

# International Organic Chemistry Competition: A Thrilling, Unique Experience

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**ABSTRACT:** The introduction of clickers into the learning environment evolved significantly reflecting major developments in student academic performance. From simple in-class, multiple-choice questions to global international competitions, this innovative tool has managed to combine both education and entertainment into an intuitive and positively reinforcing learning experience. In 2011, the PI was appointed by the International Union of Pure and Applied Chemistry (IUPAC) to represent and coordinate the activities in Lebanon in celebration of the International Year of Chemistry (IYC2011). The first seed of organic chemistry competition (OC) was thus planted, sparking a series of more successful events promoting a fun and proactive educational environment that recognized the participants' mastery of essential concepts of organic chemistry. As such, the OC has since become a platform for higher education and student-based academic involvement joining students from all around the world and different walks of life to experience and share a common interest: *organic chemistry*.

**KEYWORDS:** General Public, Second-Year Undergraduate, Organic Chemistry, Collaborative/Cooperative Learning, Humor/Puzzles/Games

## ■ INTRODUCTION

The Personal Response System, also known as clickers, is an innovative tool that has been used for years to help stimulate an active learning environment in the classroom with the aim of improving on students' capacity for knowledge retention.<sup>1</sup> Clickers have shown to go beyond enhancing student–lecturer interaction and student–student interaction.<sup>2–5</sup> As a formative assessment tool,<sup>6</sup> clickers have managed to involve students in structured activities promoting a sociohistorical understanding of the opportunities and constraints acting on chemistry, the significance of chemical theories and methods, and a holistic approach to chemistry as a field of self-expression and social commitment.<sup>7</sup> This system enables all students to submit their answers to projected multiple-choice questions simultaneously. Once the poll is closed, students then benefit from seeing and analyzing the various responses of their peers represented in a histogram function. Prompt feedback and interaction among students and professors occurs on the spot, leaving students with a better understanding of the material. The use of clickers has shown great success particularly because it provides an opportunity to discuss aspects of material concepts within notably large classes, hosting more than 100 students.<sup>8,9</sup> Thus, it has markedly contributed to the transformation of students from passive to active learners. Moreover, its advantages managed to impact instructors as well, providing them with a real time assessment of the learning outcomes, chapter, concepts, series of chapters, or even the lecture itself. One notable feature of using clickers lies in the anonymity of the system, which has encouraged all students, including those who are shy, not confident with the material, and even students that normally sit passively in the back, to actively participate. Another feature updated to the clickers includes the “fastest responders” tool, through which a list of the fastest responders who answered a certain question correctly is generated and displayed. This component has added a fun and competitive

component, pushing students to reconsider their solving strategies so as to reach a correct answer in the shortest time possible and rank top of the list.

In 2009, the use of clickers was first introduced at the American University of Beirut (AUB) in the PI's organic chemistry class. The following paradigm offers an illustration of how clickers are currently used. During the PI's lectures, clickers are distributed randomly to teams of two students to answer in-discussion multiple-choice questions that test and evaluate their level of comprehension and understanding of the material at hand. Timed questions are displayed without prior notice, offering students the opportunity to interact with their partners in solving the questions. The predominant answers are punctually evaluated using the programed histogram function of the clickers, which allows students to benefit from visualizing and analyzing the varied responses of their peers.<sup>10</sup> The PI, drawing conclusions from the displayed correct response rate, decides on whether he would proceed with the lecture or clarify any misconception first, providing prompt and relevant feedback. Presently, the PI expanded the use of clickers not only to encompass classrooms discussions, but also to serve as the key element to the success of international organic chemistry competitions. In this manuscript, we describe the use of clickers as a learning aid in innovative organic chemistry competitions (OCs) and illuminate its role in transforming a so-called bland and challenging subject into a unique and thrilling educational experience. To the best of our knowledge, this is the first report on the utility of clickers as a learning tool in the setting of an organic chemistry competition for university level students.

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## HISTORY OF THIS EVENT

In 2011, the PI was appointed by the International Union of Pure and Applied Chemistry (IUPAC) to represent and coordinate the activities in Lebanon in celebration of the International Year of Chemistry (IYC2011). This opportunity allowed the PI to plant the first seed of Organic Chemistry Competition (OC1), which took place on February 7, 2011 at AUB under the patronage of IUPAC and the United Nations Educational, Scientific and Cultural Organization (UNESCO). The event was open to all students in Lebanon, free of any registration fees, and included monetary cash awards. Forty-two teams, of two students per team, coming from six different universities, participated in OC1. To encourage teamwork and collaboration, only teams of two students were allowed to participate in the competition.<sup>11</sup> The use of clickers was crucial on three different levels: (1) to enable large-scale competitions, (2) to promptly display results, and (3) to engage the nonparticipating audience. Eighteen multiple-choice questions were projected on the screen invoking concepts covered in Organic Chemistry I and II courses.<sup>12</sup> Teams could instantly respond using their clickers in a stimulating environment, similarly to the show “*Who Wants to Be a Millionaire?*”. Clickers were programmed to register only the last answer choice submitted. The PI presented each question and allowed students some time to enter their answers. When all responses were collected, as indicated by the response counter on the slide, a histogram illustrating teams’ answer choices was later displayed. The PI then briefly explained every question, analyzing the answers choices provided by the contestants. A slide listing the top five fastest responding teams was subsequently posted. The five teams with the correct answer in the fastest time received 50 points, 40 points, 30 points, 20 points, and 10 points, respectively.<sup>13</sup> The competition gradually took on a faster pace, bringing students to submit random answer choices in hopes of being among the top five fastest responding teams and subsequently be awarded points.<sup>14</sup> Nevertheless, distinguished students from the AUB and the Lebanese American University (LAU) won first prize in the competition despite a sudden death round.

## OC COMPETITION EVOLVEMENT AND DETAILS

Building on the remarkable success of the widely celebrated 2011 OC, a second event was held again in 2012 (OC2), this time hosting 124 participants from seven Lebanese universities and four universities from the Middle East and North Africa region (MENA) region including Iran, Saltanat Oman, Turkey and the United Arab Emirates. OC2 was held under the patronage of the Lebanese Ministry of Education and Higher Education and the Lebanese National Commission for UNESCO. In the 2012 OC2, a team from Bilkent University, Turkey, won first prize. Unlike the previous competition, the presentation of the questions in OC2 was improved to give an allocated time to work on the problems before opening the poll, in an attempt to avoid random answer submissions from students. Furthermore, clickers were programmed to record only the first entry. The third edition of the competition OC3 was organized on January 28, 2014, and reached out to a global audience. OC3 posters reached 156 universities across the world. Due to its success in the previous years, funding was secured from reputable societies and publishers such as the Royal Society of Chemistry (RSC), Wiley, McGraw-Hill Education, Oxford University Press, and Cengage Learning.

An advert about OC3 was published in the May 2014 issue of Chemistry World, a magazine published by RSC reaching approximately 46,000 chemists worldwide. A total of 106 teams had originally registered for OC3 coming from 27 prestigious universities from 16 countries across the globe. Unfortunately, many international teams withdrew from OC3 mainly due Lebanon’s political turmoil and unrest at the time of the competition. A histogram showing the participation in the three competitions is depicted in Figure 1, whereas Figure 2 shows

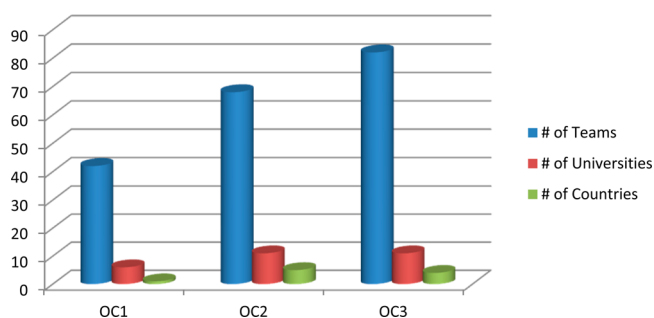


Figure 1. Participation histogram in the three competitions: OC1, OC2, and OC3.

photos from OC3 in which 84 teams participated. OC3 was distinguished from the previous two competitions in terms of its structure, which now included two separate rounds. The first round was open to all teams to answer 12 multiple-choice questions using their clickers. Each correct question was worth 10 points. All teams answering at least 6 out of the 12 questions correctly were qualified to the second round. Qualified teams from round 1 answered six additional multiple-choice questions using programmed clickers. The fastest five teams with the correct answer received 50 points, 40 points, 30 points, 20 points, and 10 points, respectively. Points from round 1 were carried on to round 2. The three teams with the greatest number of points won the first, second and third prizes of the competition, respectively. However, in the setting of a tie, as was the case in OC3, a sudden-death round was conducted to reveal the winners.<sup>15</sup> In OC4, the scoring system will further be improved by having two rounds, similar to OC3, but with a minor amendment to round 2: all teams answering correctly in round 2 will be receiving points, and the fastest responders will be granted additional points. OC4 will be conducted in 2016 in celebration of the sesquicentennial anniversary of the American University of Beirut and its Faculty of Arts & Sciences. The patronage of the Organic Competition events included the Lebanese National Commission for UNESCO, the Lebanese Ministry of Education & Higher Education, and the International Union of Pure and Applied Chemistry (IUPAC).

## ACCOMPANYING ACTIVITIES

The Organic Competition also holds accompanying activities during the event so as to make the experience all the more memorable for its attendees. In OC1, a laser show was arranged for entertainment, which was followed by the PI surprising and honoring a chemistry professor on the occasion of his 75th birthday and 46 years of service to the institution. In OC2, a flash mob dance competition between the American “hip-hop” and the traditional Lebanese dance, known as “dabkeh”, surprised the audience. In OC3, three different videos highlighted the path that was behind this successful event.





Figure 2. Photographs from OC3.

The videos in OC3 included a live TV broadcast interview to spread the message and a creative *Organic Chemistry Style* video clip prepared by the competition organizing team. Another outstanding surprise in OC3 was a flash mob poetry recital about organic chemistry and the competition. Poetry was reported to show audience how to “learn and express chemistry in a fun and creative way”.<sup>3</sup> In OC3, lodging for two nights in a five star hotel was provided at no cost for all international participants, which helped build bridges between students from different cultural backgrounds. Finally, a party was organized for the participants and OC3 organizing team to celebrate the success of this event. In all three competitions, teams of creative and hardworking students coming from different majors and faculties joined their forces to plan, prepare and organize the event under the supervision of the PI.

The music video of *Organic Chemistry Style*,<sup>16</sup> in addition to the videos of all three competitions are posted on the PI's channel on YouTube.<sup>17</sup> Further details of the Organic Chemistry Competition events can be found online.<sup>18</sup>

## CONCLUSION

The Organic Chemistry Competition creates a conduit for recognizing student mastery of essential concepts of foundational organic chemistry while simultaneously creating a lively atmosphere through hosting contestants from various backgrounds and walks of life. From simple in-class multiple-choice questions, to international organic chemistry competitions, clickers have been greatly valued for their role as both an entertainment and educational tool. Such events managed to create a fun and engaging educational environment offering students an opportunity of recognition in light of merit, skill,

logic, vigilance, and swiftness of analysis in organic chemistry. The OC has become a hub for higher education and student-based academic involvement, a leading pedestal for student engagement and academic achievement. Participants have the opportunity not only to engage in an educational event but also to share a memorable experience with people of different cultures, eager to learn about chemistry, AUB, and more importantly, Lebanon. The growth of OC is further anticipated in the hope of continuing to unite participants from all around the world who come from different and diverse backgrounds yet speak the same language, “the language of organic chemistry”.

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### Notes

The authors declare no competing financial interest.

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- (11) Students registered as teams of two members that can be from the same university or different universities.
- (12) The PI designed the questions for the competitions and was the only person to see these questions before each competition. The questions were designed to require lower to higher order as well as multilogical thinking and were arranged according to staggered complexity. Appropriate distractors were included that covered typical students errors.
- (13) Teams are asked to appear for rehearsal before the competition to get acquainted with the rules and rehearse a demo competition.
- (14) The 2011 edition of TurningPoint, the program associated with clickers, had no possibility of programming the clickers to take only one response. In the middle of the competition, students started guessing any answer and then changed their answer if they arrived to a different solution after solving the presented problem.
- (15) OC3 was covered on the AUB Web site. <http://www.aub.edu.lb/news/2014/Pages/oc3.aspx> (accessed Feb 2015).
- (16) Video of *Organic Chemistry Style*. [http://youtu.be/eWuj\\_x3tbvE](http://youtu.be/eWuj_x3tbvE) (accessed Feb 2015).
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