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Interactive Learning Supported by Artificial Intelligence to Enhance Understanding of Chemistry Experiments

Aya Mohsen, Hager Badr, Omnia Ahmed, Mariam Hussein, Nermeen Edwar and Nourhan Sayed

Supervisor: Soad Magdy, teacher, physical chemistry, Osama Gebril Ahmed, Prof., Curriculum and science education

Ain Shams University, Faculty of Education, Program chemistry

Abstract

This study investigates the impact of interactive video on enhancing the understanding of chemistry experiment concepts among secondary school students. Initially, the study identified the concepts and problems that posed challenges to students through a pre-exam. Subsequently, an interactive video targeting these specific knowledge points was developed using PowerPoint 365 and H5P. The research assessed the effectiveness of the interactive videos by comparing student performance and concept comprehension through post-test grades. Results indicate that this innovative method may improve learning outcomes and student engagement in the classroom.

Key Words:

Interactive learning, Interactive video, Chemistry experiments, Artificial intelligence, H5P

1. Introduction

Interactive learning is a method that involves students in the educational process through practical activities, discussions, and group projects. It fosters participation, critical thinking, improved information retention, and essential skills like communication, problem-solving, and collaboration. In chemistry education, interactive learning offers benefits such as increased engagement, better retention of information, and accommodating diverse learning styles. Tools like virtual simulations, online quizzes, and hands-on laboratory experiments allow students to actively engage with content and apply knowledge to real-life situations, enriching their understanding of complex chemical principles.(Zhang et al., 2006).(Camel et al. 2020) (Palaigeorgiou, Papadopoulou, and Kazanidis 2019a)

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Incorporating technology into chemistry education can bridge the gap between theoretical concepts and practical applications, making the learning process more dynamic and interactive. Tools like simulations, virtual labs, interactive whiteboards, polling software, online quizzing, and assessment tools can enhance the teaching of chemistry. Interactive whiteboards and polling software enable real-time interaction, while online quizzing and

assessment tools provide immediate feedback and promotion. (Stieff et al. 2018)

Instructional videos, filmed on mobile phones or professional recording equipment, provide visual demonstrations of chemical techniques and experiments, allowing students to learn at their own pace. Interactive simulations offer additional opportunities to practice and apply chemistry concepts, while virtual labs provide a safe and cost-effective way to conduct experiments and explore chemical reactions. Mobile apps can provide on-the-go access to chemistry concepts and resources, including interactive quizzes, flashcards, and other tools.(Cresswell et al. 2019)

The research focuses on the use of interactive videos in education, which combine traditional content with interactive elements to enhance student engagement. Artificial intelligence can personalize content based on user behavior and preferences, providing valuable insights into viewer preferences. Platforms like PlayPosit, Edpuzzle, and H5P allow instructors to incorporate AI-driven features such as personalized feedback, adaptive learning paths, and real-time analytics to enhance the learning experience in chemistry experiments.

The integration of AI and interactive videos in educational settings has the potential to make learning more interactive, personalized, and effective, enhancing student engagement and academic success. Interactive video lectures can be made interactive with just a few clicks, eliminating the need for time-consuming editing. Adding interactive elements like questions, polls, and summaries enhances engagement and transforms learners' thinking and processing of content. Assessment of student interactions leads to improved results for learners.(Benkada and Moccozet 2017)

Interactive video tools have several advantages, including boosting students' motivation, enjoyment, and learning performance. Video interactivity is adaptable, motivational, and engaging, promoting differentiation and personalized learning. They improve learners' happiness with the educational process and turn passive viewers into active learners.(Palaigeorgiou, Papadopoulou, and Kazanidis 2019b) (Priyakanth, Abburi, and Praveena 2021) (Pulukuri and Abrams 2020)

The reasoning behind our selection of this technology to enhance the understanding of chemical principles among high school students at our training school might interest your curiosity. additional challenges were existed to consider this choice, such as the lack of laboratory materials and equipment. In addition, the limited session time, and the number of students in each class pose challenges in addressing the individual needs of every student, even when studies are conducted in the school lab.

The research paper focuses on examining the effects of videos on students' cognitive abilities, bridging individual disparities, and enhancing visual, mental, and interactive skills. The hypotheses propose that videos can elevate students' comprehension of fundamental chemical principles through interactive engagement and bolster their cognitive skills for understanding concepts across various levels.

2. Methods of Research and the tools used.

Participants

This paper study the effect of interactive videos on the understanding of chemistry experiments concepts for secondary one high school students for chemistry course. this course is two semesters

divided into 5 units contain general chemistry, thermochemistry, and nuclear chemistry. This study focused on concepts associated with experiments.

42 students participate in the research pre-exam, 12 of them didn't attend the post-exam.

So, 30 students participate in the post-exam.

Their session is 30 minutes time and the tutorial videos ranges between 3-10 minutes, so the session is enough to take students feedback, questions and evaluate their understanding.

Procedures

1-identify the concepts that included in the experiments

2- preparing the experiments videos in the lab

3- choosing the editing and websites to creating the interactive video tutorials

4- taking the pre-exam of students understanding of the concepts with theoretical and traditional teaching

5- we viewed the video tutorials on students

6- taking the post-exam of the students understanding of the concepts after they saw the videos

7- evaluating the method

First, identifying the basic concepts in the fourth and fifth semesters of chemistry, a subject for the first year of secondary school, which are summarized in the heat content, the amount of heat,

Hess 'law (Anon n.d.-b), the difference between endothermic and exothermic reactions (Anon n.d.-b), and the heat content of the dissolution process. (Anon n.d.-d) This is specific to the basic concepts of the fourth semester, while the concepts main components of chapter five are: the formation of the atom, the strong nuclear force, and the belt of stability, The rays emanating from atoms are unstable (Anon n.d.-e) and the half-life period (Anon n.d.-a)

Then filming the experiments that include these concepts in chemistry laboratories, explaining these concepts, the purpose of the experiment, the tools used in it, the steps and laws related to each concept, explaining the method of calculations, and knowing the conclusions that we might obtain from the student. Then modifying the videos and adding Audio through the following programs: cap cut, video maker and Canva. and some videos were prepared using PowerPoint 365

The duration of the video ranges between 3-10 minutes. uploading the videos to a website (h5P), putting various interactive elements, including multiple choice questions, essay questions, and true or false questions on videos, with an explanation or explanation of the chosen answer, whether it is correct. or wrong

After that, preparing pre-tests for the students to know the previous information in their minds about these basic concepts, and showing the interactive videos to the students. Four days after showing the videos, getting to point of repeating the same exam, but with the wording of the questions changed, while the goal to be measured and achieved remained the same, and after that a comparison was made between the core and post-tests to know and observe the students' performance regarding the concepts and experiments that were presented through the interactive videos. Then this comparison was translated through their grades in the form of a statistical analysis.

Instrument

Style of the video tutorials based on the animations and video shooting for the experiments in lab The

videos were made using Microsoft 356 online version windows, mp4 camera, PowerPoint animations and interactive elements were added using the h5p program "website."

Video files can be viewed using any browser, its available online for all students with hyperlinks in files on their smart screen of the school and on their mobile phones, they are existing on need.

3. Results of Research

Making an exam to determine how much students understand the concepts before and after videos, exam consisted of 30 questions divided into two parts one of them contains 15 questions for fourth chapter and the other contains 15 questions on the fifth chapter and the results were as follows.

Figure (1): Comparison students' performance between pre-and post- exams identified as questions of fourth chapter performance and fifth chapter performance and the total of them.

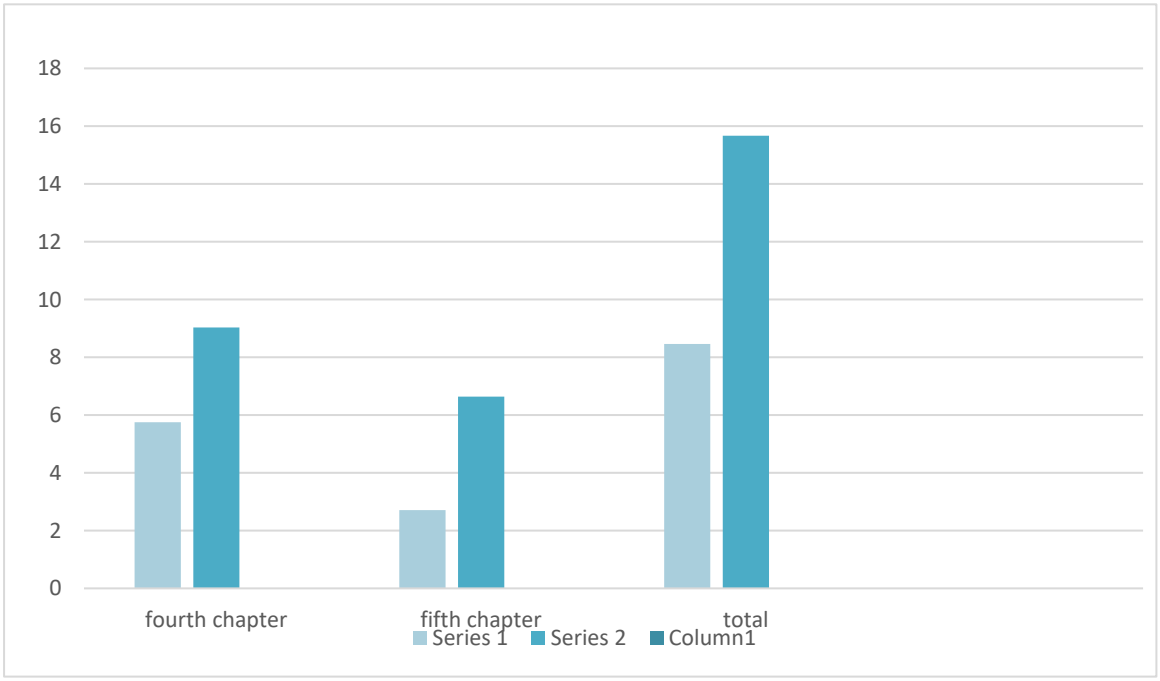

Table (2): Results of the pre and post exams for the experimental group

exam	Degree	experimental group				Average	Differences
		Pre-exam		Post-exam			
		SMA	STDEV	SMA	STDEV		
Fourth chapter exam	15	5.75	2.68	9.03	2.60	4.73	significant difference at 0.05
Fifth chapter exam	15	2.71	1.85	6.64	1.94	7.89	significant difference at 0.05
Total exam	30	8.46	3.56	15.67	3.51	7.78	significant difference at 0.05

4. Discussion

Online videos made appear to have a positive impact on students' performance because videos contained different tools like animations that make the chemistry more easy by imaging, live shooting videos about experiments in lab that allows them to understand the theoretical information better , calculations for some problems in thermochemistry and nuclear chemistry and interactive elements like multiple choice, images, multiple choice sets and true false questions these interactive videos allow student to take actions on the video while he watching

Through the results, interactive videos have a positive impact in improving the level of student understanding of basic concepts through the experiments that were filmed, by using the interactive elements, gained students the skill of collecting, analysing data, performing experimental calculations, and then deducing the concepts related to the experiment.

The justification that drives us to conduct the study is due to a lack of laboratory tools, so creating interactive videos as students save the time allocated for preparing the experiment and to compensate for the material shortage that exists within the chemical laboratories, in addition to allowing the students to learn at the speed and time students want, and students also take into account the individual differences between the students regarding A method that stimulates more than one different sense, such as visual, auditory, and cognitive, and helps students highlight their mistakes, correct these mistakes, and evaluate the students' level of progress.

Obstacles that found during the application were represented by two factors: 1- The continuous absence of students, so not many students were able to participate. 2-It was difficult to obtain an individual evaluation of the impact of the interactive videos on the students. This is due to the limits and restrictions imposed by the Ministry of Education on them. Tablet devices: The student cannot access any website external to the ministerial websites.

Future recommendations

Based on the results obtained, presenting some recommendations and proposals to increase the effectiveness of research on the ground:

1- Expanding the study of chemistry through programs or applications that create interactive videos

2- educating teachers about the importance of these interactive videos as one of the methods of active learning

3-establishing centers, a specialist for preparing these programs or applications

4-applying these videos to children with special needs and then conduct an analytical study on their academic achievement rate.

5-suggestting that interactive videos be combined with virtual laboratories.

6-suggestting that they be applied to different educational stages and different specializations

5. Conclusion

In conclusion, incorporating interactive videos in chemistry education is crucial for promoting active learning among students. By educating teachers on the importance of these videos and establishing specialized centres for creating interactive programs, enhance the academic achievements of students, including those with special needs. Additionally, combining interactive videos with virtual laboratories can further enrich the learning experience across different educational stages and

specializations. Overall, the integration of interactive videos in chemistry education has the potential to revolutionize traditional teaching methods and improve student outcomes.

Moreover, the use of interactive videos can cater to different learning styles and preferences, making the material more accessible and engaging for all students. This personalized approach can help students retain information better and develop a deeper understanding of complex concepts. In addition, interactive videos can also provide immediate feedback and allow for self-paced learning, which can be especially beneficial for students who require extra support or individualized instruction. By leveraging technology in this way, we can create a more inclusive and effective learning environment for all students, ultimately leading to improved academic success and overall student satisfaction.

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