Effects of Student-Based Approaches in Grade 10 Chemistry Education During the Covid-19 Pandemic

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Abstract

With the Covid-19 pandemic, changes in almost every aspect of our lives have become obligatory. One of the most significant changes was in the field of education around the world. In education, the vast majority of the students switched from traditional classrooms to online learning or distance learning. The pandemic hasn't changed only the students' gathering ways, also their expectations from the lectures. New expectations from students involved teachers' quest for more student-based learning approaches in science lectures by using some technological tools such as STEM, flipped classroom model, platforms like Khan Academy, Phet Colorado and simulations requiring student engagement. Using some digital educational instruments or educational technologies can support students' academic improvements especially during the global pandemic. In this article, for 10th grade chemistry students, it will be compared the relationship between the students' academic improvement in chemistry and the computer-based section of the flipped classroom model and in online class sessions, exercises from Khan Academy, Phet Colorado, EBA (Education Information Network of Turkish National Ministry of Education).

Keywords: *Academic Improvement; Distance learning; Educational Technologies; Flipped Classroom; Student Engagement*

1. Introduction

About the very beginning of 2020, there were several cases of Coronavirus disease (Covid-19) for an unknown reason in Wuhan, China. [25] People catching this mysterious disease mostly suffer from fever, dry cough and tiredness [24]. While the disease was spreading among the other countries, governments had to take precautions in order to prevent social gatherings because the cases of Coronavirus were rapidly increasing. The Covid-19 pandemic has paralyzed various sectors such as finance, entertainment, agriculture and more. Education is one of the most affected sectors. Due to increasing cases, many countries have replaced face-to-face learning with distance learning. Still, the lesson structures during the pandemic need to be reviewed in order to satisfy distance learning's needs and increase student satisfaction. The structures are still intended for face-to-face learning [15].

1.1 Distance learning

Distance learning is a method of learning that requires physical presence of neither students nor teachers. At this point, distance learning offers a more flexible learning environment [2].
Distance learning is often confused with flexible learning and open learning. Open learning is predominantly an "educational policy" or a "goal". The fundamental point in open learning is to reach everyone by removing the obstacles, such as personal disabilities and the difference in prior knowledge. Open learning needs to be flexible and scalable. Flexible learning, on the other hand, offers individualized studying hours depending on the variables such as location, time and other social considerations [4]. Flexible learning is not new for students in higher education who have studied in different times and places and used library resources. The difference between distance learning, open learning and flexible learning is that distance education might be within open learning, or depend on flexible learning [9].
Due to the precautions against Covid-19, students are not able to go to the school anymore. Still, this is not an obstacle to enhancing learning by developing new methods. These can be derived from pre-existing ways of teaching/learning such as the flipped classroom model and science simulations.

1.2 Flipped Classroom

As defined in [6], the flipped classroom is "an educational technique that consists of two parts: interactive group learning activities inside the classroom, and direct computer-based individual instruction outside the classroom." The order of the content in traditional classrooms is switched. The flipped classroom is a student-based approach [19]. The model was developed by two high-school

chemistry teachers [5]. In this method; before the classes, students study the theoretical topics in various ways including presentations, preparing their own questions and online videos [13].

1.3 Simulations

As defined in [3], simulation is "The imitation of the operation of a real-world process or system over time". Simulations being computer-based models of experimental concepts enable students to manipulate the variables [7]. In chemistry education during the pandemic, simulations may be preferred in order to fulfill the experiments.

2. Literature Review

2.1 Contributions of Technology to Science Lectures

The use of technology has become more prevalent for its affordability and effectiveness [14]. According to [16], multimedia consists of at least two types of media. In education, simulations may include visual and video media. Simulations provide a demonstration of the related subject when the conditions are unavailable.

Simulations take place in chemistry education when the laboratory facilities are inadequate. Simulations create an efficient learning environment as students engage with the simulation [1, 12]. Simulations are a cost-effective and practical way of conducting laboratory experiments. Simulations help students have a deeper understanding on the topic. [1, 12]. Simulations also offer a safer environment for experiments because there's no safety risks as it was in the laboratory conditions. For teachers, using simulations requires no preparation for laboratory equipment or previous experience on simulations. Furthermore, using simulations takes a shorter time and students can repeat the experiment if they would like to [22].

Distance learning, if well structured, also guides students to expand their knowledge and set new targets [4]. Online learning platforms such as MIT OpenCourseWare, Khan Academy, Coursera and lecture notes of academicians contributed to constructing a global classroom that anybody can access [6].

Similarly in Turkey, during this pandemic process, K-12 students in public schools maintain their academic education by using EBA, launched in 2011, a learning platform with educational activities and science simulations, a service of the Turkish National Ministry of Education.

Students can also access the lecture videos on three TRT EBA TV channels for primary, secondary and high school students, respectively to their level [18].

2.2 Variables of Simulations Affecting the Student Engagement

Some research results indicate [8, 11, 17], in order to prevent the overload cognitively, the usage of both graphical information with text and audio narration needs to be avoided; while some studies [10; 21] contradict. Similarly, an experimental study [20] indicates additional instructions within the simulation confuse students and cause chaotic behavior patterns.

2.3 Possible Integration Ways of Technology into Grade 10 Chemistry Education

In the Turkish educational system; Grade 10 chemistry curriculum contains "Fundamental Laws of Chemistry", "Mixtures", "Acids, Bases and Salts" and "Chemistry is Everywhere" as units [23]. Especially regarding topics that students may have difficulties imagining in their heads such as mole principle, acids and bases; the usage of simulations in order to ease the understanding process may be considered.

During this pandemic process, the combination of the computer-based section of the flipped classroom with science simulations in order to increase the student engagement and human interaction requiring interactive classroom activities with open learning sources such as Khan Academy and EBA may be efficient in increasing students' academic performance in chemistry. As the experiments in the chemistry curriculum are unable to be conducted in real laboratory conditions due to the pandemic strictions, real laboratory conditions can be replaced with the simulations.

3. Conclusion

With its arrival, the Covid-19 pandemic has brought many issues waiting to be reviewed. Education is one of these topics that concern many students worldwide. This caused many educational institutes to push the button to teach online to their students by distance learning. The flipped classroom, similarly, is a student-based model that appears as a two sided medallion: In the classroom, students reinforce learning with interactive group learning activities. Outside of the classroom, students learn the lectures

by online materials such as presentations and online videos. In chemistry education, the laboratory experiments couldn't have been conducted as they used to be, due to the pandemic. At this point, simulations are an option as a fulfillment; considering their ease of use, creating an adequate learning environment, reducing safety risks and requiring no previous knowledge. As the paper proposes, experiments may be replaced with simulations and be delivered in the classrooms, corresponding to the in-class section of the flipped classroom; and activities from online learning platforms as assignments for outside of the classroom. The combination of those student-based approaches may contribute to students' academic success in Grade 10 chemistry education.

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