evaluation process. These emails were responded to promptly by the chief teacher. We did not receive any emergency emails regarding the completion of the e-assignment, and we did not receive any enquiries about technological difficulties encountered during the process.

Impact COVID-19 on Student's Academic Performance

Table 3 depicts the percentage distribution of student marks in 2019, when COVID-19 did not exist and the final test, which was conducted in person, had an assessment weighting of 60% compared with the previous year. When COVID-19 caused a disruption to our F2F assessment in 2020, the real-time take-home online assignment was deployed. The following factors were considered in converting students' overall scores to grades: A (≥80%), B (70% to <80%), C (60% to <70%), D (50% to <60%), and F (<50%). As indicated earlier, the department took the choice to adjust the weightings of the evaluation when we had to substitute our F2F final test. However, the final-grade distribution produced by such a changed weighting turned out to be comparable to the grade distribution obtained prior to the COVID-19 implementation. We surmised that performing an additional analysis to redistribute the score components according to the original assessment weightings (prior to COVID-19) would have significantly skewed the grade distribution, resulting in almost half of the class receiving an A grade, which would be an unrealistic representation of the cohort's competencies and performances in this

notoriously difficult freshman organic chemistry course at TQU.

Table 3: Distribution of Student Grades by Percentage for the Semester Taught Before COVID-19 (2019), during COVID19 with Updated Assessment Weightings (2020), and Without Modified Assessment Weightings.

	Distribution/%		
Grade[d]	2019a	2020b	2020c
A	20	13	45
B	51	67	41
C	14	10	9
D	9	8	4
F	6	2	1

(a) Based on the weightings of participation in the evaluation (20%), midterm test (30%), and final exam (50%). (b) In accordance with the assessment weightings of participation (10%), midterm test (30%), and real-time take-home assignment (60%). (c) Based on the weightings of participation in the evaluation (10%), midterm test (30%), and real-time take-home assignment (60%). (d) (≥80%) Grade A, B (70% to <80%) Grade B, (60% to <70%) Grade C, (50% to <60%) Grade D, (<50%) Grade F.

Impact on Teacher's Teaching Evaluation

TQU students are invited to participate in an online student feedback exercise prior to the semester's conclusion. Student input on instruction is an important part of the university's quality-assurance process (Tennant & Khamis, 2017). The input assists the university in its ongoing effort to improve teaching and learning to improve the learning experience of students in general. In most cases, the online student-feedback exercise is carried out two weeks before the start of each semester exam. It will not be until after the examination results have been released that the instructor will be able to view the feedback responses submitted by the students. A student-feedback questionnaire was developed to obtain information about students' learning experiences, as well as their views regarding the course and teachers. Reactions to statements including general comments on the course, seek responses to specific components of the course, as well as responses to the course instructors, are collected using a five-item Likert scale with 1–5 points (1 being strongly disagree and 5 being strongly like). Through two open-ended questions in the last portion, students can provide feedback to the instructor. The author's student input before and after COVID-19 is compared in Table 4.

Table 5: Comparing the Author's Pre-COVID-19 and Post-COVID-19 Teaching Feedback Scores on the University-Wide Online Student Feedback Exercise (On the 1-5-point Likert scale, 1 indicates strong disagreement and 5 indicates strong agreement)

Questionnaire Statements	Pre-COVID-19	During COVID-19
Response rate	67%	54%
The teacher has enhanced my thinking ability.	4.3	4.4
The teacher provides timely and useful feedback.	4.1	4.2
The teacher has increased my interest in the subject.	4.5	4.2
Overall, the teacher is effective.	4. 4	4.3

Nomination for best teaching award	32%	16%

No significant differences were found in the scores, which ranged from 4.1 to 4.3, for comments such as 'The instructor has improved my thinking abilities', 'The teacher delivers timely and meaningful feedback', and 'Overall, the teacher is effective'. According to COVID-19 data, the response rate for instructional input declined to 56% from a high of 68% before 2020, a significant decrease. An explanation for the reduction in these data points could be linked to the abrupt transition from on-campus to online instruction (Paul & Jefferson, 2019). When faculty members have access to the appropriate technological tools, they can continue to provide education effectively, and students acquire the content and perform well on assessments (Dyhrkopp, 2021). However, when we teach student F2F, we get to know them better. Through the process of online teaching, a certain amount of interpersonal connection is lost. Students who expressed their initial concerns about the influence of COVID-19 on their learning felt comfort in knowing that the teachers were there to assist them and support them throughout the process. The absence of F2F classes and the change in evaluation mode caused natural dissatisfaction amongst students, who were sympathetic to the difficulties that instructors were experiencing (Gherheş et al., 2021). This finding is just an example of some of their comments. Interestingly, the university provost announced in early May 2020 that the teaching feedback for this semester can be excluded from consideration for faculty-performance evaluation in anticipation of poorer teaching feedback as a result of the cataclysmic shift to remote learning and online teaching brought about by COVID-19. Teachers can choose not to submit these teaching reports for consideration for promotion or tenure; in this case, student feedback reports clearly indicate that the semester is exceptional.

Substitutes for Face-To-Face Education

In the previous semester, when COVID-19 engulfed the world, educators were forced to discover alternatives to traditional teaching approaches to replace them during the lockdowns (Famularsih, 2020). The authors have firsthand experience with various replacement tactics and discovered the following choices that teachers may consider if e-learning continues to be the default form of instruction for the Fall 2020 semester. First, we substituted large-class review sessions with video presentations that were taped and uploaded to Google Classroom by using video-recording software. We experimented with live streaming via internet platforms such as Telegram, Facebook, and YouTube to facilitate synchronous learning. We used Zoom's breakout rooms for small-group conversations, which were quite convenient. The importance of this is particularly apparent in flipped courses such as INCH106011. We also held virtual office hours through the use of Zoom and Microsoft Teams, which were open to the public. We discovered that the usage of cameras allowed for a more personal exchange of information (Madianou & Miller, 2013). During COVID-19, we investigated a number of alternative substitutes for various educational activities, as 36 ummarized in Table 5.

Table 5: Changes in Flipped-Classroom Teaching Activities as a Result of COVID-19 Regulations.

Teaching Practice Before COVID-19	Changes Due to COVID-19
Hands-on activities in small groups that functioned with white-board discussions	Utilize Zoom's breakout rooms to facilitate small group discussions.
Large-class review sessions	Utilize video recording tools to create video presentations and upload them to the LMS.
Office hours	• Encourage proactively the use of webcams. • Hold virtual office hours using Zoom and Microsoft Teams.

Reflections and Conclusions

As a result of the pandemic's abrupt turn of events throughout the world, many educators were forced to use various forms of online teaching and evaluation (Rapanta et al., 2020). This has accelerated digitisation and caused educators to reassess the nature of examinations (Bao, 2020). In particular, a fundamental shift in how we approach distant learning may have been generated as educators or administrators recognise that physical presence in the classroom is not required for LOs to be achieved (Li & Lalani, 2020). Finally, the COVID-19 scenario engulfed tertiary-institution academics in an unprecedented manner and at an unprecedented moment, yet we surmounted the instructional difficulties. As a result of the present heightened safety precautions, faculty members had to adjust and manage their teaching and learning activities swiftly to maintain their current high levels of education. Alternative online examinations must be developed to compensate for the loss of F2F assessment methods. As learned persons in the academic environment, we may exert a positive influence in our own lived learning experiences and in the future-digital society that will become the new norm as the COVID-19 situation progresses. We discussed how we went forward throughout the pandemic based on our experiences in a 'flipped' freshman organic chemistry course

References

1. Alon, T., Doepke, M., Olmstead-Rumsey, J., & Tertilt, M. (2020). *The impact of COVID-19 on gender equality* (No. w26947). National Bureau of economic research.
2. Alrefaie, Z., Hassanien, M., & Al-Hayani, A. (2020). Monitoring online learning during COVID-19 pandemic; Suggested online learning portfolio (COVID-19 OLP). *MedEdPublish*, *9*.
3. Alsayed, R., Ali, A., Makia, R., Kadhom, M., Raheem, R., Al-Obaidi, O., ... & Yousif, E. (2020). Challenges Facing Iraq to Tackle the Spread of COVID-19: An Overview. *J. Uni Anbar Pure Sci*, *14*(2), 22-27.
4. Bao, W. (2020). COVID-19 and online teaching in higher education: A case study of Peking University. *Human Behavior and Emerging Technologies*, *2*(2), 113-115.
5. Bilen, E., & Matros, A. (2021). Online cheating amid COVID-19. *Journal of Economic Behavior & Organization*, *182*, 196-211.
6. Dyhrkopp, C. (2021). Technology Use in Education by Students and Teachers.
7. Elameer, A. S. (2021). Iraqi higher education digitizing trail during COVID19 pandemic. *European Journal of Molecular & Clinical Medicine*, *8*(2), 1321-1332.
8. Famularsih, S. (2020). Students' experiences in using online learning

applications due to COVID-19 in English classroom. *Studies in Learning and Teaching*, *1*(2), 112-121.
9. Gherheș, V., Stoian, C. E., Fărcașiu, M. A., & Stanici, M. (2021). E-Learning vs. Face-To-Face Learning: Analyzing Students' Preferences and Behaviors. *Sustainability*, *13*(8), 4381.
10. Hussain, J. N. (2021). Modeling and forecasting of COVID-19 infection cases in Iraq. *Journal of Interdisciplinary Mathematics*, *24*(2), 367-380.
11. Hussein, N. R., M Saleem, Z. S., Musa, D. H., Ibrahim, N., & Naqid, I. A. (2020). Impact of COVID-19 on the medical education: experience from Kurdistan region of Iraq. *Journal of Medical Education*, *19*(1).
12. Kniffin, K. M., Narayanan, J., Anseel, F., Antonakis, J., Ashford, S. P., Bakker, A. B., ... & Vugt, M. V. (2021). COVID-19 and the workplace: Implications, issues, and insights for future research and action. *American Psychologist*, *76*(1), 63.
13. Lafta, R., Qusay, N., Mary, M., & Burnham, G. (2021). Violence against doctors in Iraq during the time of COVID-19. *Plos one*, *16*(8), e0254401.
14. Li, C., & Lalani, F. (2020, April). The COVID-19 pandemic has changed education forever. This is how. In *World economic forum* (Vol. 29).
15. Madianou, M., & Miller, D. (2013). *Migration and new media: Transnational families and polymedia*. Routledge.
16. Nachum, R. N., Ding, W. A., Pageler, L. B., Majeti, N. R., & Omiye, J. A. (2021). Effect of reopening orders on covid-19 hospitalizations in the US. In *AMIA Annual Symposium Proceedings* (Vol. 2021, p. 455). American Medical Informatics Association.
17. Paudel, P. (2021). Online education: Benefits, challenges and strategies during and after COVID-19 in higher education. *International Journal on Studies in Education*, *3*(2), 70-85.
18. Paul, J., & Jefferson, F. (2019). A comparative analysis of student performance in an online vs. face-to-face environmental science course from 2009 to 2016. *Frontiers in Computer Science*, *1*, 7.
19. Pokhrel, S., & Chhetri, R. (2021). A literature review on impact of COVID-19 pandemic on teaching and learning. *Higher Education for the Future*, *8*(1), 133-141. Mohan, B. S., & Nambiar, V. (2020). COVID-19: an insight into SARS-CoV-2 pandemic originated at Wuhan City in Hubei Province of China. *J Infect Dis Epidemiol*, *6*(4), 146.
20. Rapanta, C., Botturi, L., Goodyear, P., Guàrdia, L., & Koole, M. (2020). Online university teaching during and after the Covid-19 crisis: Refocusing teacher presence and learning activity. *Postdigital Science and Education*, *2*(3), 923-945.
21. Tennant, G., & Khamis, T. (2017). Student evaluation of teaching: Bringing principles into practice. *Journal of Higher Education in Africa/Revue de l'enseignement supérieur en Afrique*, *15*(1), 89-104.
22. World Health Organization. (2020). Updated WHO recommendations for international traffic in relation to COVID-19 outbreak. 29 February 2020.