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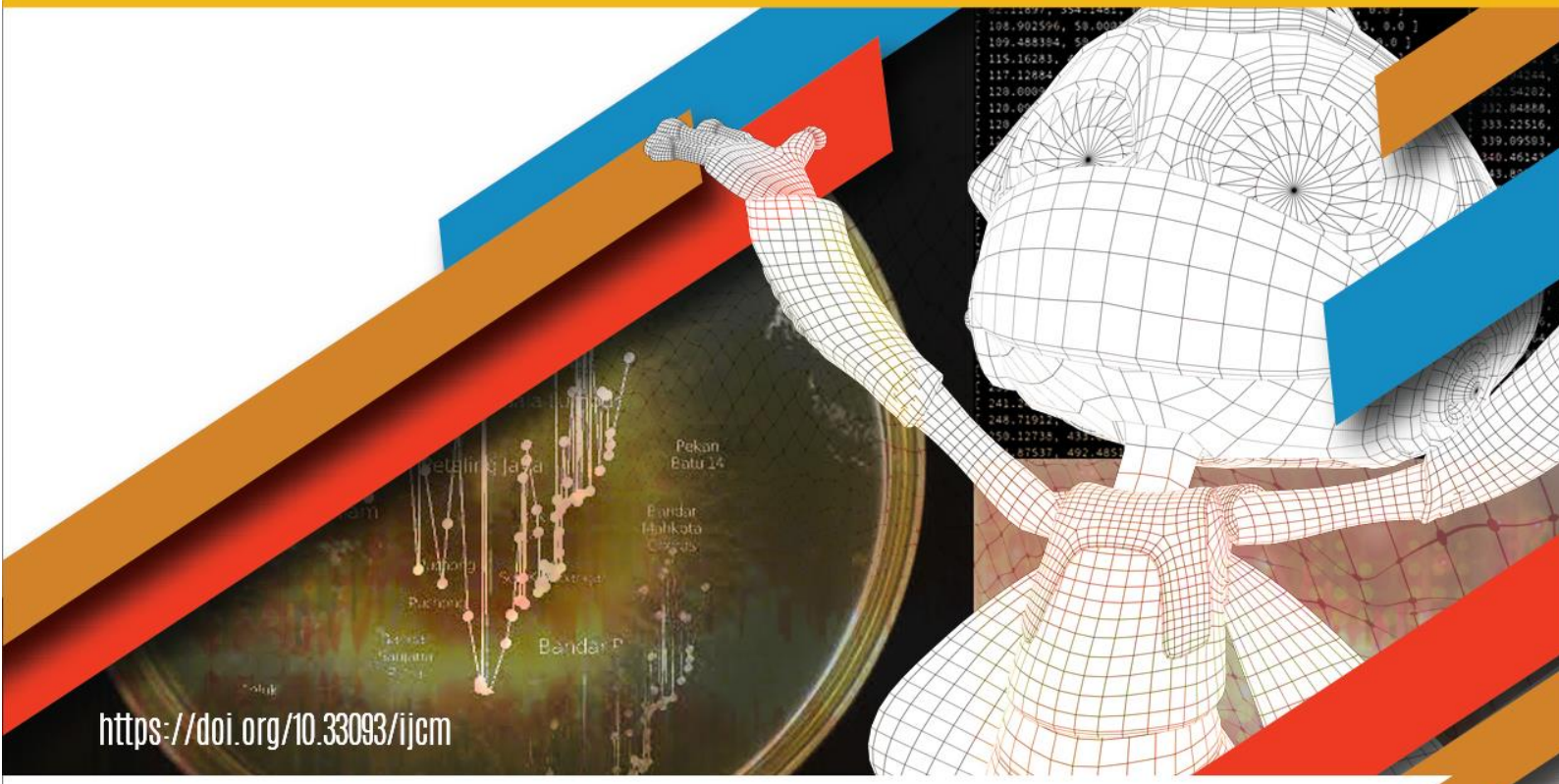

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Editorial Board

Aim and Scope

The International Journal of Creative Multimedia (IJCM) is a peer-reviewed open-access journal devoted to publish research papers in all fields of creative multimedia, including Digital Learning, Film & Animation, Media, Arts & Technology and Visual Design & Communication. It aims to provide an international forum for the exchange of ideas and findings from researchers across different cultures, and encourages research on the impact of social, cultural and technological factors on creative multimedia theory and practice. It also seeks to promote the transfer of knowledge between professionals in academia and industry by emphasising research where results are of interest or applicable to creative multimedia practices. We welcome all kinds of papers that connect academic researches with practical and industrial context in the field of creative multimedia. The scope of the IJCM is in the broad areas of Creative Multimedia following the five major thematic streams, includes but not limited to:

- Digital Learning
- Media, Arts & Technology
- Games and Virtual Reality
- Cinema and Film Studies
- Animation and Visual Effects
- Visual Design and Communication

Foreword from Digital Learning Editorial Team

Greetings from the Editors and welcome to the Special Issue on Digital Learning in the 21st century. In this Issue, we present papers from international and local researchers focusing on research papers in areas of education technology, learning analytics, e-learning, engineering, IT, business and management, creative multimedia and many other domains that seek to improve the learning process of the learner with technologies. These papers were presented in the ELITE 2019 International Conference held in Multimedia University, Cyberjaya, Malaysia on October 2, 2019, in conjunction with the 2019 IDE4TE International Exhibition on Oct 1, 2019. Themed, "Empowering Learning, Innovating Teaching Environments", this event showcased best practices of Malaysian Universities, particularly from the network of Industry Driven Education Alliance (GLU iDE4) comprising of Universiti Teknologi Petronas (UTP), Universiti Multimedia (MMU), Universiti Tenaga Nasional (UNITEN) and Universiti Kuala Lumpur (UniKL), as well as from international presenters from China, India, Bangladesh and Maldives.

The papers presented in this Special Issue centred around 5 sub-themes; 1) Innovative Pedagogies & Instructional Design, 2) New Roles of Teachers, 3) Redesigning Curriculum for Education 4.0, 4) Emerging Technologies In The Classroom, and 5) Designing Learning Spaces for 21st Century Education, and are very timely articles for readers interested in adapting technology in today's classrooms. We hope that these papers will provide further insight and contributions to the knowledge base in these fields and we hope you enjoy reading them.

Prof. Ts. Dr. Neo Mai, Multimedia University, Malaysia

Professor Dr. Neo Mai is the Director for Academic Development for Excellence in Programmes and Teaching (ADEPT) for Multimedia University, and Professor in the Faculty of Creative Multimedia, and the Institute for Digital Education and Learning (IDEAL). Prof. Mai is the Director of the award-winning MILE Research lab and founding Chairperson form the CAMELOT (Centre for Adaptive Multimedia, Education and Learning cOntent Technologies) Research Centre. Prof. Mai's research interests are in the design of constructivist learning environments, micro-learning, team-based learning and web-based education. She was the recipient of the 2014 Excellent Researcher Award, an AKEPT Certified Trainer for Interactive Lectures (Level 1, 2, 3), an HRDF certified trainer and is certified in Team-Based Learning from the Team-Based Learning Collaborative, USA.

Dr. Gan Chin Lay, Multimedia University, Malaysia

Dr. Gan Chin Lay is a Senior Lecturer affiliated with the Faculty of Business, Multimedia University. Her main research interest is in learning analytics, particularly related to technology-enhanced student-centered learning environments. Her research domains include teaching and learning issues such as student engagement, and educational technology integration frameworks.

Dr. Liew Tze Wei, Multimedia University, Malaysia

Dr. Liew Tze Wei is a Senior Lecturer at the Faculty of Business, Multimedia University, Malaysia. He is leading the Human-Centric Technology Interaction Special Interest Group, in addition to serving as the collaboration & innovation coordinator and research & innovation committee member in the faculty. His research interests and contributions fall within learning sciences, human-computer interaction, and media psychology; with a strong focus on experimental research approach.

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International Journal of Creative Multimedia

Usage of Mobile Application in Assisting Chemical Experiments

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Abstract

ChemEx is a mobile application that is created to assist students in performing chemical experiments. Students who study Bachelor of Electronic Engineering majoring in Nanotechnology use chemical experiment to synthesise nanoparticles. Through observation, they lack of confidence during the nanoparticles synthesis because they were not involved in any chemistry activities after foundation. To overcome this issue, a mobile application called ChemEx is created using Android Studio. In ChemEx, the usage of apparatuses and instruments, lab safety, the concept molarity and dilution, as well as the data of chemicals are introduced. Pre and post-test are used to evaluate the effectiveness of ChemEx in helping the students. Besides this, feedback form is used to evaluate the satisfaction of students after using ChemEx. The pre and post-test results show that the students have improved their understanding in apparatuses, safety, molarity and dilution. In the meantime, feedbacks show students are satisfied using ChemEx.

Keywords Mobile learning; Chemistry; Laboratory

Introduction

EPE 3016 Capstone Project is offered to third year students in Faculty of Engineering at Multimedia University. One of the tasks in this project that needs to be accomplished by students who study Bachelor of Electronic Engineering majoring in Nanotechnology is nanoparticles synthesis. Students will be involved in chemical experiments while synthesising nanoparticles. There are no lectures after foundation and no chemistry laboratory after secondary school for those students. Under these circumstances, students lack of confidence while performing chemical experiments.

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Based on the observation, students will spend more time to familiarize themselves on their first experiment that unabled them to finish their work in time. Furthermore, students work under high risk that is prone to wrong doings as they are lack of confidence in handling chemicals. Misuses of apparatus or instruments and improper waste disposals commonly happen during chemical experiments.

Through feedback from students, wrong doings, misuses and improper disposals are due to unfamiliarity with the practice in chemical laboratory as well as the need for revision on molarity and dilution of chemicals. Chemical laboratory is different from electronic laboratory. There are more safety precautions that need to be followed by students to ensure their safety. Furthermore, the apparatus and instruments are new to them as they have not been in chemical laboratory in years. Molarities of the used chemicals need to be determined by students while designing their experiments. Some chemicals in higher concentration need to be diluted before the chemicals are used in the experiments.

Literature review

Application of smartphones is no longer limited to communication only. Nowadays, smartphones can be used for games, entertainments, information retrieval and even trading. It is also a push to develop mobile applications for learning purposes. Esteban (2014) found in his survey that students in higher education found satisfactory when they can retrieve course content through smartphones and they perceived smartphones have high didactic function. The utilisation of mobile devices in supporting teaching and learning is known as mobile learning or 'm-learning'. The ubiquitous characteristic of mobile learning allows students to learn anywhere at any time (Masrom et al., 2016, p.268). Masrom et al. (2016) reported that the mobile learning in Malaysia begin with the mobile learning prototype designed by Wahab et al. in 2010. In 2016, Ismail et al. studied on the readiness of university students for mobile learning. Ismail et al. (2016) reported that the students were moderately ready for the integration of mobile technologies in education system. However, they are interested to know more about mobile learning. Malaysian researchers concluded their study that Malaysia should implement mobile learning to assist educational process (Masrom et al., 2016, p.268; Ismail et al., 2016, p.17).

Compare to using desktop computer in laboratory, mobile devices have advantages because they are portable, direct access to internet, lower cost and high computational power (Melo and Çomo, 2016, p. 49). Melo and Çomo (2016) created a mobile application to be used in physical chemistry laboratory for data collection during experiments as well as interaction between students-to-students and students-to-

teachers. They obtained positive feedback from students and teachers on the experience in using mobile devices during laboratory works. Enrique and Patricia (n.d.) had listed out numerous mobile applications that are useful in learning chemistry. In their survey, they concluded mobile applications can simplify learning and be a good assistant under teachers' supervision and guidance.

In this project, a mobile application, ChemEx, is developed to help students who study Bachelor of Electronic Engineering majoring in Nanotechnology in nanoparticles synthesise using chemical experiments.

Methodology

Content Planning of Mobile Application: ChemEx

ChemEx is a mobile application that is designed to assist students during chemical experiments in EPE 3016 Capstone. There are four functions in ChemEx that can minimise the issue of wrong doings, misuse and improper disposals during chemical experiments. They are "Lab Safety", "Apparatus and Instruments", "Molarity and Dilution" and "List of Chemicals and MSDS". The content of ChemEx is illustrated in Figure 1.

In "Lab Safety", rules and regulations in chemical laboratory are listed. A YouTube link will direct students to watch a video that explains 'Dos' and 'Don'ts' while being inside a chemical laboratory. A list of apparatuses and instruments that are available in Nanotechnology Lab 1, Faculty of Engineering will be provided in "Apparatus and Instruments". Image and description will be shown. A YouTube video on how to use the apparatus or instruments will be provided too. Concept of molarity and dilution are explained in the "Molarity and Dilution" function. Calculator for molarity and concentration of chemical solutions in dilution are created. Some chemicals that are available in Nanotechnology Lab 1 will be provided in the "List of Chemicals" function and the link of their material safety data sheet (MSDS) will be inserted.

Feedback on The Usage of ChemEx

Pre and post-tests were designed to evaluate the usefulness of ChemEx in the introduction of apparatuses and instruments, lab safety awareness, as well as the calculation of molarity and dilution in preparing chemical solutions. Before ChemEx was introduced to the students, they were asked to answer some questions according to their best understanding and their common knowledge in chemistry. The same

questions will be asked again after ChemEx was installed into their smart phone. At this moment, they can answer the questions with the assistance of ChemEx. The questions are listed in Figure 2.

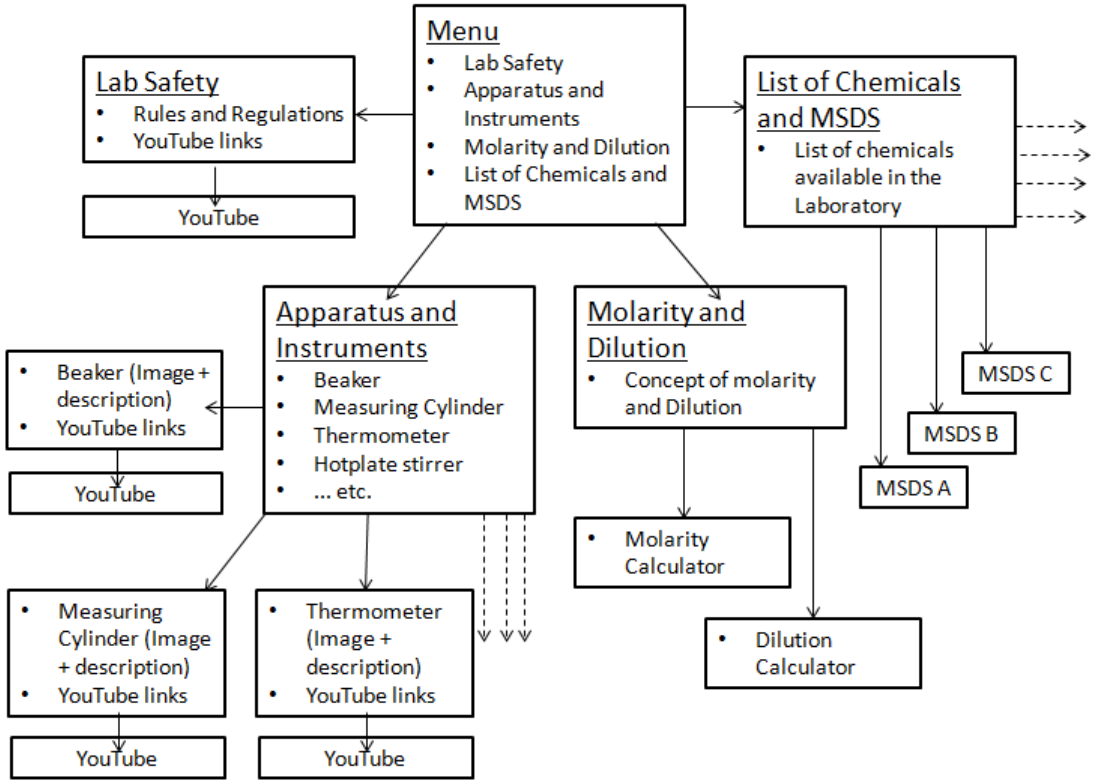


Figure 1 Content Planning for Mobile Application: ChemEx

1. What is the function of listed apparatus in Nanotechnology Lab 1?
   a. Beaker
   b. Glass rod
   c. Spin coater
   d. Erlenmeyer flask
   e. Furnace
2. What is the best tool to be used for measuring the volume of solution?
3. List out 3 Dos and 3 Don'ts in Nanotechnology Lab 1.
4. How many grams of NaCl (solid) is needed to prepare 50ml 0.5M NaCl solution? (Atomic mass for NaCl= 58.44 g/mol)
5. To prepare 50ml of 0.3M solution, how much ml of 1M solution and how much ml water is needed?

Figure 2 List of Questions for Pre and Post-test to Evaluate the Usefulness of ChemEx.

A feedback form as shown in Table 1 was distributed to the students to evaluate their satisfaction in using ChemEx. Firstly, the feedback form evaluated the easiness of the usage of ChemEx. Subsequently,

the form evaluated the sufficiency of the list of apparatuses and chemicals, rules and regulations, as well as the effectiveness of molarity and dilution calculator in helping students to perform chemical experiments in the laboratory. Lastly, the students were asked about their willingness to recommend ChemEx to students that will take EPE 3016 Capstone Project. All statements were evaluated with 4 levels Likert scale: Strongly Agree, Agree, Disagree and Strongly Disagree.

Table 1 Feedback form to evaluate the satisfaction in using ChemEx.

	Strongly Agree	Agree	Disagree	Strongly Disagree
ChemEx is easy to use.				
You can know how to use apparatus with the help of ChemEx.				
The list of apparatus is sufficient.				
With the help of ChemEx, you know the Dos and Don'ts in Nanotechnology Lab 1.				
Do you agree the rules and regulations in ChemEx ("Lab Safety" function) can make sure you are safe in Nanotechnology Lab 1?				
You understand the concept of molarity using ChemEx.				
Do you agree that ChemEx (Molarity Calculator) can help you to calculate molarity easily?				
You understand the concept of dilution using ChemEx.				
Do you agree that ChemEx (Dilution Calculator) can help you to calculate dilution easily?				
The recipe in ChemEx ("Chemicals and MSDS" function) helps you to start the planning of your nanoparticles synthesis.				
You will recommend ChemEx to Capstone student working in Nanotechnology Lab 1.				

Results and Discussion

Mobile User Interface of ChemEx

The mobile user interface of ChemEx is created using Android Studio as shown in Figure 3. There are four icons that are linked to four functions: Apparatus, Lab Safety, Molarity and Dilution, as well as Chemicals and MSDS. As suggested in content planning, list of apparatuses was displayed after the Apparatus icon was tapped. Further from that, image and description of the apparatus or instrument was provided once its

name was tapped. For an example, the image and description of centrifuge was displayed as shown in Figure 3. Besides this, a YouTube button will show the video introducing the centrifuge.

Dos and Don'ts were listed when the Lab Safety icon was tapped. A YouTube is available to show the video which explains safety precautions while performing experiments in Chemical Laboratory. The students' safety can be enhanced when they aware what they should and should not do in Chemical Laboratory.

The concept of molality and dilution were introduced after tapping the Molarity and Dilution icons. An example for molarity was given. 1 gram sodium hydroxide (NaOH) is added into 25 ml distilled water to prepare 25 ml 1M NaOH. Calculator for molarity and dilution were provided to help the students in preparing the required molarity or concentration (Figure 3).

By tapping the Chemicals and MSDS icon, recipe to synthesise zinc oxide and titanium oxide nanoparticles were provided. The required chemicals were listed and the MSDS can be retrieved through the MSDS buttons. Furthermore, chemicals used for cleaning were listed as well as their MSDS.

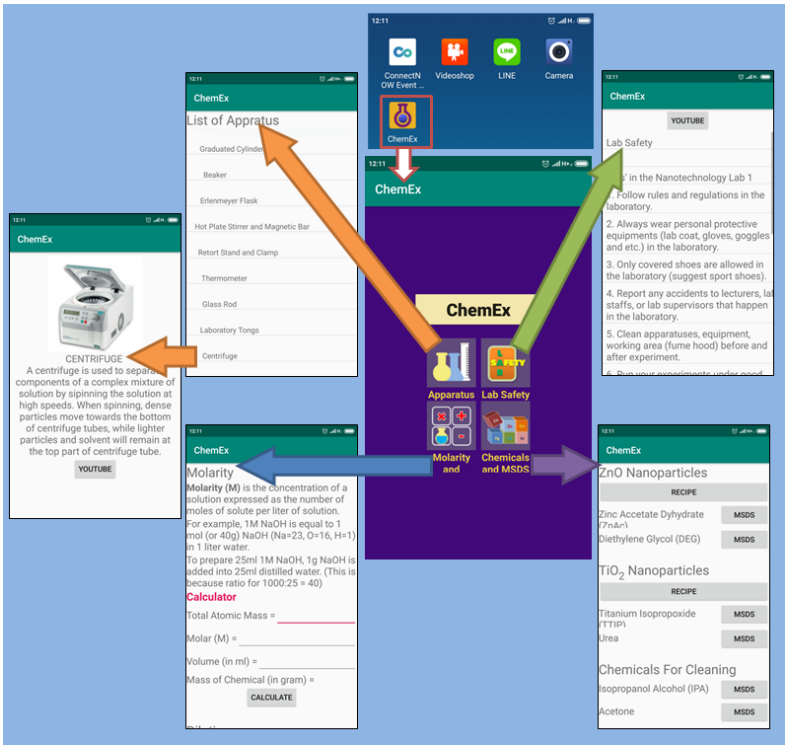


Figure 3 Mobile User Interface of ChemEx.

Pre and Post-Test Results Using ChemEx

There were seven students (Bachelor of Electronic Engineering majoring in Nanotechnology) who registered EPE 3016 Capstone Project in Trimester 1 of 2019/2020. Pre and post-test results using ChemEx is shown in Figure 4. A paired-sample t-test was conducted to compare students' knowledge in the function of apparatuses, safety awareness in chemical laboratory and ability in determine molarity of chemical solution before and after ChemEx was introduced to them. There was a significant difference in the scores for pre-test (Average=31.75, Standard Deviation=11.88) and post-test (Average=93.65, Standard Deviation=5.94); t(6)=-18.73, p=0.0005. The pre and post-test clearly shows that the ChemEx can help students to know better the function of apparatuses, be aware of the safety in chemical laboratory and prepare chemical solutions with correct molarity and concentration.

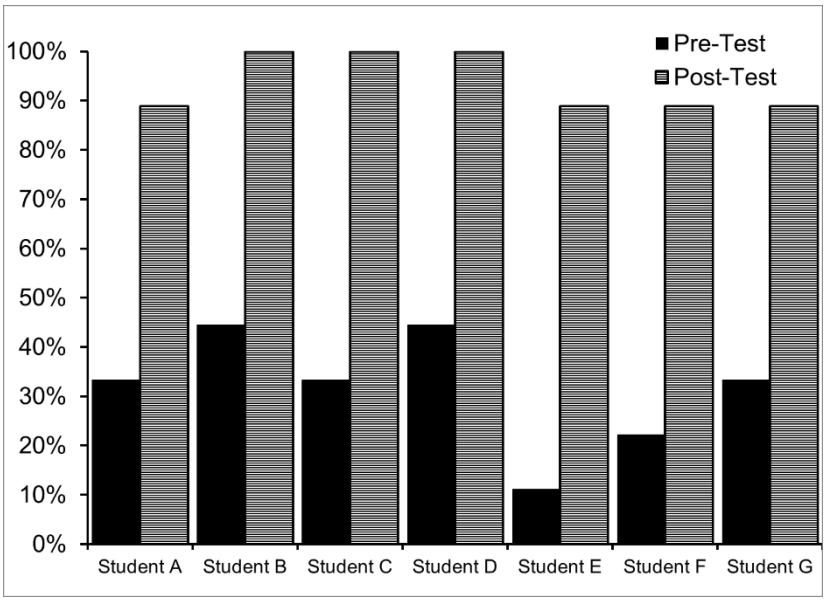


Figure 4 Pre and Post-test Results Using ChemEx.

Students' Satisfactions in Using ChemEx

Figure 5-11 shows the feedback results of students after using ChemEx. As shown in Figure 5, all students agreed that ChemEx is easily to be used. Furthermore, they agreed that ChemEx can help them know how to use the apparatuses, and that the listed apparatuses in ChemEx are sufficient. This is proved by the feedback results shown in Figure 6. In Figure 7, all students agreed that ChemEx can effectively introduce the Dos and Don'ts in chemical laboratory. 6 out of 7 students (86%) think ChemEx can ensure their safety while performing chemical experiments. Figure 8 (a) and 9 (a) respectively show that only 1 out of 7 students (14%) disagrees ChemEx can introduce the concept of molarity and dilution. All students agree ChemEx can help them to calculate molarity, while 86% students agree ChemEx helps in determining the

amount of chemical solution and water in dilution process. The feedback results are shown in Figure 8(b) and 9(b), respectively. Figure 10 shows that 86% students think ChemEx helps them in starting the planning of their nanoparticles synthesis. Figure 11 shows that only 1 out of 7 students (14%) will not recommend ChemEx to students from Capstone Project who are working in chemical laboratory.

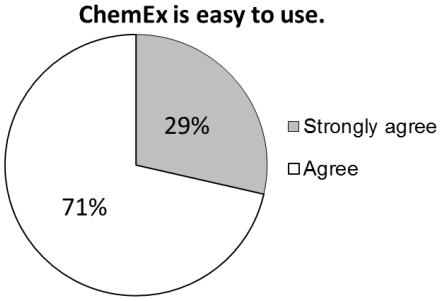
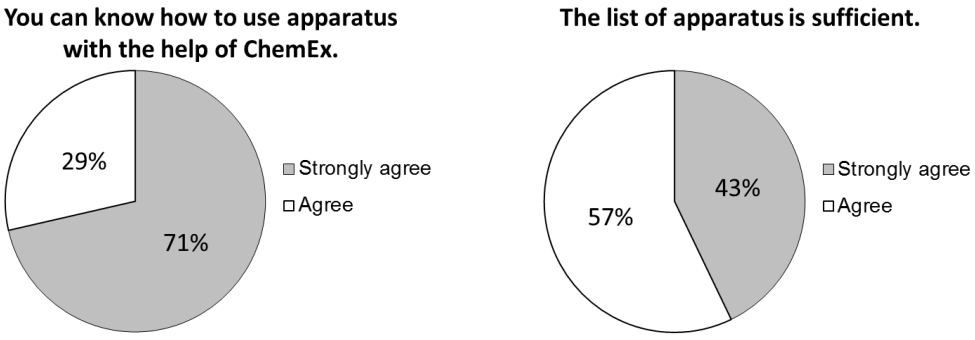
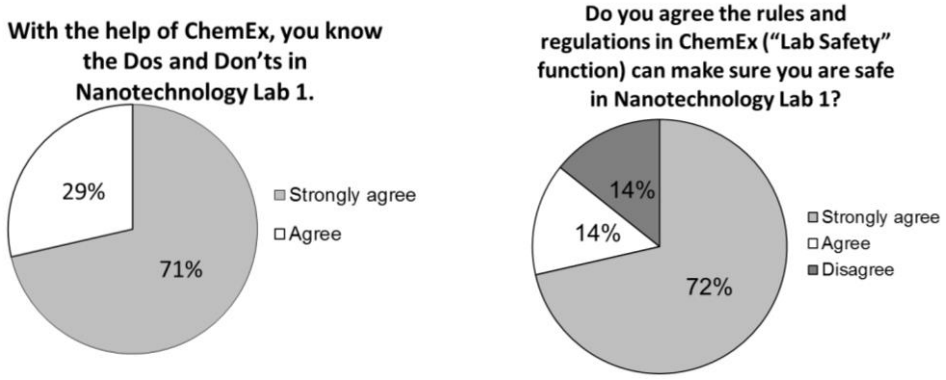


Figure 5 Feedback Result on the Easiness of the Usage of ChemEx



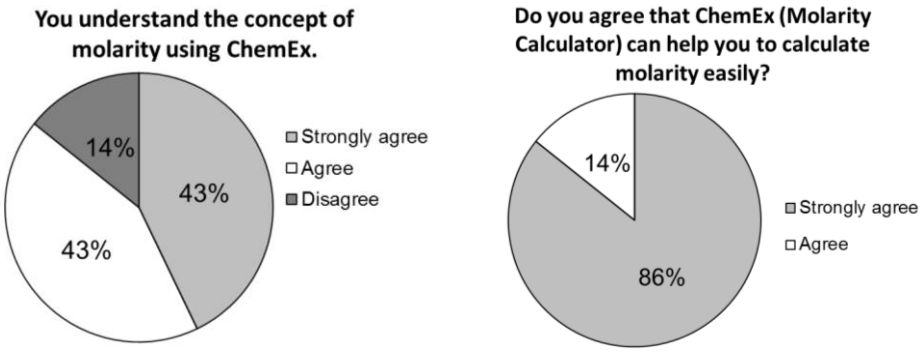
(a) (b)

Figure 6 Feedback Result on (a) the Effectiveness of ChemEx in Introducing Apparatus or Instrument, and (b) the Sufficiency of the Listed Apparatuses or Instruments



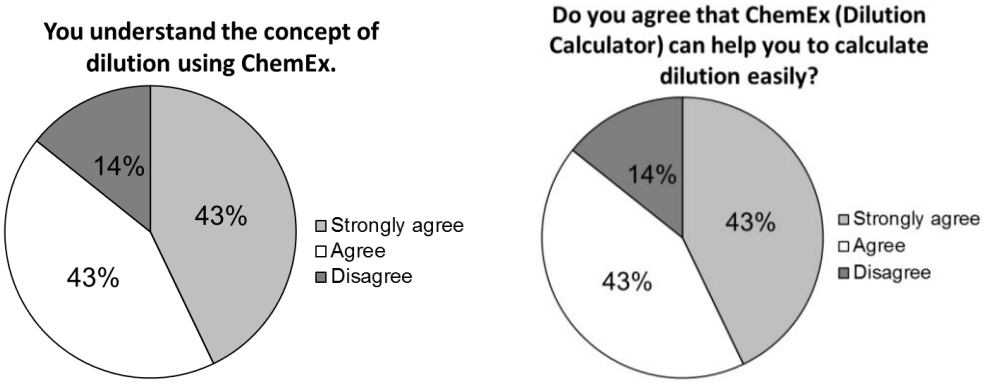
(a) (b)

Figure 7 Feedback Result on the Effectiveness of ChemEx in (a) Introducing the Safety Precautions in Chemical Laboratory, and (b) Creating Confidence in Safety while Working in Chemical Laboratory



(a) (b)

Figure 8 Feedback Result on the Effectiveness of Chemex in (a) Introducing the Concept of Molarity, and (b) Assisting the Calculation of Molarity



(a) (b)

Figure 9 Feedback Result on the Effectiveness of ChemEx in (a) Introducing the Concept of Dilution, and (b) Assisting the Calculation of Dilution.

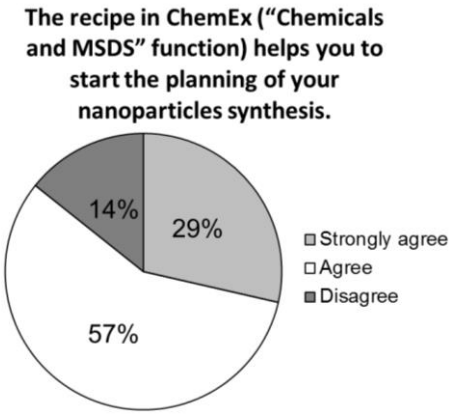


Figure 10 Feedback Result on the Effectiveness of ChemEx in Assisting the Planning of Nanoparticles Synthesis

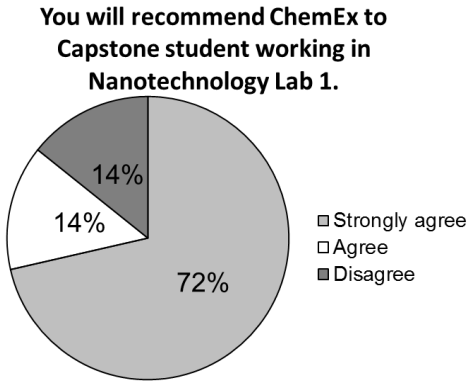


Figure 11 Feedback Result on the Willingness of Student to Recommend ChemEx to the Students Taking EPE3016 Capstone Project.

Almost all of the students are satisfied in using ChemEx and agree that ChemEx is helpful in chemical laboratory. However, students think that there is room for improvement in ChemEx. Students think the design of ChemEx can be more interesting and suggest ChemEx in iOS version to be created. Nik Mohammad et al. (2012) forecasted the cross platform solutions will be a challenge in mobile learning. Furthermore, students think BACK buttons are necessary to return to main page easily. Last but not least, students hope that more calculations and formulas can be included in ChemEx.

Conclusion

The pre and post-test results had shown the mobile application (ChemEx) can help to improve students' know-how on the usage of apparatuses and instruments in chemical laboratory. Awareness on the safety precautions in chemical laboratory were improved, hence students can minimise accidents from happenning. With the molarity and dilution calculator, students can prepare the chemical solutions at required concentration and molarity correctly. These were proved by the paired-sample t-tests with significant difference in the scores for pre-test (Average=31.75, Standard Deviation=11.88) and post-test (Average=93.65, Standard Deviation=5.94); $t(6)=-18.73$, $p=0.0005$. The feedback results also showed that students think ChemEx is easy to use. Furthermore, six out of seven students think ChemEx is helpful in understanding the usage of apparatuses, safety precautions, concept of molarity and dilution, as well as the chemicals. However, ChemEx encounters the challenge of cross platform solutions that was predicted by Nik Mohammad et al. (2012).

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Authors' Bio

Dr. Sin Yew Keong graduated Diploma in Laboratory Technology and Bachelor of Applied Science in Applied Physics and obtained his PhD. from Universiti Sains Malaysia in 2000, 2003 and 2010, respectively. He joined Multimedia University since July 2010. He is actively involved in projects like nanoparticles synthesis and simulation of electronic devices. He has taught subjects like Electronics I, Circuit Theory, Semiconductor Devices, Nano-Science and etc. Dr. Sin started facilitating EPE 3016 Capstone Project since 2014 which involves chemical experiments.

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