

Bridging Workshop on Practical Skills for Year-one Biology Students

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Preamble

This Teaching Development Grants project aimed to organise a training workshop for freshmen (i.e. Year-one Biology students) to better equip them with essential technical skills that were required for the three-year BSc programme.

It has been noticed in recent years that year-one undergraduate students generally lacked proficiency in technical skills for undertaking and performing experiments. This could be attributed to the abolishment of the A-Level Practical Examinations as well as the limited exposure to the use of advanced instruments in secondary schools. To make up for the deficiency, it is recommended to organise a three-day workshop before the commencement of the academic period of undergraduate studies at the end of August. The workshop will be delivered via a series of learning activities of lectures sessions, practical classes, demonstrations as well as field trip.

Results and findings from the past Bridging Workshops showed that students and demonstrators were supportive to such workshops and positive responses were received for its effectiveness. It is believed that the Bridging Workshop would be beneficial in improving both teaching and learning processes.

Abstract

In recent years, our staff have noticed that most year-one students were not competent to perform experiments. One of the reasons might be due to the discontinuation of the previous A-Level Practical Examination after adopting the Teacher Assessment Scheme (TAS) in secondary schools. In order to compensate for this deficiency, a three-day "Bridging Workshop" was proposed for the year-one biology students.

In this workshop, the students had a chance to expose themselves to basic practical skills through a series of learning activities, such as brief lectures, practical classes, demonstrations and field trip. At the end of the workshop, an assessment was carried out to measure the learning outcome of the students.

Keywords

Bridging Workshop, practical skills, Biology

Introduction

It has been noticed in recent years that there are generally a lack of proficiency in technical skills among year-one university students. This could be attributed to the fact that historically A-Level students were required to take the A-Level Practical Examination, which focused on assessing their technical skills. Ever since the TAS was adopted, the practical examination was abolished. Furthermore, there are limitation to the use of more advanced laboratory instruments in secondary schools, which limits students' exposure to these instruments and the ability to develop advanced techniques involved. A gap is therefore created when they enter their first year of university education. Not only does this pose difficulties to the teachers in universities, in which extra time is required to polish the students' skills, students also found it difficult to adapt to and learn the basic skills again.

Aims and Objectives

The major purpose of this teaching grant was to organise a workshop so as to bridge the existing gap and to better equip students with the necessary technical skills required for the three-year university education.

After completing the workshop, it was expected that the students would be better equipped to embark on their BSc

degree programme and have a better understanding in handling the instruments and chemicals in a safe manner. Also, through the demonstration of some advanced instruments in biological science, students would have an earlier exposure to foster more enthusiasm in the study of Biology.

Methodology

This programme was a three-day workshop offered to year-one students before the classes began. Held in our campus, the workshop consisted of different learning activities such as practical class, brief lectures, demonstration, discussion and field trip. In the first half of this workshop, a wide variety of skills and knowledge to be used in the coming semester, such as review of common lab techniques and correct methods in using lab equipment, were covered. The students were also aware of the need for appropriate safety procedures in handling chemicals. In the second half, demonstration of advanced instruments in biotechnology and environmental science was organised. We wished to show our students that our daily life had been benefited much from the advanced development in biological science. The main purposes were

1. to teach the students some basic techniques in Biology and refresh their memory;

- to keep the students abreast of the latest scientific and technological development in biological instrumentation; and
- to allow the students to develop and sustain the curiosity to learn and explore.

At the end of this workshop, a field trip was organised. This gave an opportunity for students to further discover Biology through outdoor studies, particularly they could develop their interests in the relationships among organisms. During the

field trip, the students were more aware of (1) the need for appropriate safety measures in ecological field studies, and (2) a respect of life and the environment while carrying out ecological field studies.

The daily programme was subdivided into many topics. Each session took about one hour and was taught by our staff members who are experienced in the relevant topic. At the end of each day, a session was reserved for review and feedback on the training. A rundown of this workshop is shown below:

Schedule of Bridging Workshop

Time	Day One	Staff in-charge
10:00 AM to 10:15 AM	Welcome Session (Registration and grouping) (Room T1006)	Head of Department
10:15 AM to 11:00 AM	Departmental Tour	All technicians
11:00 AM to 12:00 PM	Introduction to Lab Safety - by BU Safety Unit (Part 1) (Oen Hall E1017)	Thomas Tse (EHSU)
12:00 PM to 12:15 PM	Use of Fume Cupboard - by Biology Dept (Room T1006)	WK Ip
12:15 PM to 2:00 PM	Lunch Time	
2:00 PM to 2:30 PM	Introduction to Lab Safety - by Biology Dept (Part 2) (Room T1006) (Safe use of Bunsen burner; Oven, Flammable Liquid, Corrosive Chemicals and Heat Generating Instrument)	WK Ip
2:30 PM to 3:00 PM	Basic animal dissection technique (Room T1006)	KW Chan
3:00 PM to 3:15 PM	Break	
3:15 PM to 4:15 PM	Use of Pipetter; hot plates, balance, centrifuge & pH meter (Rooms T1006 & T1008)	Louise Ng, LY Man, KW Chan & CK Leung
4:15 PM to 4:30 PM	Review and Feedback Session (Rooms T1006 & T1008)	All Technicians

Time	Day Two	Staff In-charge
10:00 AM to 11:00 AM	Use of Microscope, basic plant sectioning technique & wet-mount technique (Rooms T1006 & T1008)	Olivia Chau & Louise Ng
11:00 AM to 11:15 AM	Break	
11:15 AM to 12:15 PM	Biological Drawing Technique and Lab Report Writing Skill (Part 1) (Room T1006)	Olivia Chau & CK Leung
12:15 PM to 2:00 PM	Lunch Time	
2:00 PM to 2:30 PM	Lab Report Writing Skill (Part 2) (Room T1006)	Olivia Chau & CK Leung
2:30 PM to 3:00 PM	Demonstration of advanced development in Biology (Part 1) (Room T1109) (Gel Electrophoresis)	Fiona Luong
3:00 PM to 3:15 PM	Break	
3:15 PM to 4:15 PM	Demonstration of advanced development in Biology (Part 2) (Rooms T1101 & T1118) (Real-Time PCR & Flow Cytometer)	Fiona Luong & LY Man
4:15 PM to 4:30 PM	Review and Feedback Session (Rooms T1107 & T1109)	All Technicians
Time	Day Three	Staff In-charge
10:00 AM to 11:45 AM	Demonstration of advanced development in Biology (Part 3) (Rooms T1006A, T1011 & T1110) (Confocal Laser Microscope, Atomic Absorption Spectrometer & Gas Chromatography System)	LY Man, KK Ma & KW Chan
11:45 AM to 12:00 PM	Break	
12:00 PM to 12:30 PM	Review, Feedback and Assessment Session (Rooms T1006 & T1008)	All Technicians
12:30 PM to 1:30 PM	Lunch Time	
1:30 PM to 5:30 PM	Field Trip (Mai Po Nature Reserve)	KK Ma

To monitor the effectiveness of the project, students and demonstrators were asked to fill in assessment forms (see attached copy of the questionnaires in Appendix) to evaluate the usefulness of the project. The assessment was conducted at three levels during the course of the project:

1. Student evaluation at the end of the training.
2. Student evaluation after they have taken laboratory courses for one semester.
3. Demonstrator evaluation of the cohort, who had completed the training, after taken laboratory courses for one semester.

In the first evaluation, the background of the students and their views of the training course were summarised. This helped evaluate whether it was necessary to continue giving pre-university training to the students. Also, information was collected to improve the content of the training course.

In the second evaluation, students having completed the training were asked of their views of the workshop.

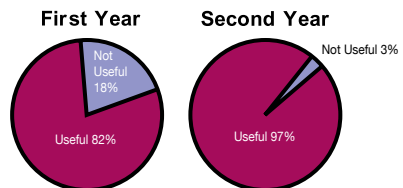
Finally, demonstrators, who had been teaching the same laboratory course for many years, shared their views on the quality of the students who had taken the training course prior to entering the laboratory.

Results/Findings

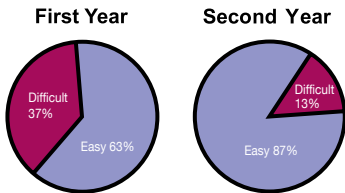
In order to acquire more data for analysis and evaluation, the workshop was organised twice for two different groups of freshmen in two consecutive years. Two copies of questionnaire for practical class demonstrators and year-one students were issued and collected in both years' Bridging Workshops in order to review and assess the helpfulness and usefulness of the workshop in improving the learning performance of year-one students in practical classes and reducing the difficulty in teaching year-one students with low proficiency in laboratory technical skills. After analysing the questionnaires, conclusions of the outcomes of this project are illustrated in the following paragraphs.

Evaluation and Feedback from Students on the Workshop before the Semester

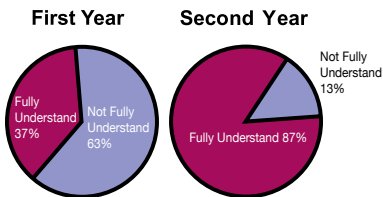
1. 82 % and 97% of students, in the two consecutive years, reported that the workshop was useful and helpful to them. The workshop not only provided them with some basic concepts of the equipment and technology, but also enabled them to adapt to the laboratory environment and made them feel more comfortable with the laboratory before the class began.



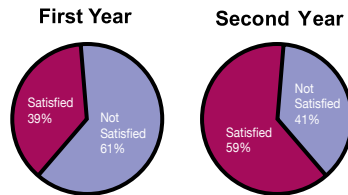
2. Over 30% of students found that the contents of some training topics in the workshop were difficult to understand in the first year. The topics were mainly about the theory and application of the advanced instruments used in biological science. The second difficulty was that the majority of our training materials and technical terms were delivered in English. This may be a great barrier for students coming from Chinese-Medium School. After re-designing the contents of some difficult topics and using more Chinese technical terms, only 13% of the freshmen had difficulty in understanding in our workshop organised in the second year.



3. After re-designing the contents of some training topics in the second year, the percentage of students who fully understood the presentation raised from 37% to 87%.

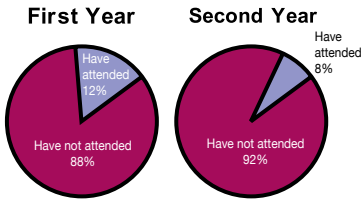


4. In the first year, only 39% of the students were satisfied with the duration of the workshop. They expressed that the duration of some topics was too long but the duration of some other topics was too short. After reviewing their feedback, it was found that there was not enough time for them to follow the contents of some topics, such as learning the theory of advanced instruments and practicing the use of some laboratory equipment. Some freshmen complained that they spent a long time on waiting for trying the instruments. In order to tackle these problems, we re-adjusted the duration of some training topics and provided more instruments for them in order to cut down their waiting time in the workshop held in the following year. Thus, after making such improvement, the percentage of students who found the duration of workshop suitable increased to nearly 60% in the second year.

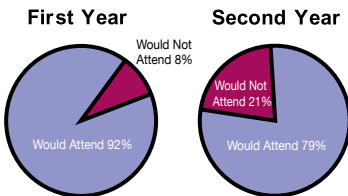


5. According to their feedback, the majority of them (around 90% in both years) had not attended this kind of workshop before. That was why they felt difficult in understanding some

training topics such as the use of some common laboratory instruments (e.g. pipette and pH meter) as well as learning the theory and application of the advanced instruments. This implied that there was a great need for our Department to continue offering this kind of training workshop to the freshmen in the future.

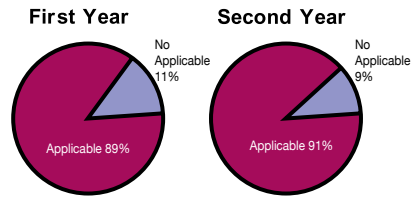


6. Finally, over 90% and about 79% of the students in the first and second years replied that they would attend another workshop at a “higher level” if we were going to organise and offer it in the future. This information was a clear indication that the workshop not only offered a good training to the freshmen in smoothly transiting from secondary school to university, but also stimulated and enhanced their interest in exploring the knowledge and new development in biological science.

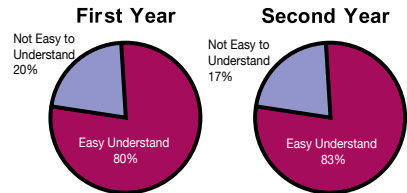


Evaluation and Feedback from Students after the Semesters

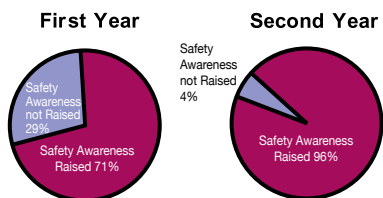
- About 90% of the students attending both years' workshops found that the skills and knowledge acquired from the workshop were applicable in the year-one lab class, e.g. the use of pipette, hot plate, balance, centrifuge, pH meter, microscope, plant sectioning and wet-mount technique, biological drawing technique, lab report writing skill, etc.



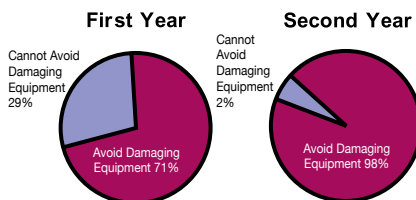
- Over 80% of students found that the lab classes were easier to understand after attending the workshop in both years, such as using microscope, learning gel electrophoresis and flow cytometer.



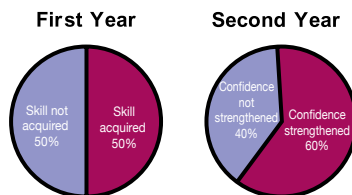
3. The percentage of students thinking that the workshop could raise their awareness of laboratory safety when carrying out experiments increased from 70% to 96% in the second year compared to that in the first year, particularly when (1) using Bunsen burner, oven, centrifuge and hot plate, and (2) handling flammable liquid, corrosive chemicals and toxic chemicals. During lab class, using fume cupboard and wearing personal protective equipment (e.g. gloves and glasses) became their normal practice when handling dangerous chemicals.



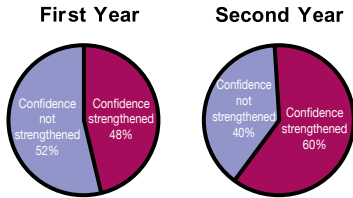
4. In the first year, about 70% of the students found the workshop was useful in avoiding damaging the delicate laboratory equipment during practical class, e.g. pipette, balance, centrifuge, pH meter and microscope. In the second year, over 90% of the students had the same feedback that the workshop could teach them how to avoid damaging delicate equipment in their year-one lab class.



5. However, half the students (50%) in the second year commented the workshop was not helpful for them to acquire the skill of getting accurate experimental results in practical class, even though the percentage dropped down to 36% in the following year. It could be considered as a weakness of the workshop.



6. In the first year, over 50% of the students said that the workshop did not increase their confidence in solving problems encountered in the lab class, especially in (1) interpretation of experimental results, (2) finding experimental error, and (3) drawing conclusions on the results. The percentage of students who did not feel more confident decreased to 40% in the second year.



7. Apart from the above feedback, the students expressed that the following topics of the workshop were very useful in the year-one lab classes, but not detailed enough:

- calibration and use of pH meter;
- use of centrifuge,
- use of Bunsen burner;
- use of pipette,
- skill of gel electrophoresis,
- biological drawing and plant sectioning technique,
- lab report writing skills, especially in the area of experiment result and discussion,
- use of microscope (apart from bright field), and
- the principle of flow cytometer and real-time PCR.

8. Moreover, some students recommended the topics or lab skills listed below should be included in future workshop or training course:

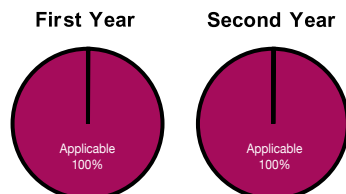
- dissection technique,
- problem solving skills,
- technique of getting accurate experimental results,
- techniques of plotting graphs,
- field trip sampling techniques,

- result interpretation,
- lab techniques in microbiology, such as serial dilution, disposal of used pipette and agar plates, aseptic transfer of bacteria, Gram stain, sterilisation, using oil immersion lens and cell counter as well as the examination of water sample.

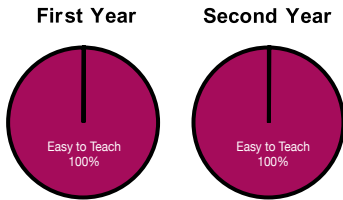
Evaluation and Feedback from Demonstrators after the Semesters

The following paragraphs describe the experience of and feedback from the demonstrators after teaching the practical classes involving students who had attended the Bridging Workshop. The practical classes monitored for enhancement on teaching and learning in the two consecutive academic years were *Cell Biology, Microbiology, Plant Diversity, Animal Diversity, Biodiversity, Field Biology, Genetics, Animal Physiology and Plant Physiology*.

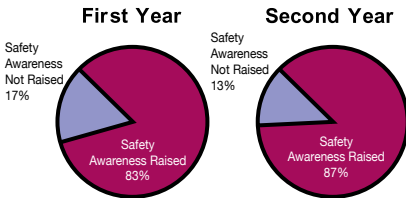
1. All demonstrators found that the students could apply the skills and knowledge acquired from the workshop during the semester, e.g. using pipette, pH meter; microscope and animal dissection tools as well as performing biological drawing.



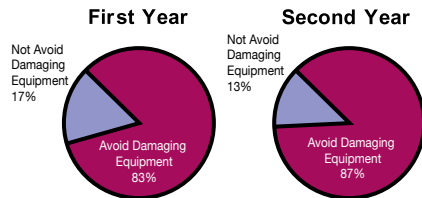
2. Moreover, all demonstrators found that the students understood the lab briefing and demonstration to a greater extent than before and thus the practical classes were easier to teach, particularly in some advanced topics such as serum protein gel electrophoresis and flow cytometer.



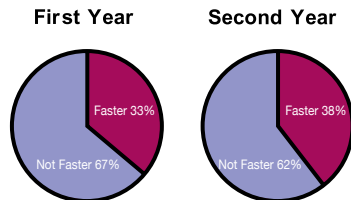
3. Over 80% of the demonstrators in both years realised that the workshop could raise the students' awareness of laboratory safety when carrying out experiments since the number of accidents and seriousness of injury during lab classes were lower than that before, such as injury caused by spillage of acid into eye, Bunsen burner and corrosive chemicals.



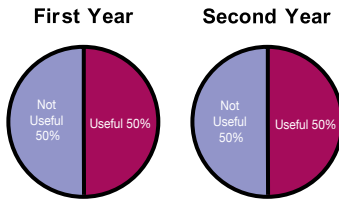
4. Similarly, over 80% of our demonstrators found the two years' workshops were useful in teaching the students using and handling the delicate equipment properly so as to avoid damaging the equipment in classes. For instance, the occurrence of cracking the glass slides and scratching the microscope lens decreased in the past two years.



5. Nevertheless, over 60% of the demonstrators in both years realised that even though the students had attended the workshop before, they could not complete the experiments faster than those not attending the workshop in previous years. Yet the demonstrators admitted that the students had already acquired the lab techniques and made fewer mistakes than before.



6. Although the students had already attended the training courses, half of our demonstrators (i.e. 50%) in both years found that the students could not get accurate experimental results during their practical classes. In other words, they could not correctly and accurately measure and interpret the experiment results.



Discussion

Among the feedback from the students mentioned above, some topics of the workshop training were very useful in the year-one lab classes, but the explanations were not detailed enough, such as (1) calibration and use of pH meter; (2) use of centrifuge; (3) use of Bunsen burner; (4) use of pipette; (5) skill of gel electrophoresis; (6) biological drawing and plant sectioning technique; (7) lab report writing skill, especially in the area of result and discussion; (8) use of microscope (including the oil immersion lens); (9) the principle of flow cytometer and real-time PCR; (10) dissection technique; (11) techniques of measuring accurate experimental results; (12) field trip sampling techniques and (13) lab techniques in microbiology (e.g. serial dilution). We should reserve the first lab

lesson for each course to cover the above topics at the beginning of each semester.

Apart from the above feedback, some students also recommended the following topics to be included in our future workshop or training course. They were (1) problem solving skills, (2) techniques of plotting graphs, and (3) result interpretation/data analysis. This recommendation from students was supported by their feedback shown in the questionnaire given to them after the semester as about 50% of them found our workshop could not help them to get accurate experimental results and did not strengthen their confidence in solving problems encountered in the lab classes. Similarly, only 50% of our demonstrators pointed out that the students could not correctly and accurately measure and interpret the experiment results. Therefore, there was a need of improvement to be made in the future bridging workshop which should devote some time to delivering the skills of problem solving, experimental result measurement, results presentation, interpretation and analysis. However, if the schedule of the bridging workshop was very tight, we could include these topics in the first lab sessions (i.e. briefing session) of some practical classes.

Nevertheless, about two-thirds (i.e. 66%) of the demonstrators found that the workshop training could not help the students to complete the experiments earlier even though the students were able to apply the lab skills they had learnt in the

workshop before. It was because (1) some students needed to repeat the experiments which were interrupted by mistakes and (2) they spent a lot of time on reading the lab manual procedure during lab class before starting the experiments. These might be caused by their insufficient preparation work and carelessness.

Enhancement on Teaching and Learning

The proposed three-day workshop was tailor-made for year-one students, aiming to give them a general exposure and an overview on the practical skills required for their three-year BSc programme. The workshop was delivered via various teaching formats, e.g. demonstrations, field trips, hands-on experience etc. Using an interactive approach helped to arouse students' interest, hence speeding up the process of mastering the skills required. The value of the workshop could not be underestimated. Students and demonstrators also gained substantial benefits. This workshop could be used as an introductory course for students to acquire a higher level of skills required for university education. Demonstrators, on the other hand, were able to relieve their time from teaching basic lab skills, experimental procedures and safety issues; hence improving the quality of teaching and learning. For example, the demonstrators had much more time to discuss with students the experimental results interpretation, presentation and analysis, and to solve the problems encountered during the lab classes. The

workshop could also be incorporated into a routine orientation programme hosted by the Department to increase the communication and interaction between students and teachers. As no other workshop of similar nature existed at that time, this workshop provided long term benefits and prepared students to become life-long learners in the biological science field.

Limitation/Difficulties

When organising the Bridging Workshop, it was difficult to find a suitable time slot to hold the workshop for all the freshmen as they might engage in other orientation activities (e.g. O-Camp, O-Day), bridging workshops organised by other departments (e.g. English training course and IT training course) and so on.

Since our workshop was delivered to the students at the beginning of the first semester, another difficulty was that they might forget most lab skills and knowledge after the semester. Therefore, it might be better to split our training workshop into two parts and offer them at the beginning of each semester in the first year.

Conclusion

In summary, the Bridging Workshop served its function by providing a brief introduction of common laboratory equipment and safety to the freshmen as some apparatus and equipment were seldom used in secondary schools but were commonly used in the practical classes of university undergraduate teaching, such as pipettes

and pH meters. This could surely help the students to understand the practical classes easily and perform the experiments in a proper and safe way. On the other hand, it shortened the briefing time used by the demonstrators during lab sessions. Moreover, the lab safety briefing was able to raise the students' awareness of laboratory safety as required by our Department and the University.

Since students coming from various secondary schools might have different levels of technical skills, one of the aims of the workshop was to help all freshmen to gain the same level of basic skills required for further studies in Biology, such as the proper use of microscopes and basic plant and animal sectioning techniques.

Furthermore, demonstration of advanced instruments in biological science could arouse the interest and curiosity of freshmen in studying Biology.

Appendixes:

Appendix A1-4: Questionnaires for students and demonstrators

Appendix B: Photos of the Bridging Workshop



DEPARTMENT OF BIOLOGY

Bridging Workshop on Practical Skills for Year-one Biology Students
(First Year)
Questionnaire

(1) Is the workshop useful for you?

Not Useful

1	2	3	4	5
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 Very Useful

(2) Did you find the level of Biology introduced in this workshop difficult?

Easy

1	2	3	4	5
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 Difficult

(3) Did you understand the presentations given?

Not Understand

1	2	3	4	5
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 Fully Understand

(4) Did you find the duration of the workshop suitable?

Not Satisfy

1	2	3	4	5
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 Very Satisfy

(5) Have you attended this kind of workshop before?

Yes	No
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(Remarks: delete the answer where not appropriate)

(6) If we organise another “advanced level” workshop, would you like to attend?

Yes	No
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(Remarks: delete the answer where not appropriate)

(7) Which topic(s) in the workshop puzzle you and need further elaboration?

(8) Which part of the workshop did you find most enjoyable?

(9) Do you recommend any other topics/aspects to be included in future workshop?

(10) Please give your overall comment on this workshop.



DEPARTMENT OF BIOLOGY
Bridging Workshop on Practical Skills for Year-one Biology Students
(Second Year)
Questionnaire

Please answer the following questions and put a "√" in the appropriate box.

(1) Is the workshop useful for you?

Not Useful

-10	-5	0	5	10
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 Very Useful

(2) How did you find the topics covered in this workshop?

Difficult

-10	-5	0	5	10
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 Easy

(3) Did you understand the presentations given?

Not Understand

-10	-5	0	5	10
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 Fully Understand

(4) (a) Did you find the duration of the workshop suitable?

Not Suitable

-10	-5	0	5	10
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 Suitable

(b) If your answer is "Not Suitable", it is because the workshop duration was

Too Short	Too Long
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(5) (a) Would you prefer more in-depth topics for this workshop?

Yes	No
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(b) If your answer is "Yes", please state one (or more) topic you prefer to be elaborated in depth.

(6) Have you attended this kind of workshop before?

Yes	No
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(7) If we give another "advanced level" workshop, would you like to attend?

Yes	No
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(8) Which topic(s) of the workshop puzzle you and need further elaboration?

(9) Which part of the workshop did you find most enjoyable?

(10) Do you recommend any other topics/aspects to be included in this workshop next year?

(11) Please give your overall comment on this workshop.



DEPARTMENT OF BIOLOGY

Bridging Workshop on Practical Skills for Year-one Biology Students

Questionnaire for Practical Class Demonstrators

- (1) Did the students complete the experiments in shorter time compared with those students from previous years after taking the workshop?

(Remarks: delete the answer where not appropriate)

Yes	No
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- (2) Did the students apply the skills and knowledge acquired from the workshop during the semester?

Not Applicable

1	2	3	4	5
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 Very Applicable

- (3) Did you find the lab classes easier to teach because of the workshop?

(Remarks: delete the answer where not appropriate)

Yes	No
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- (4) Did the workshop raise the students' awareness of laboratory safety when carrying out experiments?

(Remarks: delete the answer where not appropriate)

Yes	No
-----	----

- (5) Did you find the workshop useful in avoiding damaging the laboratory equipment?

(Remarks: delete the answer where not appropriate)

Yes	No
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- (6) Did you find the workshop useful for the students in acquiring more accurate results from the experiments?

(Remarks: delete the answer where not appropriate)

Yes	No
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The End



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Bridging Workshop on Practical Skills for Year-one Biology Students

Questionnaire given to students after 1st Semester

- (1) Did you find the skills and knowledge acquired from the workshop applicable in the lab class of this semester? (e.g. Use of Pipetter, hot plates, balance, centrifuge, pH meter, microscope, plant sectioning and wet-mount technique, biological drawing technique, lab report writing skill, etc.)

(Remarks: put a "√" in the appropriate box)

Not Applicable

1	2	3	4	5
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 Very Applicable

- (2) Did you find the lab classes easier to understand because of the workshop?
(e.g. Use of microscope, learning gel electrophoresis and flow cytometer, etc.)

Yes	No
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(Remarks: delete the answer where not appropriate)

- (3) Did the workshop raise your awareness of laboratory safety when carrying out experiments? (e.g. (1) Use of Bunsen burner, oven, centrifuge and hot plate, (2) Handling flammable liquid as well as (3) Using fume cupboard and wearing personal protective equipment such as gloves when handling corrosive/toxic chemicals)

Yes	No
-----	----

(Remarks: delete the answer where not appropriate)

- (4) Did you find the workshop useful in avoiding damaging the laboratory equipment?
(e.g. Use of Pipetter, balance, centrifuge, pH meter and microscope)

Yes	No
-----	----

(Remarks: delete the answer where not appropriate)

- (5) Did you find the workshop useful in acquiring more accurate results from the experiments?

Yes	No
-----	----

(Remarks: delete the answer where not appropriate)

- (6) After attending the workshop, have your confidence in solving problems encountered in the lab class been strengthened?
(e.g. Interpretation of experiment results, find out experimental error and conclusion of results)

Yes	No
-----	----

(Remarks: delete the answer where not appropriate)

- (7) Which topic(s) of the workshop you found very useful in the first semester lab class but not detailed enough?

- (8) Do you recommend any other topics/lab skills to be included in future workshop?

Appendix B: Photos of the Bridging Workshop

Day One



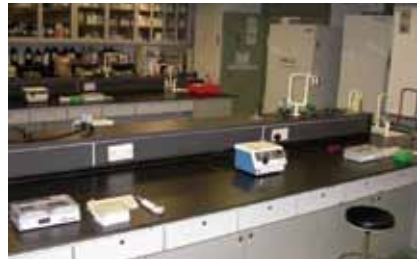
Day One



Day Two



Day Two



Day Two



Day Three



Day Three



Day Three - Field Trip

