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VCD on Common Laboratory Techniques in Analytical Chemistry and Organic Chemistry

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Preamble

Chemistry is considered to be an experimental science. Year-one Chemistry students may not have acquired the necessary basic laboratory skills training in secondary schools. Two multimedia VCDs were developed to provide detailed descriptions and demonstration of the basic laboratory skills in Analytical and Organic Chemistry. Students could learn the basic laboratory techniques on their own pace. After acquiring the proper laboratory skills, students could conduct experimental investigations and tackle various chemical problems in their future studies.

Abstract

The VCDs aiming to provide relevant self-learning materials for year-one Chemistry majored students to learn the basic laboratory techniques encountered in Analytical and Organic Chemistry laboratories were produced. To enhance teaching and learning, two different presentation approaches - role-playing and experiment demonstration - were adopted in the video. The first part of the video covers basic analytical chemistry techniques such as proper chemical weighing and handling, correct use of volumetric flasks, titration with standardised NaOH and accurate burette reading. The second part involves techniques commonly employed in an Organic Chemistry laboratory such as simple distillation, general reflux, liquid-liquid extraction, vacuum filtration and thin-layered chromatography.

Keywords

Laboratory techniques, low cost VCD, analytical chemistry, organic chemistry

Introduction

Year-one Chemistry majored students often have difficulties in conducting experiments properly in the laboratory. One of the reasons is their lack of necessary basic laboratory skills training in secondary schools. If our students do not possess the

necessary skills, they will be frustrated and suffer in their ongoing laboratory work. Most importantly, the success of their final year honor research project will very much depend on the skills acquired over the years.

In view of the above-mentioned factors, VCDs emphasising modern techniques in performing Analytical/Organic Chemistry experiments were produced to assist students in learning the basic laboratory techniques on their own pace and working efficiently in the laboratory.

Aims and Objectives

1. To produce VCDs on Analytical/ Organic Chemistry laboratory techniques that are relevant to year-one Chemistry majored students.

2. To use the VCDs as a multimedia teaching tool, allowing students to learn at their own pace.

3. To explore the idea of distributing the VCDs to local high schools in the hope of getting the students better prepared for college laboratory work.

Methodology

In addition to the Principal Investigator and Co-investigator, the production team comprised a Project Assistant, a student helper and demonstrators/technicians of the Chemistry Department who had carried out all the planning, script-writing, preparation and demonstration work. CED staff was responsible for video-taping, editing and other technical support in video production.

To promote teaching and learning, two different presentation approaches - role-playing and experiment demonstration - were used in the illustration. In the first part of the video, the Analytical Chemistry techniques are demonstrated through a role-play in which an Analytical Chemistry experiment "Determination of Acid Content in Unknown Vinegar Sample" (Christian, 1994, Chapter 7) is featured. Two technicians acted as students to perform the experiment. One technician acted as the instructor to correct the mistakes made by the students and showed them the proper techniques. Techniques such as standardisation of NaOH with KHP, titration, and proper handling and weighing of chemicals were shown accordingly. (Skoog & West, 1988, Chapter 8 & 10)

The second part of the video features two common organic chemistry experiments, namely "Extraction of Caffeine from Coffee Beans" (Williamson, 1999, pp. 152-153 & pp. 160-163) and "Oxidation of Toluene with KMnO4". (Gilbert & Martin, 1998 pp. 659-660) The Principal Investigator was responsible for the demonstration section while three technicians were responsible for the on-spot narration and material preparation during video-taping. The illustration was interspersed with slides on chemical structures and equations.

The beta version of the video was shown to our year-one *Organic/Analytical/Chemistry*

for Life Science students. In addition, our colleagues were invited to comment on our illustration. Student feedback and valuable comments from our colleagues on the beta version of the video had been collected and improvement had been made. The final version of the VCDs was made available for faculty-wide distribution.

Results/Findings

Several copies of the VCDs are available in the library for student access. Part of the video was broadcast again during the semester when specific techniques were called for.

We found that students had paid extra attention to the illustration for two main reasons. Firstly, the illustration was performed by the technicians and the instructor, who are familiar to the students. Secondly, the narration is in Chinese and captured some students' attention as they came from Chinese-medium secondary schools. The material was easier to be understood and absorbed since it was in the students' mother tongue.

We used the finished VCDs in our undergraduate laboratory teaching. However, we had decided not to issue the online questionnaire to our year-one or year-two students when they watched the VCDs due to technical difficulties.

Discussion

The organic chemistry experiments chosen for illustration, namely "Oxidation of Toluene by KMnO4" and "Extraction of Caffeine from Coffee" (Mayor, Pike & Trumper, 1994, pp. 232 – 241), were taken from the student laboratory manual. By demonstrating the same experiments in the VCDs, we hoped that the students would have a better understanding of the underlining principles and the required techniques involved. It would also enhance their interest in self-learning.

As for the analytical chemistry experiment "Determination of Acid Content in Unknown Vinegar Sample", it was also taken from the undergraduate laboratory manual, which allowed our students to learn and prepare the basic analytical chemistry techniques before class.

Starting from next year, the VCDs will become part of the teaching materials in the laboratory classes and the video will be shown during the check-in period of *Organic/Analytical/Chemistry for Life Science/ Chemistry for Applied Physics* in the first year. In addition, the VCDs will be continuously made available for students to check out.

We introduced the laboratory technique VCDs to local high school teachers at the International Conference on Micro-scale Chemistry organised by our Department. About 50 copies of the VCDs were made available for distribution to the local high school teachers during the conference. It is one of our goals to have high school teachers to adopt the video CD to their laboratory teaching. By watching the VCDs during class, the high school students would be better prepared for college

laboratory work after leaving secondary school. The tertiary education sector would be benefited as the new generation of students would be more proficient in performing experiments in a safe and efficient manner.

Enhancement on Teaching and Learning

Feedback evaluation on our newly developed VCD on organic laboratory techniques was carried out after the first view by the year-one Chemistry majored students. Results of the evaluation have been summarised and attached in Appendix A. It was encouraging to find that over 75% of the students agreed that it is more efficient/effective to learn laboratory techniques from the video demonstration than from the book. This confirmed the importance and need of this organic technique VCD production. In addition, the majority of students agreed that VCD is a good learning aid for self-learning and found the content of the VCD useful for them to learn and improve their organic laboratory skills.

In addition, feedback evaluation on our newly developed VCD on laboratory techniques in analytical chemistry was carried out after the first view by the Chemistry majored and non-Chemistry majored students. Results of the evaluation have been summarised and attached. Again, very positive response to the value of this analytical technique VCD was obtained. To our surprise, students did not agree that the use of Chinese narration could assist their understanding of the VCD presentation. They would like to see more teaching aids produced in the future.

Using VCD as a teaching tool/medium provided a great degree of flexibility and efficiency. It could allow students to learn the materials on their own pace, which is one of the effective means to promote teaching and learning.

Limitations/Difficulties

We planned to put the VCDs on the Department Homepage so that students can download them whenever and wherever they like. However, due to the size of the VCDs, this option was not viable at the moment. We may explore other alternatives in the near feature. Students expressed their interest in making use of the VCDs again; however, they were not very keen on checking out the VCDs from the library. This may be due to the busy schedule of students and the location of the University library. Our library is located in the Shaw Campus which is quite a distance from the Ho Sin Hang Campus where most of the lectures take place. We are planning to set up a check-out counter in the Department so that students can gain access easily.

Conclusion

In summary, the VCD project was a success and students will certainly benefit from it in the long run. Feedback from students affirmed an important value of these newly produced VCDs. Our products were the very first VCDs on Organic/Analytical

Chemistry laboratory techniques with Chinese narration. It is our utmost goal that local high school students can benefit from the VCDs and they can be used over and over again in local high schools and undergraduate laboratory teaching. Our effort to promote teaching and learning using this newly developed VCDs will continue.

References

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Mayo, D.W. Pike, R.M. Trumper, P.K. (1994). *Microscale organic laboratory with multistep and multiscale syntheses* (3rd ed.). New York, NY: John Wiley & Son.

Skoog, D. West, D. Holler, F (1988). *Fundamentals of analytical chemistry* (5th ed.). New York: Saunders College.

Williamson, K. (1999). *Macroscale and microscale organic chemistry* (3rd ed.). Boston, MA: Houghton Mifflin.

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Common Laboratory Techniques in Organic Chemistry

Experiment: Extraction of Caffeine from Coffee

Picture 1 - Pouring the dissolved caffeine into the separation funnel.

Picture 4 - Pouring the dried extracted caffeine into a 250 mL round bottomed flask.

Picture 2 - Extraction of caffeine with dichloromethane in the separation funnel.

Picture 5 - Collection of crude caffeine after simple distillation.

Picture 3 - Collection of extracted caffeine using a 250 mL Erlenmeyer flask.

Common Laboratory Techniques in Analytical Chemistry

Experiment: Standardisation of Sodium Hydroxide (NaOH) solution with Potassium Hydrogen Phthalate (KHP)

Picture 1 - Dissolve NaOH in deionized water.

Picture 4 - Addition of phenolphthalein, indicator of the KHP solution.

Picture 2 - Transfer the NaOH solution into a 250 mL volumetric flask.

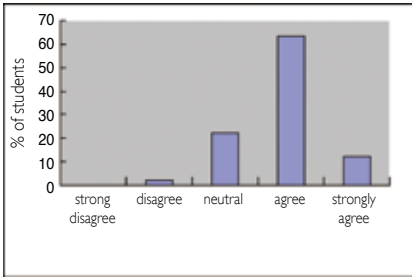
Picture 5 - Titration of KHP with NaOH solution. The pink colour shows that the end point has been reached.

Picture 3 - Rinse and fill the burette with NaOH solution.

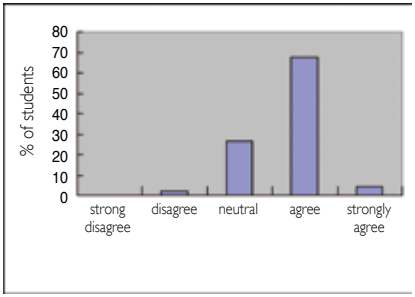
Appendix A
Results of Feedback Evaluation on Laboratory Techniques in Organic Chemistry VCD

Class	No. of Students
Organic Chemistry Lab I	49

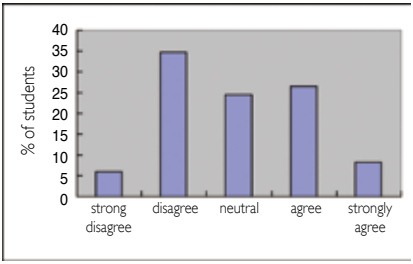
Question 1.
It is more efficient/effective to learn the laboratory techniques from video demonstration than from the book.



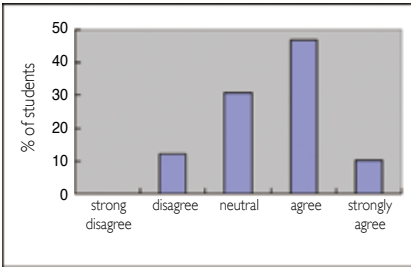
Question 2.
I find the content of this VCD useful in learning/improving my laboratory skills.



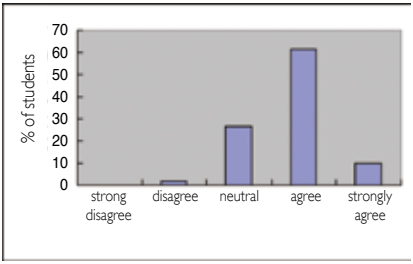
Question 3.
Chinese narration assists me in understanding the VCD presentation better.



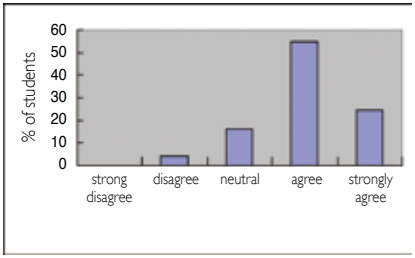
Question 4.
I understand the VCD demonstration clearly.



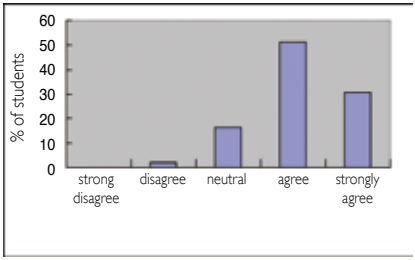
Question 5.
I will check out from the library reserve and review the techniques again when needed.



Question 6.
VCD is a good learning aid for self-learning.



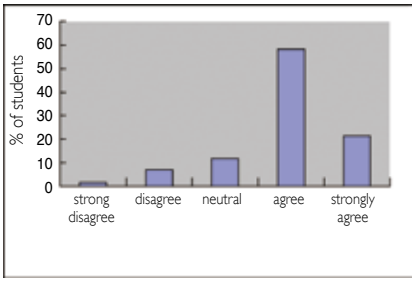
Question 7.
I would like to see more teaching aids produced in the future by the Department.



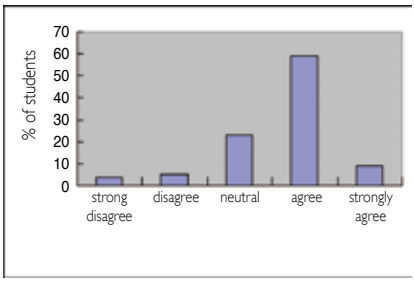
Results of Feedback Evaluation on Laboratory Techniques in Analytical Chemistry VCD

Class	No. of Students
Chemical Analysis Lab	46
Analytical Chemistry Lab	42
Chemistry for Apply Physics	24
Total	112

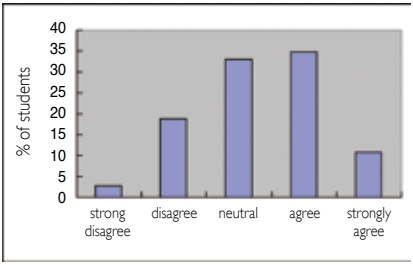
Question 1.
It is more efficient/effective to learn the laboratory techniques from video demonstration than from the book.



Question 2.
I find the content of this VCD useful in learning/improving my laboratory skills.



Question 3.
Chinese narration assists me in understanding the VCD presentation better.



Question 4.
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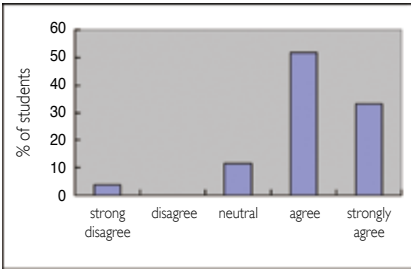

Question 5.
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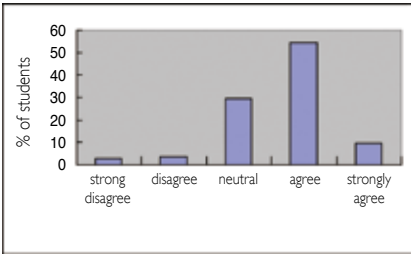
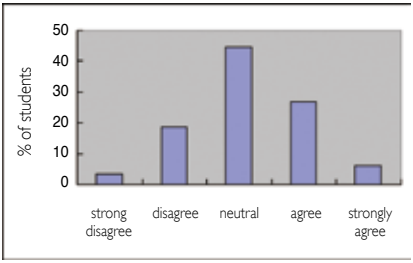


Question 6.
VCD is good learning aid for self-learning.



Question 7. I would like to see more teaching aids produced in the future by the Department.