MOLECULAR GEOMETRY TOOLKIT

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ABSTRACT

Molecular Geometry Toolkit is a mobile education application. The toolkit allows users to make quick references, engage interactive tools and simulations related to the study of Molecular Geometry. A study involving 104 students focuses on the use of the Molecular Geometry Toolkit to help improve students' understanding of Molecular Geometry and use it as an alternative to the traditional ball and stick model set. This study consists of two cycles. The first cycle involved the use of the application in a lecture while the second cycle involved the use of the application in a tutorial. At the end of both cycles 95% of the students scored As. Students found the application very helpful, easy to use and made the topic interesting and easier to understand. Molecular Geometry helped students learn objectives faster and at a lower cost compared to the classic ball and stick model set. This study finds the Molecular Geometry Toolkit to be a cost-effective tool for learning molecular geometry.

Keywords: science education, chemistry, molecular geometry, educational application, twenty-first-century learning

1. INTRODUCTION

Molecular Geometry Toolkit (MGT) is a mobile application. The toolkit allows users to make quick references, engage interactive tools and simulators related to molecular geometry on mobile devices. Molecular Geometry is difficult to visualize [1]. The use of physical models has been the traditional way of helping students acquire the skill to relate 2-D chemical symbols with 3-D molecular geometry. Since this skill is crucial to understanding chemistry, the matriculation program has allocated a two-hour laboratory session to learn molecular geometry using the ball and stick model kit. In 2018, as a result of a curriculum review, Practical 6: Molecular Geometry was dropped from the course. Since then, students no longer use molecular models with teachers in class. Without Practical 6 the time allocated for Molecular Geometry has been reduced by two hours. A new learning tool was desperately needed. One that could achieve the same learning outcomes faster. Thus, the Molecular Geometry Toolkit was developed.

2. OBJECTIVES

This study aims to investigate the use of MGT as an alternative to the molecular model kit in teaching molecular geometry to matriculation students. Specific objectives of this study are: 1) Determine students' level of achievement after learning molecular geometry using MGT. 2) Determine students' views on the usability of MGT as a tool for learning molecular geometry. 3) Evaluate the cost-effectiveness of MGT compared to the traditional physical molecular model kit.

3. METHODS

The application layout of the Molecular Geometry Toolkit is shown in Figure 1.

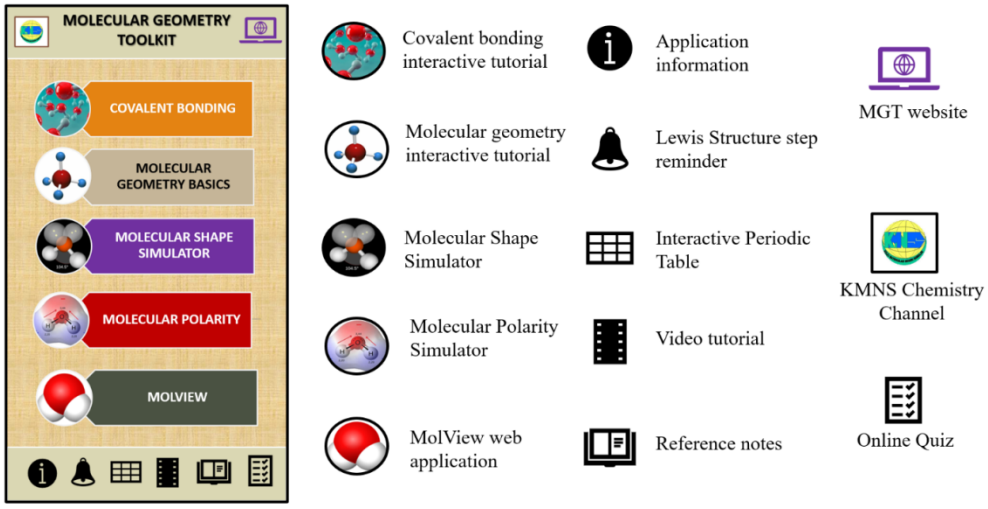

Figure 1. Application layout of the Molecular Geometry Toolkit

This usage study involved 104 students. Molecular Geometry Achievement Test is used to determine students' achievement level. It consists of 10 multiple choice questions carrying 10 marks. The Molecular Geometry Toolkit Usage Questionnaire is used to gauge students' view on the use of the application. The questionnaire comprises 10 four-point Likert scale questions and an open-ended question on students' experience using the application.

4. RESULT AND DISCUSSION

Students' level of achievement in Molecular Geometry were determined twice in the study. First after the Molecular Geometry lecture and then after the students have undergone classroom tutorial sessions on the same topic. This finding shows that the use of application has allowed 95% of students to score A in the post-test with only two hours of instruction. Traditionally the time allocation for the study of Molecular Geometry is four hours.

Table.1 Summary of post-test results

	Mean	Median	Range
Post-lecture	6.1	6	2-10
Post-tutorial	9	9	4-10

Results presented in Table 2 generally shows that the Molecular Shape Simulator is well received by the students. More than 90 % of students agree that the use of the application brings numerous positive effects.

Table 2. Summary of Molecular Shape Simulator Usage Questionnaire

	Strongly disagree	Disagree	Agree	Strongly agree	% Agree
I enjoy using MGT applications to learn this topic.	0%	7%	55%	38%	93%
I easily understand the concept topic with MGT.	0%	6%	56%	38%	94%
MGT is easy to use.	0%	8%	52%	40%	92%
The MGT allows me to visualise molecular shapes	0%	4%	55%	41%	96%
The MGT app increases my interest in the topic.	0%	13%	59%	28%	87%
I understand what is taught by the teacher more when MGT is used	0%	6%	61%	33%	94%
MGT is suitable for use in lectures.	0%	4%	54%	42%	96%
MGT app is suitable for use in tutorials.	0%	11%	54%	36%	89%
MGT app is suitable as a self-study tool	0%	5%	60%	35%	95%
MGT is effective for learning molecular geometry.	0%	6%	62%	32%	94%

Potential of large-scale use of MGT as a substitute to the traditional physical model kit is highlighted by its advantage over the traditional physical model. This is shown in Table 3.

Table 3. Advantages of Molecular Geometry Toolkit over Traditional Physical Model

	Physical Model (Ball and Stick)	**Molecular Geometry Toolkit**
Cost	RM 94 /set@RM 6016/64 set /college	Free
Allocated usage	2 hours of practical class /semester	Unlimited, anytime and anywhere.
Ownership	Property of college	Can be stored in mobile devices
Features	Build molecular models	Build molecular models and numerous other features from supporting applications.

5. CONCLUSIONS

The Molecular Geometry Toolkit is a cost-effective method for students to learn molecular geometry both inside and outside the classroom. Students who used the application scored highly in the achievement test and were very positive about the use of the application. Additional student benefits can be gained from other supporting applications in the toolkit, not just for Molecular Geometry but also other chemistry topics.

REFERENCES

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