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DETERMINING INTERACTIVE ONLINE RESOURCES IN TEACHING CHEMISTRY LABORATORY

Abstract. In this review paper we will determine the interactive online resources. Here, we analyzed educational research studies related to the specifically chemistry laboratory courses. This paper provides us the types of virtual lab, learning platforms, simulators, educational web sites that used to teach chemistry laboratory in nontraditional format. And we can see that the impact of COVID 19 to the educational research on online learning boosting.

Keywords: interactive online resources, teaching chemistry laboratory, chemical Virtual laboratory, learning platforms.

Introduction

In the field of education, the use of online interactive resources has revolutionized to a new level of teaching and learning methods. These resources provide students with easy access to materials and interactive tools that enhance their understanding of complex concepts in science. The explosion of technology has also made possible teaching outside of the traditional classroom laboratory. It helped to solve the problems that accrued when the chemistry laboratory courses needed to be conducted online. Laboratory instruction unifies conceptual and procedural knowledge, and constitutes an important part of chemistry education practice (Reid and Shah, 2007). Also, it was beneficial on the case of shortage of tools and reagents in the laboratory, leading to limited hands-on experience. This creates a challenge in teaching chemistry laboratory. Therefore, this heeded find alternative ways to optimize learning in the laboratory. The Virtual laboratory environments have emerged as a potential solution of the faced problem. By offering students a simulated laboratory experience that can be accessed online. Virtual laboratories or laboratory simulations have been used for two main purposes in chemistry education. Firstly, they have been used to provide students with visual representations of chemistry concepts, and secondly, they have been used to prepare students for their laboratory sessions. (Dalgarno, Bishop, Adlong, Bedgood Jr., 2009, 854). Also, learning platforms and multimedia resources allow students to visualize and interact with the feelings that will be experienced during experiments, improving their understanding of the traditional laboratory environment.

Literature review

The study carried out by a literature review and analyzing research from previous studies. To get the only relevant studies defined the inclusion and exclusion criteria to limit the searching process. The criteria for eligibility include a) the paper must emphasize on interactive online chemistry laboratory

tools focused on educational research; b) language must be in English; and c) the studies should be published from 2014 onwards. To search for research information, were used electronic databases such as Scopus, Web of Science and Google Scholar. The keywords used in the search queries were "online interactive resources", "interactive online laboratory", "teaching chemistry laboratory" and "Virtual Laboratory".

Through the keywords, we found and collected more than 30 articles. The range of years selected was from 2014 to 2024. Here is the one thing to highlight that biggest part of papers were studied after or during the COVID 19 lockdown. When the instructors forced to switch from offline traditional to online classes. Firstly, we read the summary and evaluated the content of each article to ensure its suitability for our study. Then, we filtered the documents according to our scope. Eight documents are listed in the tool as shown in Table 1 below.

Reference	Year	Description	Interactive online Tool
[1]	2021	The method that used to teach chemistry laboratories during lockdown.	-Live demonstration video watching.
[9]	2020	Teaching laboratory during COVID 19 lockdown.	- online lab simulator, - remote devices
[2]	2020	Online multimedia resources were implemented in laboratory courses.	-Video -simulation
[10]	2022	Free, interactive, and widely accessible chemical education resources.	-BACON (Biology and Chemistry Online Notes -Backside Attack, a smartphone game -QR Chem, a site that allows students, instructors, and researchers to create QR codes that link to interactive 3D structures. -R/S Chemistry
[16]	2018	Teaching chemistry with ICT tools in Czech Republic and Kazakhstan.	-The PhET Interactive Simulation -Virtual kids lab
	2022	The compilations of chemistry laboratory course during COVID 19	-Live demonstration with daily used things.

[13]	2024	Online laboratories that helped teaching chemistry laboratory course during COVID 19.	-ChemCollective virtual laboratory -you tube videos
[3]	2021	General chemistry lab programs by using interactive online resources	Remote lab

Table 1

Data analyze

Reference	Online Resources	Frequency	Percentage
[2], [5],[6],[7], [10],[11],[13], [15],[19]	Virtual lab	9	45%
[4],[11],[15]	Simulator	3	15%
[1],[2],[8]	Learning website	3	15%
[2],[5],[9], [17],[18]	Video	5	25%
[3],[20]	Remote laboratory	2	10%

According to the result virtual lab and video record of lab demonstration method were mostly used in online chemistry laboratory courses. The difference between Virtual lab and simulator is virtual lab simulate laboratory experiences in a digital environment. And simulators model the behavior of real-world systems or processes to provide training or testing. A learning website is a platform that hosts educational content and resources for acquiring knowledge and skills across various subjects. Remote laboratories enable to access equipment or computers via the internet to perform experiments and laboratory tasks without being in the physical lab space. But this equipment comparatively is expensive that not all institutions can afford.

Conclusion

In conclusion, this paper determined 5 online interactive recourses that used in teaching chemistry laboratories. There are virtual labs, simulators, learning platforms, multimedia (video) and remote labs. We tried to find the alternative way to conduct the laboratories to get the results as traditional method. The main criteria were flexible, free, and affordable tools.

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SEARCHING INTEGRATED STEM FRAMEWORKS IN CHEMISTRY

Abstract. This study explores the incorporation of STEM (Science, Technology, Engineering, and Mathematics) frameworks in Chemistry education through thorough analysis and evaluation. Utilizing established STEM frameworks as a basis, the research employs comparative analysis to assess their effectiveness within Chemistry. Through literature review and research analysis, the prevalence of integrated approaches, termed "Integrated Chemistry," is evident. Methods include identifying common themes, evaluating alignment with Chemistry curriculum standards, and exploring interdisciplinary