Program Innovation

Prosthodontic Olympics: Gaming to Aid Students Gain Proficiency

Robert W. Loney, D.M.D., M.S.; H. Joseph Murphy, Ed.D.; Victor J. Miller, Bch.D., M.S.

Dr. Loney is Professor, Dept. of Dental Clinical Sciences, Faculty of Dentistry, Dalhousie University; Dr. Murphy is Associate Professor, Dept. of Dental Clinical Sciences, Faculty of Dentistry, Dalhousie University; and Dr. Miller is Senior Lecturer, Department of Restorative Dentistry, School of Oral Health Sciences, University of the Witwatersrand, Johannesburg, South Africa. Direct correspondence to Dr. Robert W. Loney, Department of Dental Clinical Sciences, Faculty of Dentistry, Dalhousie University, Halifax, NS, CANADA B3H 3J5; 902-494-7179 phone; 902-494-1662 fax; rloney@is.dal.ca e-mail.

Key words: prosthodontics, game theory, games, experimental games, teaching methods, dental education, human learning

Submitted 9/20/99, returned for revision 11/10/99, accepted 12/13/99

The recent increase in emphasis on competencies in dental education[1,2] has served to reinforce the importance of emphasizing the quality and not simply the quantity of work completed by dental students in both preclinical and clinical situations. While this emphasis on competencies helps ensure that beginning dentists will be safe practitioners, there is a need to assist dental students to perform routine procedures in an efficient, timely manner. When the emphasis in learning shifts from quality to quantity, as students progress from competency to proficiency, it is appropriate to employ educational approaches that will be more suited to the latter than the former.

The advantages and disadvantages of using games in the clinical setting as an aid to teaching have been described by de la Cour.[3] She emphasized that games focus on feedback and practice, not simply on information processing. Additionally, she has emphasized that, to be successful, educational games must adhere to six principles. Games should i) include a competitive element and a clear set of rules; ii) be very attractive to the learner; iii) be modeled after existing, well-established games; iv) include activities that are purposeful and useful; v) provide evaluation and feedback on performance; and vi) be fun. Basford and Downie[4] have described the motivational qualities of games and how games can be used to develop teamwork and support in a group. Walljasper[5] claimed that games make learning fun, rather than a chore to be endured, and Crancer and Mavry-Hess[6] stated that a game allows students to test their knowledge in a non-threatening environment. Others[7,8] have argued that games and simulations allow participants to apply theory, comprehension, skills, and experiences to everyday work situations.

The purpose of this study was to assess the ability of an educational game, "The Prosthodontic Olympics," to improve the speed of dental students in their performance of a selected laboratory procedure.

Event

The Prosthodontic Olympics consists of six events: i) custom tray fabrication; ii) irreversible hydrocolloid impressions; iii) clinical remount of complete dentures; iv) boxing final impressions; v) crown preparations; and vi) setting denture teeth. Each student enters only one event. All procedures are performed on manikins or models, with the exception of the impression event, in which classmates participate as subjects. Students are randomly assigned to teams, chose team names, and make team costumes and banners for the day of the competition. Students are assigned a faculty mentor who provides feedback for several weeks prior to the Olympics, culminating in a formal, team practice session with faculty mentors, one week prior to the event.

Upon commencement of an event, all participating students work simultaneously. When a contestant has completed his or her event, the product is taken to a judge's table, where a time is assigned. After all participants have completed an event, the

judges (full- and part-time faculty) rank the products for quality from best to worst. Products that are deemed "unacceptable" are disqualified. A score is assigned for both speed and quality. The winner of each event is the student with the greatest cumulative score of quality and speed. In the event of a tie, the student with the highest score for quality wins the competition. The quality scoring criteria for the custom tray event are listed in Table 1. The scoring schema for events is provided in Table 2. First, second, and third place contestants receive donated prizes (dental equipment, materials, or books). A grand prize is awarded to the member with the highest score on the team with the best total score for the six events.

Evaluation

For the purposes of evaluating the effectiveness of the Prosthodontic Olympics on the quality and proficiency of student performance, sixteen third-year dental students participated in a pretest/posttest exercise that required them to make an acceptable edentulous custom tray as quickly as possible in a maximum time of twenty minutes. Normally only fourth- and fifth-year students participated in the Prosthodontic Olympics, but third-year students were used for this study, since they were unaware that they would be participating in the Olympics competition at the time when the pre-test was given (three weeks prior to the Olympics). Students had previously made an average of eight (range of five to twelve) custom trays in fixed or removable prosthodontics courses prior to the pretest. One week after the Prosthodontic Olympics, students were required to repeat the test. Times for all tests were recorded. All pretest and posttest custom trays were coded and rated on a 5-point scale for quality (0 = Unacceptable, 4 = Outstanding) by a blinded, calibrated examiner. Examiner reliability was tested prior to rating, by rating sixteen trays on two occasions and determining an intrarater reliability correlation coefficient (r = .768). A paired t-test was used to analyze the time data, and a Wilcoxon signed rank test was used for analyzing the quality data.

Pretest and posttest scores, means, and standard deviations are shown in Table 3. The mean time required to fabricate a custom tray in the posttest was slightly less than half the time in the pretest (8.9 and 18.9 minutes respectively), the difference being statistically significant ($p<.0001$). There was no statistically significant difference detected in the quality of the trays from the pretest and posttest as determined by the Wilcoxon signed rank test (N=12; NT=39; p=.9999).

Discussion

In this investigation, students had made an average of eight custom trays prior to the pretest. It might be expected that students who had made this number of custom trays would be relatively efficient at the procedure. It was not expected that the times for making custom trays would decrease by 50 percent. Times for other procedures were not studied and might not show as dramatic a change. Nonetheless, over ten years, students and faculty have consistently reported surprise at the improved times recorded for the related events.

Despite the emphasis on speed, the competition did not ignore the importance of quality in clinical procedures. While the original purpose of the Olympics was not to improve the quality of clinical products, all products in the competition had to be deemed "acceptable" to receive scores and be eligible for prizes. In addition, the value of the quality score always exceeded that of the speed score for same rank level (i.e., the best quality product received ten points, while the fastest score received nine points). Nine out of sixteen students had quality

Table 1. Criteria for evaluating Acrylic Custom Tray

___Tray not significantly underextended, close to proper extension
___Stable, does not rock on cast
___Uniform thickness (~ 3mm; wax relief not showing through tray)
___Wax relief extends to within 3mm of the base outline on cast
___Labial and buccal notches properly placed
___Small handle, properly positioned

Table 2. Scoring for the Prosthodontic Olympics

Quality		Speed	
Rank	Score	Rank	Score
Best	10	Fastest	9
2nd	9	2nd	8
3rd	8	3rd	7
4th	7	4th	6
5th	6	5th	5
6th	5	6th	4
etc.			

Table 3. Pretest and posttest times and grades for custom tray fabrication

	Time (minutes)		Grade (0-4)	
Student	Pretest	Posttest	Pretest	Posttest
1	19.3	8.5	2	1
2	20.1	8.6	2	1
3	19.5	9.3	1	3
4	18.6	8.3	1	2
5	18.3	11.3	3	2
6	20.0	6.2	3	1
7	20.0	8.0	1	1
8	19.4	8.1	0	2
9	19.3	6.2	1	1
10	20.1	12.1	4	4
11	20.1	10.3	1	3
12	16.1	10.6	0	1
13	18.1	9.1	2	2
14	17.2	9.2	2	3
15	15.6	6.2	3	1
16	20.1	10.4	2	0
Mean	18.9	8.9	1.8	1.8
Std. Dev.	1.5	1.8	1.1	1.1

scores that remained the same or improved in the posttest, while seven student products were rated lower than the pretest. It should be noted, however, that only two pretest and one posttest samples were rated as unacceptable. Some variation in quality scores may be attributable to both student variation and intra-rater variation.

The Prosthodontic Olympics also provided other educational benefits. The formal practice session with faculty mentors provided students with intensive, informal, formative feedback. During this practice session, it was not unusual for students to perform six or more repetitions of an event, in rapid succession, with immediate faculty feedback. Faculty were able to observe a number of students simultaneously during the practice and provide verbal feedback while students were performing their procedure. The use of full- and part-time faculty as judges provided an informal calibration opportunity, since faculty evaluating the products had to reach consensus on the ranking of the items submitted. While not a substitute for formal calibration, the Olympics provided an additional venue for calibration in an enjoyable learning environment.

While individuals compete against each other for prizes, teams are used to improve the spirit and competitive aspects of the Olympics. Since the grand prize is awarded to a member on the team with the best total score, participants tend to cheer for their teammates. In essence, teams help to maintain interest of students for events in which they are not entered. By helping to keep students watching others perform, students can learn aspects of proficiency in events that they have not entered. In an evaluation of the Olympics, all of the students in the present study answered that they "agree" or "strongly agree" with the statement that "I learned by watching others do events." Students have made verbal comments to instructors that they will change how they perform some clinical procedures after watching others perform in the Olympics.

The Prosthodontic Olympics satisfied de la Cour's six principles for successful educational games.[3] The Olympics had a competitive element and a clear set of rules, and they were modeled after an existing, well-established competition. They included activities that were purposeful and useful from a clinical viewpoint. Students received formative evaluation in the practice session and summative feedback through the ranking of products and distribution of prizes. De la Cour stated that games must be attractive to the learner and include an element of fun. This aspect of the Prosthodontics Olympics can be demonstrated in the following statement from a course evaluation: "My favourite day of the whole year was the Prosthodontic Olympics—it was great to achieve excellence in clinical dentistry."

The results of this study demonstrated that an educational gaming activity such as the Prosthodontic Olympics has the potential to improve the proficiency with which students perform clinical and laboratory procedures. Student feedback regarding the Prosthodontic Olympics has been extremely positive. Graduates have noted that they use procedures that they once thought were too time-intensive to use in private practice, because they realize that they can perform them with reasonable efficiency. Instructors have informally commented on increased efficiency in clinics for some of the event procedures. While the opportunity for faculty to observe each type of procedure subsequent to the games can vary, instructors have commented on an improved quality and efficiency of those procedures that they observe on a regular basis (e.g., making irreversible hydrocolloid impressions). Administrators have noted that the competition aids school spirit. Perhaps most importantly, the Prosthodontic Olympics provided an opportunity for students and faculty to have fun learning in an environment that does not sacrifice quality.

Acknowledgments

The authors would like to acknowledge Dr. Brien Lang of The University of Michigan for being the inspiration for the Prosthodontic Olympics; the Association of Canadian Faculties of Dentistry Teaching Institute for providing a creative environment that led to the idea of the Prosthodontic Olympics; and the College of Dentistry, University of Saskatchewan and Faculty of Dentistry, Dalhousie University for allowing the innovation to be tried and developed over the past ten years.

REFERENCES

1. Chambers DW. Toward a competency-based curriculum. J Dent Educ 1993;57:790-3.
2. Boyd MA, Gerrow JD, Chambers DW, Henderson BJ. Competencies for dental licensure in Canada. J Dent Educ 1996;60:842-6.
3. de la Cour J. Use of games in the clinical setting as an aid to teaching. British J Nursing 1994;3:70-4.
4. Basford P, Downie C. How to use gaming. Nurs Times 1990;86:59.
5. Walljasper P. Games with goals. Nurs Educator 1982;7: 15-8.
6. Crancer J, Mavry-Hess S. Games: an alternative to pedagogical instruction. J Nurs Educ 1980;19:42-52.
7. Wilson CC, Netting FE, Henderson SK. Gaming as a method for learning to resolve ethical dilemmas in long term care. Health Educ 1988;19:42-4.
8. Merchant HW, Morse PK. Games, a strategy for learning. J Dent Educ 1973;37:47-8.