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Problem-based learning for Diploma Yi Jin students in pouring dental stone models

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Abstract

The government of Hong Kong has put much support in the training of dental care providers for high quality dental services. We designed a quality framework (QF) level 3 elective course in Diploma Yi Jin namely Basic Knowledge in Dental Sciences and Health Care to train students who would like to join the dental field. One teaching unit in casting dental stone model of Fixed and Removable Prosthodontics used the problem-based learning (PBL) task. PBL has been applied to many fields of study and training, it is different from the traditional learning methods with facilitating learning, and group discussions assisted by facilitators. PBL undeniably requires students to have certain knowledge to search for proper information. PBL also offers a peer group or cooperation study.

After several practice in groups of pouring dental stone and peer discussion, we provide students with feedback from us showing their strengths and weaknesses in the whole procedure. By applying of PBL research type to produce a dental stone model from an impression trains the students the proper technique as required in clinical dental uses. This is a fundamental practical skill for a dental assistant in any dental clinics of Hong Kong.

Keywords: Dental Sciences; Problem-Based Learning; Dental Stone; Students-Centred Learning; Dental Model

1. Introduction

Many developed countries have built up a good dental healthcare system to provide dental health services to their citizens (WHO, 2011) and Hong Kong is no exception. However, many people still lack adequate dental care due to shortage of trained staff in dental health services (Food and Health Bureau 2010, 2018; Guay, 2004; Lee, Kim, Albert and Nelson, 2014). The government of Hong Kong has put much support in the training of dental care providers for high quality dental services (Food and Health Bureau, 2010, 2018; Hong Kong Year Book, 2018). Therefore, we designed a quality framework (QF) level 3 elective course in Diploma Yi Jin namely Basic Knowledge in Dental Sciences and Health Care which comprises "Basic Dental Sciences and Common Diseases" to train students who would like to join the dental field. This course provides the basic dental chair-side knowledge and skills to assist dentists. The Basic Dental Sciences and Common Diseases introduces the routine duties of dental assistants, the student should learn how to arrange the dental chair side work station; sterilize and prepare instruments; interpret the patient's dental records. The above course contains a total of 15 units, each consists of two lessons which are 2-3 hours.

We designed one teaching unit in casting dental stone model of Fixed and Removable Prosthodontics as this problem-based learning (PBL) task. This task will make use of a PBL research type to conduct experiments (Chan, 2019, Session 3 and4; Colliver, 2000). PBL has been applied to many fields of study and training, it is different from the traditional learning methods with facilitating learning, and group discussions assisted by facilitators. The teaching role as a teacher is replaced by a facilitator to allow students-centred learning making it more fun (Chan, 2019, Session 1-7; Colliver, 2000; David, 2014; Gallagher, Stepien and Rosenthal, 1992; Dolmans, De Grave, Wolfhagen and Van Der Vleuten, 2005;

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Duch, Groh and Allen, 2001). PBL undeniably requires students to have certain knowledge to search for proper information. The questions are set to be an open format, providing them with unlimited directions for debates and more ways of the thoughts so more information will be gathered. The solutions for PBL problem should not set correct or wrong answer in fixed situation. Most PBL questions aim to mimic the situation of daily life so that the students may learn the skills and apply this to their job (Chan, 2019, Session 1-7; Colliver, 2000; David, 2014; Gallagher *et al*., 1992; Dolmans *et al*., 2005; Duch *et al.*, 2001). It encourages the students to study the facts more distinctly when facing real life situation. PBL offers a peer group or cooperation study (Chan, 2006, 2014). The learners are trained on their communication skills and perceptive discussions enhance their social skills (Chan, 2019, Session 1-7; Colliver, 2000; David, 2014; Gallagher *et al*., 1992; Dolmans *et al*., 2005; Duch *et al.*, 2001).

A dental impression is a negative imprint of teeth and periodontal tissues for a positive reproduction (dental stone model) to be made. After impression taking, dental stone models are casted for diagnosis and treatment planning in prosthodontics (such as making crown or dentures), orthodontic (Bonsor and Pearson, 2012; Hyde *et al*., 2013; Flügge, Schlager, Nelson, Nahles and Metzger, 2013).

Why use PBL in casting stone (plaster) from dental impression? When the dental model was made, the problem of air bubbles would always appear in the teeth (Figure 1) or periodontal area because of inappropriate mixture of powder and water and if vibrator is not used to remove air bubbles from the mixture (Bonsor and Pearson, 2012; Hyde *et al*., 2013; Flügge *et al*., 2013). The bubbles may cause model to become weak, if these are located in fitting area of teeth or soft tissue it may cause failure to fit the crown or denture to abutment teeth or tissue. As a result, patients may feel pain wearing the crown or denture as they are unstable. Unfitted crown or denture may lead to temporomandibular joint disorder (Burhenne, 2019; Marquezan, and Figueiró, 2017; Watamoto *et al*., 2008).

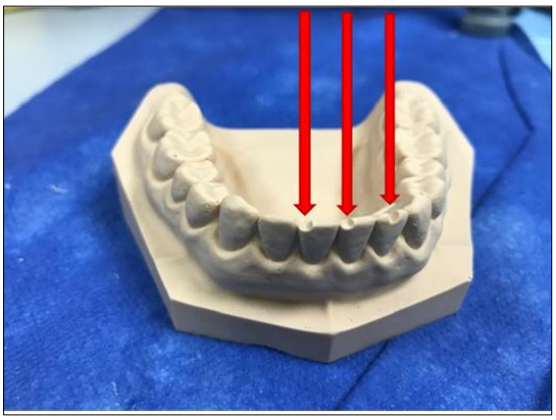


Figure 1 Bubbles on the cutting edges of teeth

When students graduate from our course some of them will start working in dental clinics, pouring dental stone from impression is one of common procedures as a dental assistant. Therefore, the students need to practice much more in order to be skillful in pouring dental stone into impression bubble-less for a better dental model.

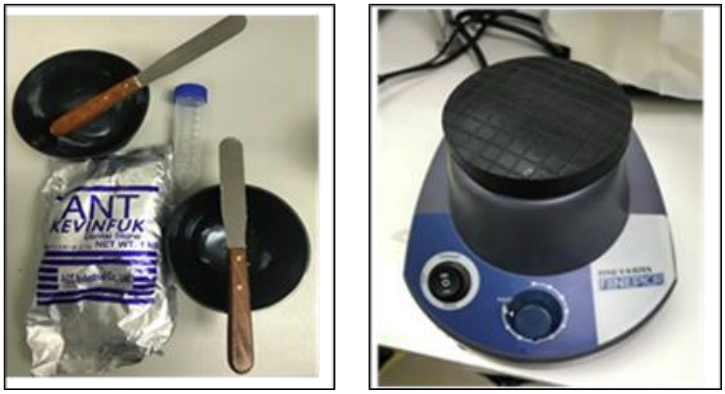
In this research type PBL, only a pilot study (experiment) can be set due to the small-scale sample size. Its advantages are feasibility, shorter period of time, less cost, controllable and it is always applied prior to a full-scale study (Thabane, 2010), without control group. The research questions will be set as follows:

- What are the characteristics of different dental stones (plasters)?
- How to prevent the air bubbles in dental model?
- How to evaluate a casted dental model?

After a brief lecture, the students will be divided into 4 groups each with 3 members, the group leader will be elected by members. We encourage cooperative learning method and heterogenous grouping. We understand that the character of every student needs to be taken into account to properly assign them into groups so that they can help each other out. Heterogeneous grouping would help more passive and self-contained students, every student has different abilities as well as different educational and emotional needs (Chan, 2018, Session 5; Zamani, 2016). 3-4 student are grouped to learning and discuss together, they could help each other out. Cooperative learning group enhances their achievement

in study and increases their understanding of the content thereby strengthening their self-esteem (Chan, 2014; 2018, Session 5; Johnson and Johnson, 2008; Johnson and Johnson, 2011; Zamani, 2016).

The questions and standard procedures will be given to them, they will then discuss and practice. We will prepare the plastic mould instead of clinically used alginate impression, this mould can be used repeatedly and is similar to real impression. The materials required include: dental stone powder, plastic mould, plastic bowl, spatula and vibrator (Figure 2 A-B).



A B

Figure 2 A-B Dental stone powder, plastic mould, plastic bowl, spatula and vibrator

Although the whole procedure will be demonstrated (Figure 3 A-E), they may not remember all steps so video clips from YouTube will be introduced to strengthen their memory (School of Dentistry, University Michigan 2009).

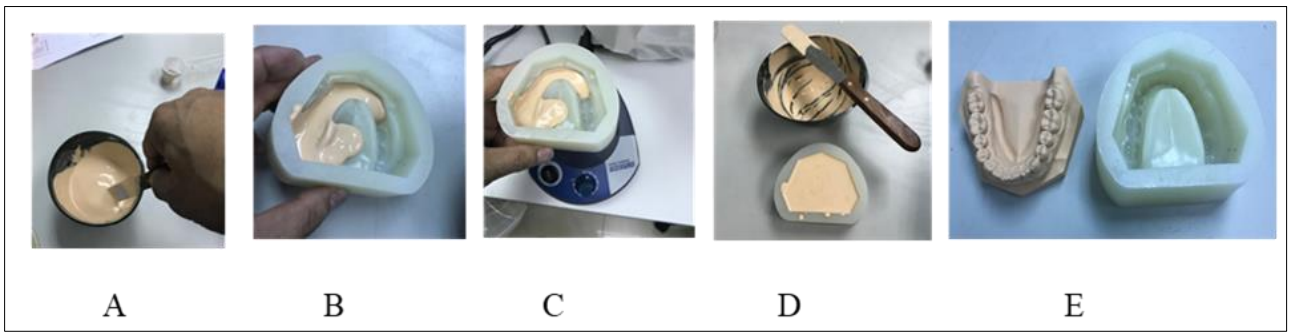
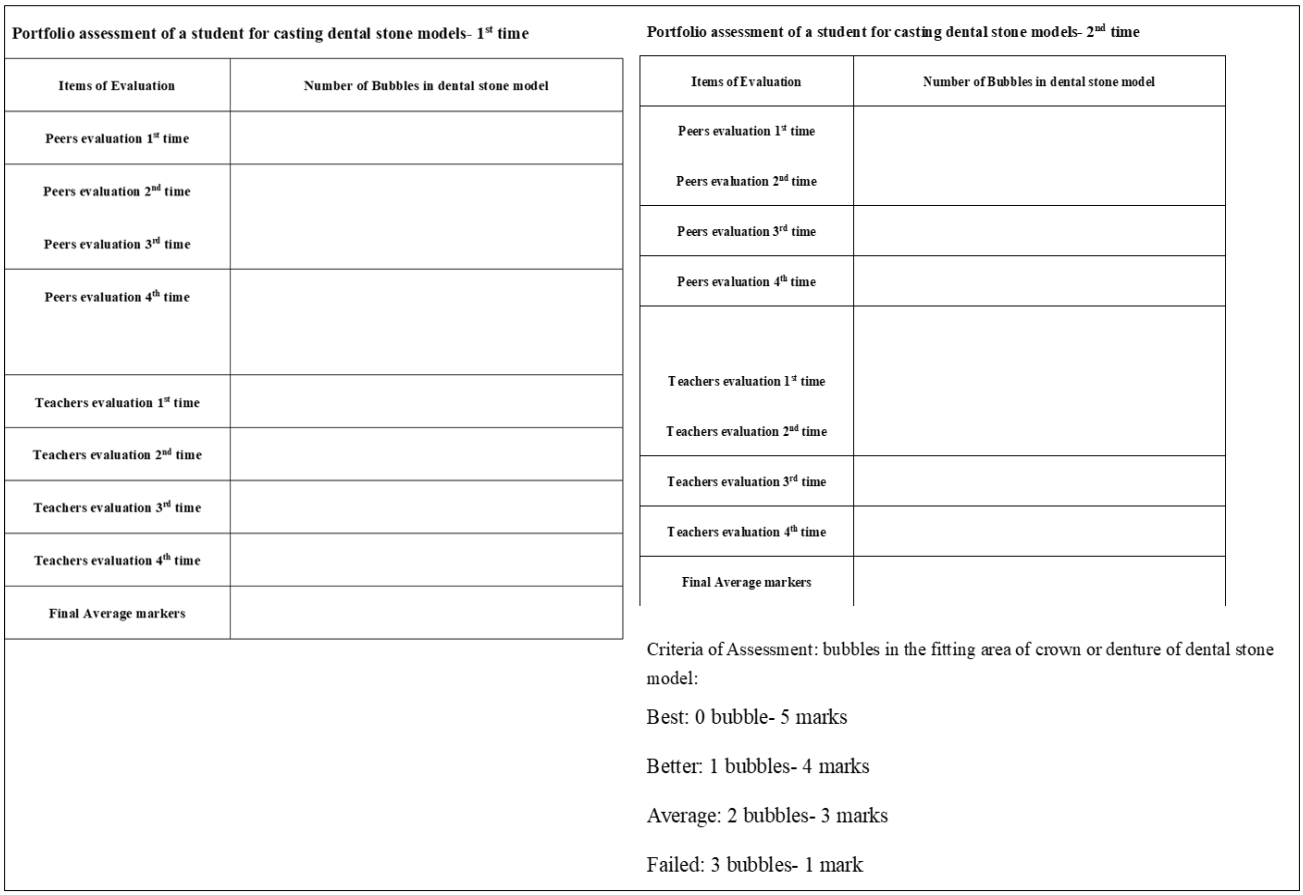


Figure 3 A-E General procedures of dental stone model casting

After several practice in groups and peer discussion, there will be 4 times of pouring dental stone in each class for every student, the practicals will be repeated 4 times the following week. A total of 8 stone models will be casted, group members (peer) and teacher will give the marks to the models according to the evaluation charts (Figure 4). Peer evaluation allows student to observe during practice. They learn how to conduct meetings in groups and share experiences to solve problems (Hui, 2019, Class 8, Lo, 2008). By observed others, students will learn to appreciate and comment their group members' work based on the set criteria, they will also learn to fairly judge peer's work (Hui, 2019, Class 8, Lo, 2008) (Figure 4). We will provide students with feedback from us showing their strengths and weaknesses in the whole procedure. The feedback will hopefully improve their performance and refresh the students' mind in the future (Hui, 2019, class 9, Lo, 2008). We will help the students to set up a portfolio to records their progress. Portfolio assessment is an authentical work of a student, it should include all collection of their work together with the standard required from them. This collection of work is often gathered over a long period of time to reflect what students have been taught as well as what students have learned. The portfolio may be used to show progress over time, it may also be used to promote a student's abilities, and to evaluate a student's learning within a specific course (Hui, 2019, class 9, Lo, 2008).



Portfolio assessment of a student for casting dental stone models- 1st time

Items of Evaluation	Number of Bubbles in dental stone model
Peers evaluation 1st time	
Peers evaluation 2nd time Peers evaluation 3rd time	
Peers evaluation 4th time	
Teachers evaluation 1st time	
Teachers evaluation 2nd time	
Teachers evaluation 3rd time	
Teachers evaluation 4th time	
Final Average markers	

Portfolio assessment of a student for casting dental stone models- 2nd time

Items of Evaluation	Number of Bubbles in dental stone model
Peers evaluation 1st time Peers evaluation 2nd time	
Peers evaluation 3rd time	
Peers evaluation 4th time	
Teachers evaluation 1st time Teachers evaluation 2nd time	
Teachers evaluation 3rd time	
Teachers evaluation 4th time	
Final Average markers	

Criteria of Assessment: bubbles in the fitting area of crown or denture of dental stone model:

Best: 0 bubble- 5 marks

Better: 1 bubbles- 4 marks

Average: 2 bubbles- 3 marks

Failed: 3 bubbles- 1 mark

Figure 4 The evaluation charts and marking criteria

2. Conclusion

Application of PBL research type to produce a dental stone model from an impression trains the students the proper technique as required in clinical dental uses. This is a fundamental practical skill for a dental assistant in any clinics.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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