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Al-Chemy: e-learning platform for foundation students

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ABSTRACT

The unexpected closure of educational institutions as a result of the emergence of COVID-19 prompted the authorities to suggest adopting alternatives to traditional learning methods. E-learning is an innovative approach for delivering electronically mediated, well-designed, learner-centred interactive learning environments by utilizing internet and digital technologies with respect to instructional design principles. This paper presents the implementation and prototyping of an innovative web-based e-learning platform for chemistry course known as Al-Chemy. Al-Chemy was developed for foundation students at Tahmidi Centre, Universiti Sains Islam Malaysia. The rapid application development (RAD) methods have been used in developing Al-Chemy through website wix.com. Al-Chemy was structured with interactive notes, animation, virtual experiment, quizzes, and games. The combination of these activities helps students in learning basic and advanced concepts of chemistry.

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1. INTRODUCTION

The COVID-19 pandemic has struck the education system around the globe. The pandemic initiated an immediate and complete lockdown to all the educational institutions for social distancing to curb the transmission of the virus. All the people from the education system had to accept that teaching and learning methods need to be altered in the period of COVID-19 as the situation led to the forced adaptation of e-learning methods. Research by Shidiq *et al.* [1] was conducted to investigate the response of chemistry teachers to online learning in the COVID-19 pandemic. The result found that chemistry teachers had tried to utilize various technology platforms in conducting the learning activities. Most of them faced difficulty to arrange the lab-work activities and consequently, it could contribute to no task related to lab-work activities can be done. Chemistry lab work activities are important for student in order to understand the chemical micro representation and to support collaborative learning [2], [3]. This is the current limitations and challenges facing by all chemistry educators globally.

Rapid developments in technology have made distance education easy. E-learning is defined as learning experiences in synchronous or asynchronous environments using different devices such as mobile phone and laptop with internet access. The synchronous learning environment is structured in the sense that students attend live lectures, there are real-time interactions between educators and learners, and there is a possibility of instant feedback, whereas asynchronous learning environments are not properly structured [4], [5]. The revolution in the

learning and application of computer education as well as the use of computers in education is still new and evolving day by day. Finally the concept of technically guided e-learning was introduced to supply educational knowledge to students in an effective way [6]–[8]. The acceptance of e-learning is not only changing the traditional mode of learning, the cost of the program, and the online version, but the user can increase the level of teaching effectiveness, save costs, and increase the level of student satisfaction in seeking knowledge.

The traditional educational methods were replaced by e-learning when the COVID-19 virus appeared because social gatherings in educational institutions are considered an opportunity for the virus to spread [9]–[11]. Students no longer have to travel to campuses and attend classes at a specific time and place. Instead, they can receive their educational goals besides their ordinary lifestyle. E-learning is a futuristic mode of education that accommodates the different requirements and expectations of different users. In this way, it allows varied methods of educational technology to operate, redesigns instructional methods, and refines performance and effectiveness to adapt to the priorities of e-learning [12]–[14]. All institutions must scramble different options of online pedagogical approaches and try to use technology more aptly. Many universities around the world have fully digitalized their operations understanding the dire need of this current situation [15], [16]. According to Aziz *et al.* [17], e-learning is the best approach for time saving, no additional cost and effective.

There are various applications of e-learning. E-learning can be employed in knowledge management system where students can create and communicate new ideas as well as search for information in a certain area using diverse and distributed knowledge sources [18]. Different teaching aids have been developed to support the e-learning process such as Kahoot, Socrative, Class Dojo, Clickers, Padlet, and videoconferencing. Social media such as Facebook, Twitter, and Instagram can also been used in e-learning process. Social media platforms are one of the best sources that help learners to interact with instructors to ask questions and clear doubts [19], [20]. The usage of online learning will test both the educator and learners. It will enhance problem-solving skills, critical thinking abilities, and adaptability among the students. In this critical situation, users at any age can access the online tools, reap the benefits of time, and location flexibility associated with online learning [4]. Overall, e-learning helps eliminate barriers of communication, provides efficacy of knowledge, and qualifications via ease of access to a huge amount of information [21]. This research focuses on the development of a web-based system known as Al-Chemy to enhance the learning process and skills in chemistry field for foundation student at Tamhidi Centre, Universiti Sains Islam Malaysia.

2. METHOD

Al-Chemy was developed using rapid application development (RAD) methodology through wix.com as building platform. The key benefit of RAD approach is fast project turnaround, making it an attractive choice for developers work in a fast-paced environment like software development. This rapid pace is made possible by RAD's by focusing on minimizing the planning stage and maximizing prototype development.

Figure 1 shows RAD model adapted from creatio.com which is comprised of four phases namely outlining planning, user design and input, construction, and finalization. At outlining phase, engineer and analyst need to identify the objective of the system as well as gather the requirements from client-stake holder. The purpose of this step is to solve the needs of client-stake holder. At user design phase, users collaborated with systems analysts to create models and prototypes that reflect all system operations, inputs, and outputs. It involved software engineer to communicate with system analyst to develop their requirements that allows users to comprehend, change, and ultimately accept a functioning model of the system. Next, at construction phase, programmer will take charge to program the system which involved the development of application and coding. At initialization phase new system was designed, constructed, and put into service. It is also called final phase when all activities are ready for use.

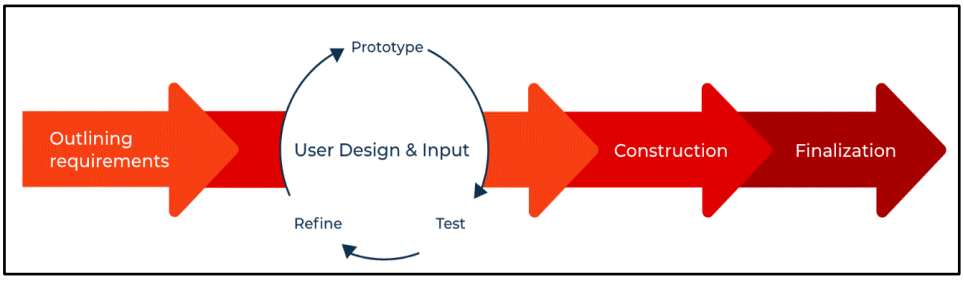

Figure 1. Rapid application development [22]

The chosen of this method is due to the excellent quality information system provided by RAD. It is allowing the system more adaptable to the end users. Moreover, the RAD model is useful to reduce the overall project risk and able to adjust during the requirements gathered at early stages. The RAD also produces high percentage of project completed within time and budget. Finally, the RAD is suitable for rapid changes that accomplish from user request.

3. RESULTS AND DISCUSSION

The website was developed by using wix.com. Wix is a website builder with easy-to-use tools which enable users to quickly create an online presence via a drag-and-drop interface. Additionally, elements of the interactive media, online laboratory, videos, quizzes, and games will also be incorporated on the website.

Al-Chemy will be able to be used in helping students to acquire sufficient chemistry knowledge in line with the requirements provided by universities. The user interface design gives a visualization of the users interaction with the system. The developed interactive Al-Chemy website is easy to access, understand, and use in order to facilitate the e-learning process.

Al-Chemy is a user-friendly website containing interactive notes, animation, virtual experiment, quizzes, and games for each topic. The combination of these activities can enhance the learning patterns of students. Figure 2 shows the homepage of Al-Chemy platform. It possesses two ways to select the topic of interest for chemistry subject as shown in Figure 3. There are total of seven chapters included such as matter, states of matter, atomic structure, periodic table, chemical bonding, chemical equilibrium, and ionic equilibria. The notes for each chapter are presented in simple, clear, and concise for easy learning as depicted in Figure 4. Various techniques on problem solving related to each chapter are also included in order guide students in applying the new concepts learn as shown in Figure 5.

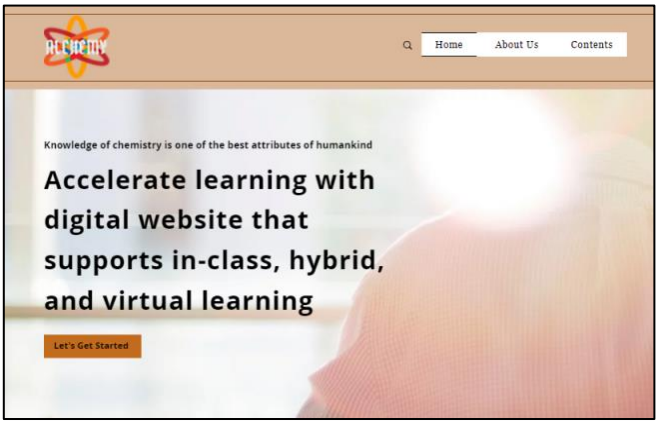

Figure 2. The homepage of Al-Chemy

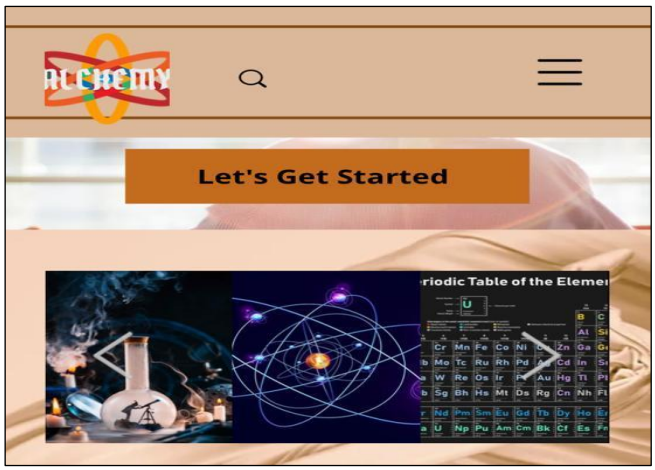

Figure 3. Two ways to select the topic of interest

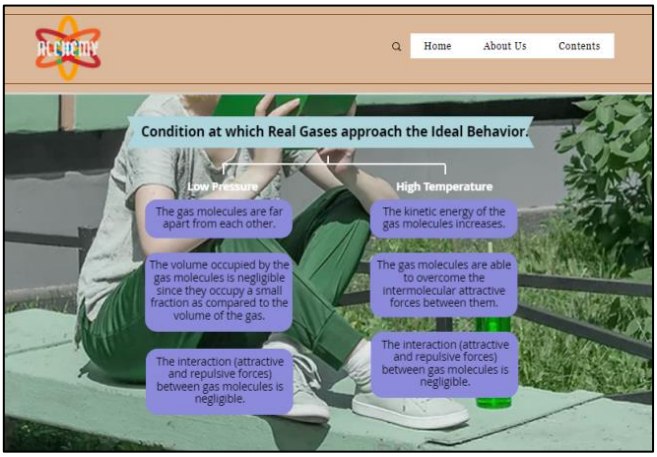

Figure 4. Simple, clear, and concise note presented for easy learning

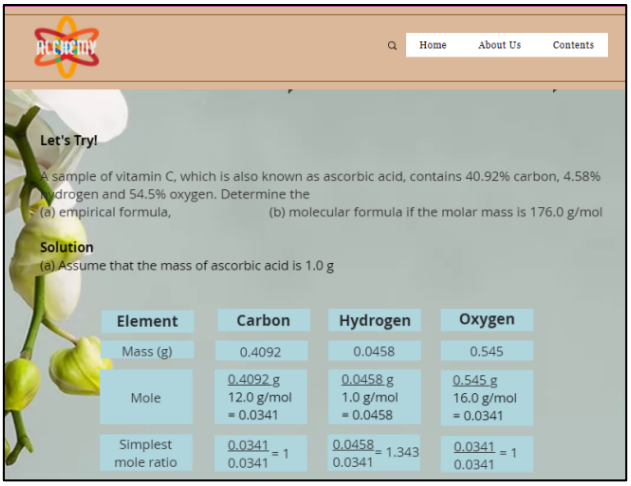

Figure 5. Worked examples and problem solving techniques reinforce ideas and guide students in applying the new concepts learn

Al-Chemy equips with multiple games based on chemistry subject to stimulate students thinking and understanding (Figure 6). In addition, students also can conduct virtual Chemistry Laboratory through Al-Chemy. It is can helps them in learning basic and advanced concepts through remote experimentation (Figure 7).

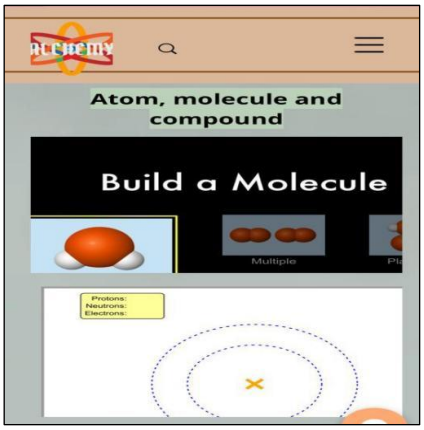

Figure 6. Exercise through playing game based on chemistry to stimulate thinking and assess students understanding

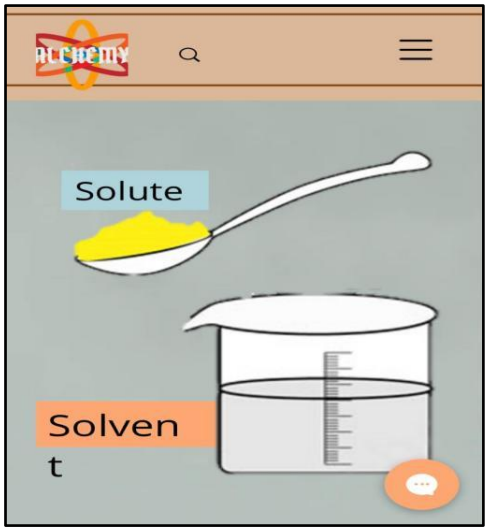

Figure 7. Virtual Chemistry Lab which helps students in learning basic and advanced concepts through remote experimentation

Figure 8 displays interactive periodic table showing names, properties, electrons, isotopes, and compounds for each element. It helps in understanding the patterns and trends within the periodic table, which makes science interactive. Al-Chemy also contains naqli element which connects the knowledge to the Quran and the Sunnah (Figure 9). As shown in Figure 10, students can make real interaction with the chemistry lecturers in Tamhidi Centre, Universiti Sains Islam Malaysia through chatting or email.

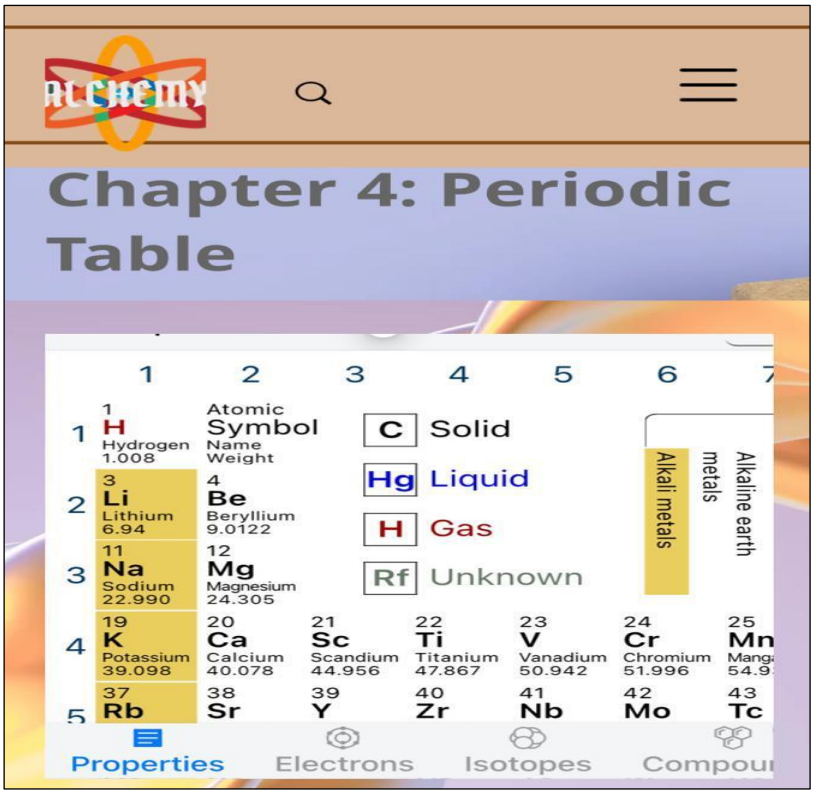

Figure 8. Interactive periodic table showing names, properties, electrons, isotopes, and compounds for each element

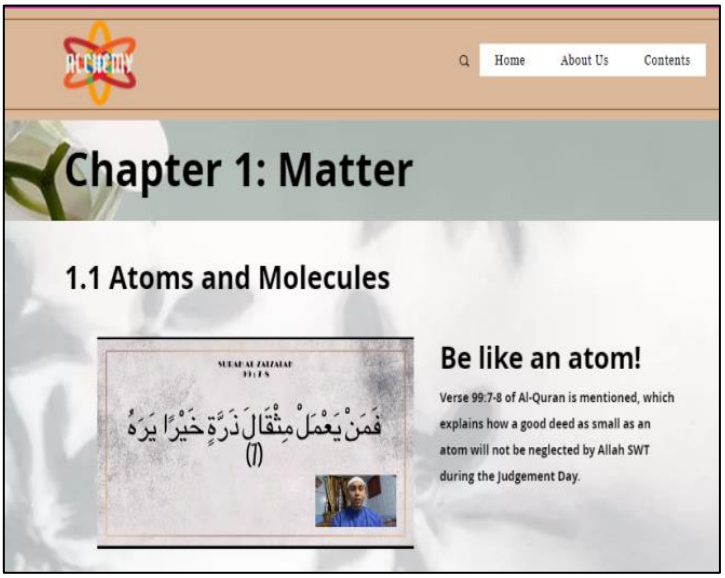

Figure 9. Video on naqli elements for each chapter in Al-Chemy

Figure 10. Real interaction with the chemistry lecturers

The development of information technology helps to create a new technology platform for the education system. Web-based e-learning platforms enable instructors to plan lessons, put assessments, tasks, and monitor the progress of every student. The research on Al-Chemy development can be easily implemented in other teaching institutions. The web-based e-learning platform is user friendly, does not require any special knowledge and skills in web programming, more affordable options than textbooks, receive huge demand from students to learn online, can replace land-based learning in the future, and it is ready to use.

Several studies have addressed the development of interactive learning for chemistry course. Dineva and Ducheva [23] has developed a web-based e-learning materials for chemistry course including general and inorganic chemistry in order to implement new interactive devices during lecture activities. They found that the system can support learning activities in chemistry among student in college. The students appreciated the

flexibility of the system, as a result of the online tests and tutor communication tools, they reported having less anxiety about exams, improved their confidence level, and perceived learning.

Koleva *et al.* [24] has developed sets of interactive learning materials designed for students following different bachelor and master degree courses. Interactive e-learning materials were experimentally applied to countervailing training in chemistry of new students in Computer Systems and Technologies (CST) and Mobile and Satellite Communications in the Department of Electrical and Electronic Engineering. It aimed to eliminate the learning differences at different types of secondary schools and to build the required volume of knowledge providing an equal entry level of knowledge to the first-year university students so that they can better cope with their academic studies. The learning materials were developed on the basis of the Moodle. They reported that majority of students agreed that the results from
e-learning are used in course work assessment during training at university.

Munzil and Mentari [25] has produced e-learning teaching materials that are arranged using problem based learning model which is equipped with augmented reality for nature of chemistry and scientific methods. The combination between e-learning teaching materials and augmented reality based on problem based learning is suitable and applicable for use in learning chemistry and scientific method. Maatuk *et al.* [26] has explored the potentials challenges facing learning activities. They focussed on e-learning from students and instructors perspectives in using and implementing e-learning systems in a public university during the COVID-19 pandemic. The study targets the society that includes students and teaching staff in the Faculty of Information Technology (IT) at the University of Benghazi. As the outcome, students believed that e-learning contributes to their learning experiences.

The uniqueness of the Al-Chemy website comes from the integration of naqli and aqli elements related to chemistry subject offered at foundation level in Universiti Sains Islam Malaysia. Naqli reveals the source of knowledge that comes from the Quran and Sunnah whereas aqli is a conventional knowledge. The combination of both elements can help to instill islamic values while learning chemistry through Al-Chemy. This website can also become a suitable reference for Malaysian Matriculation Programme, Sijil Tinggi Persekolahan Malaysia (STPM), and other pre-university chemistry course.

4. CONCLUSION

The implementation and prototyping of an innovative web-based e-learning platform for chemistry course which is called Al-Chemy has been developed for students at Pusat Tahmidi, Universiti Sains Islam Malaysia. The RAD methods have been used to develop Al-Chemy through website wix.com. Al-Chemy contains clear and concise notes for easy learning, more examples and problem solving to guide students applying new concept. Al-Chemy contains some game tests based on chemistry matters to stimulate thinking and assess students understanding. Al-Chemy offers virtual chemistry lab demography which helps students in learning basic and advanced concepts through remote experimentation. Other than that, this platform also provides interactive periodic table, video on naqli elements for each chapter, and students can have interaction with the lecturers for further learning process.

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