

Distribution Statement

Distribution A: Public Release.

The views presented here are those of the author and are not to be construed as official or reflecting the views of the Uniformed Services University of the Health Sciences, the Department of Defense or the U.S. Government.



UNIFORMED SERVICES UNIVERSITY OF THE HEALTH SCIENCES

POSTGRADUATE DENTAL COLLEGE
SOUTHERN REGION OFFICE
2787 WINFIELD SCOTT ROAD, SUITE 220
JBSA FORT SAM HOUSTON, TEXAS 78234-7510
<https://www.usuhs.edu/pdc>



THESIS APPROVAL PAGE FOR MASTER OF SCIENCE IN ORAL BIOLOGY

Title of Thesis: "The Flipped Classroom in Orthodontic Residency Programs"

Name of Candidate: Gregory M. Gittleman
Master of Science Degree
June 30, 2020

THESIS/MANUSCRIPT APPROVED:

DATE:

Dr. Ryan Snyder
TORP PROGRAM DIRECTOR, AIR FORCE POST-GRADUATE DENTAL SCHOOL

30 Jun 20

Dr. Craig Vandewalle
USAF CONSULTANT IN RESEARCH, AIR FORCE POST-GRADUATE DENTAL SCHOOL
Committee Chairperson

30 Jun 20

Dr. Jacob Kitson
DEPARTMENT OF ORTHODONTICS, AIR FORCE POST-GRADUATE DENTAL SCHOOL
Committee Member

30 Jun 20

Uniformed Services University of the Health Sciences Manuscript/Presentation Approval or Clearance

Initiator						
1. USU Principal Author (Last, First, Middle Initial)						
2. Academic Title						
3. School/Department/Center						
4. Phone			5. Email			
6. Clearance		Paper	Article	Book	Presentation	Other
7. Title						
8. Intended Publication/Meeting						
9. Required by			10. Date of Submission			
<p>**Note: It is DoD policy that clearance of information or material shall be granted if classified areas are not jeopardized, and the author accurately portrays official policy, even if the author takes issue with that policy. Material officially representing the view or position of the University, DoD, or the Government is subject to editing or modification by the appropriate approving authority.</p> <p>Neither I nor any member of my family have a financial arrangement or affiliation with any corporate organization offering financial support or grant monies for this research, nor do I have a financial interest in any commercial product(s) or service(s) I will discuss in the presentation or publication.</p> <p>The following statement is included in the presentation or publication: The opinions or assertions contained herein are the private ones of the author(s) and are not to be construed as official or reflecting the view of the DoD or the USUHS.</p> <p>The following items have been included in the presentation and/or publication: Student and/or faculty USU affiliation. Examples: 1) LCDR Jane Doe, DMD, Resident, Naval Postgraduate Dental School and Uniformed Services University of the Health Sciences Postgraduate Dental College. 2) COL John Doe, DDS, Endodontics Program Director, Fort Bragg, NC and Associate Professor of Endodontics, Uniformed Services University of the Health Sciences Postgraduate Dental College. 3) USUHS logo included on title slide and/or poster</p>						
Chair/Department Head Approval**						
Name (Last, First, Middle Initial)						
Signature						
Commander Approval** (if applicable)						
Name (Last, First, Middle Initial)						
School						
Higher approval clearance required (for University- DoD, or US Gov't-level policy, communications systems or weapons review)						
Signature						

**Uniformed Services University of the Health Sciences
Manuscript/Presentation Approval or Clearance**

Service Dean Approval**	
Name (Last, First, Middle Initial)	
School	
Higher approval clearance required (for University-, DoD, or US Gov't-level policy, communications systems or weapons review)	
Signature	
Executive Dean Approval**	
Name (Last, First, Middle Initial)	
Higher approval clearance required (for University-, DoD, or US Gov't-level policy, communications systems or weapons review)	
Signature	
Vice President for External Affairs Action	
Name (Last, First, Middle Initial)	
USU Approved	DoD Approval Clearance Required
Submitted to DoD (Health Affairs) on	
Submitted to DoD (Public Affairs) on	
DoD Approved/Cleared (as written)	DoD Approved/Cleared (with changes)
DoD Clearance Date	DoD Disapproval Date
Signature	

Uniformed Services University of the Health Sciences Manuscript/Presentation Approval or Clearance

Initiator						
1. USU Principal Author (Last, First, Middle Initial)						
2. Academic Title						
3. School/Department/Center						
4. Phone			5. Email			
6. Clearance		Paper	Article	Book	Presentation	Other
7. Title						
8. Intended Publication/Meeting						
9. Required by			10. Date of Submission			
<p>**Note: It is DoD policy that clearance of information or material shall be granted if classified areas are not jeopardized, and the author accurately portrays official policy, even if the author takes issue with that policy. Material officially representing the view or position of the University, DoD, or the Government is subject to editing or modification by the appropriate approving authority.</p> <p>Neither I nor any member of my family have a financial arrangement or affiliation with any corporate organization offering financial support or grant monies for this research, nor do I have a financial interest in any commercial product(s) or service(s) I will discuss in the presentation or publication.</p> <p>The following statement is included in the presentation or publication: The opinions or assertions contained herein are the private ones of the author(s) and are not to be construed as official or reflecting the view of the DoD or the USUHS.</p> <p>The following items have been included in the presentation and/or publication: Student and/or faculty USU affiliation. Examples: 1) LCDR Jane Doe, DMD, Resident, Naval Postgraduate Dental School and Uniformed Services University of the Health Sciences Postgraduate Dental College. 2) COL John Doe, DDS, Endodontics Program Director, Fort Bragg, NC and Associate Professor of Endodontics, Uniformed Services University of the Health Sciences Postgraduate Dental College. 3) USUHS logo included on title slide and/or poster</p>						
Chair/Department Head Approval**						
Name (Last, First, Middle Initial)						
Signature						
Commander Approval** (if applicable)						
Name (Last, First, Middle Initial)						
School						
Higher approval clearance required (for University- DoD, or US Gov't-level policy, communications systems or weapons review)						
Signature						

**Uniformed Services University of the Health Sciences
Manuscript/Presentation Approval or Clearance**

Service Dean Approval**	
Name (Last, First, Middle Initial)	
School	
Higher approval clearance required (for University-, DoD, or US Gov't-level policy, communications systems or weapons review)	
Signature	
Executive Dean Approval**	
Name (Last, First, Middle Initial)	
Higher approval clearance required (for University-, DoD, or US Gov't-level policy, communications systems or weapons review)	
Signature	
Vice President for External Affairs Action	
Name (Last, First, Middle Initial)	
USU Approved	DoD Approval Clearance Required
Submitted to DoD (Health Affairs) on	
Submitted to DoD (Public Affairs) on	
DoD Approved/Cleared (as written)	DoD Approved/Cleared (with changes)
DoD Clearance Date	DoD Disapproval Date
Signature	

COPYRIGHT STATEMENT

The author hereby certifies that the use of any copyrighted material in the thesis manuscript entitled:
“The Flipped Classroom in Orthodontic Residency Programs”
is appropriately acknowledged and, beyond excerpts, is with the permission of the copyright owner.

Gregory Gittleman LCDR, DC, USN

INTRODUCTION

Re-examining dental education curriculum and methods is an ongoing process dating back to the original transformative Gies report in 1926¹. A more recent look concludes that dental education is at a crossroads and new models of dental education are required². Traditional lectures, while proven to be successful at conveying information are no longer seen as the most effective or efficient models³. Today's students benefit from collaborative learning and respond better to videos and interactive formats than traditional book reading⁴. In addition, millennials reared on technology throughout their education have less tolerance for traditional lectures⁵. Currently there is a movement throughout graduate health professions education to promote active student-centered learning that incorporates application of material to solve problems through group interactions⁶.

One such model of active learning that has risen in popularity of the last several years due to its appeal to the millennial learner is called the flipped classroom (FC) model. The FC model is a pedagogical approach in which learning materials, typically pre-recorded videos, are reviewed independently outside of class time. This allows the class time to be used for application of the learned material through case-based learning, small group discussion or hands-on activities⁷. Thus, the traditional lecture and homework elements are "flipped". While there are a number of different interpretations of the FC model and ways to implement the practice, O'Flaherty proposed three core defining features: provide content in advance, ensure educator awareness of learner understanding, and a focus on higher-order learning during in-class time⁸.

The FC model can be seen in K-12 education with the popularity of the Khan academy⁹. Prober was the first to propose the FC model could be equally effective in Graduate Medical Education¹⁰. Since that time, FC models have been studied in a number of settings and shown numerous benefits. For example, a radiology clerkship using an FC model was associated with a positive perception of online modules due to self-paced interactivity and ability to return and review modules in the future¹¹. Increased knowledge gains due to the FC model have been seen in medicine, dentistry, pharmacy, nursing, and veterinary medicine¹²⁻¹⁶. Another potential benefit proposed by Park can be found in the small group interactions promoted in the FC model. The opportunities to participate and teach in small group discussions could be an opening for students to discover and foster an appreciation for teaching leading to an interest in academic careers¹⁷.

A number of studies have reported the benefits of the FC model; however, it is not without drawbacks and hurdles to implementation. One of the biggest obstacles is the increased time and work involved in remodeling the course¹⁴. The initial transition can be difficult and time intensive, however, one study showed faculty feedback was more positive in the second year compared to the first¹⁸. Another pitfall can be the over-emphasis of technology without being based in sound pedagogical teaching strategies. Technology must be used in support of the material and not the other way around¹⁹. Lastly, students have expressed frustration at an increased workload due to additional after-hours time being required²⁰.

Currently 25% of dental schools have reported that their basic sciences curriculum uses active learning to replace lectures²¹. The FC model has received significant attention in the health professions education with several studies being done on the pre-doctoral dental education, however a literature review returned no results for examining post-doctoral orthodontic education^{13, 17, 18}. Therefore, we decided to conduct a survey of ADA recognized orthodontic residency program directors. Our goals

were (1) to quantify the current use of FCs in orthodontic residency education, (2) to assess program director's goals for incorporating FCs, (3) to understand perceived barriers to implementation, and (4) to examine associations between the implementation of FCs and the characteristics of the program directors and residency programs.

MATERIALS AND METHODS

The Air Force 59th Medical Wing Institutional Review Board reviewed and approved this study. The survey was also approved by the American Association of Orthodontics (AAO). A survey was created collecting demographic data from all Program Directors (PDs) of Commission on Dental Accreditation (CODA) approved Orthodontic residency programs. Additionally the survey analyzed perceptions, barriers, limitations and additional resources in the implementation of the FC Model. Lastly, a seven-item Flipped Classroom Perception Instrument (FCPI) created at the Mayo Clinic looked at preclass and in-class activities and rated their importance on a five-point Likert scale.

All 75 Orthodontic PDs from CODA approved programs in the United States and Canada were contacted by email from the AAO Partners in Research which included a link to the surveymonkey survey. A follow up letter was sent to the PDs in the mail.

The survey Likert scale data are ordinal data. Descriptive statistics for ordinal data are presented as median and interquartile range (IQR), and non-parametric tests were used (Wilcoxon Rank Sum Test for two group comparisons and Kruskal-Wallis Test for three or more group comparisons). The associations between categorical variables were analyzed using Chi-Square test. Significance was set to $p < 0.05$. Statistical analyses were performed using SAS version 9.4 (Statistical Analysis Software, Cary, NC).

RESULTS

Respondents and FC use by programs

Of the 75 PDs surveyed, 40 (53.3%) responded. Of those respondents who answered the demographic questions, the majority were male (86.1%), more than 20 years out of residency (74.4%) and in a University settings (87.2%). All 40 respondents answered the question regarding their familiarity of the FC Model with 62.5% saying they were aware of the FC Model. Despite 37.5% saying they were not aware of the FC Model, when an explanation of the FC Model was provided, a majority of respondents said they use flipped classroom sessions; 15.8% reported very often; 21.1% somewhat often; 34.2% somewhat; 7.9% somewhat rarely; 5.3% very rarely; and 15.8% never.

The FCPI scores ranged from 3.6 (online modules enhance learning) to 4.58 (In-class discussion of core content enhances learning). Overall, there was a higher favorability to the items of the FCPI that related to in-class activities (interactive, applied class activities enhance learning, in-class application of core content enhances learning, in-class discussion of core content enhances learning, and team projects enhance learning) than to pre-class activities (online modules enhance learning, learning key content prior to class sessions enhances learning).

38 of the PDs responded to the question regarding the best incentives to engage residents using the FC Model. Instructor guided questions were deemed to be the best incentive with an average score of 2.08 with quizzes (3.03 average) being the least effective incentive.

37 respondents answered the question asking what the biggest perceived barriers to implementing the FC Model. Of those that responded, lack of equipment was perceived as the most significant barrier and lack of instructor training was perceived to be the least significant.

Using a Kruskal-Wallis Test, a statistically significant difference was found in the ranking of instructor training amongst the groups. The age category 70-79 ranked lack of instructor training as a more important barrier compared to younger age groups 40-49 and 50-59.

DISCUSSION

The results from our survey show that most Orthodontic residency programs in the United States and Canada use the FC model to some extent. Over 70% of respondents indicated they use the FC Model sometimes, somewhat often or very often. This is much greater than the 40% of Internal Medicine Program Directors that responded to the same question in a 2015 survey by Wittich²². This may be due to the dramatic increase in awareness of the FC Model benefits in recent years, or perhaps the FC Model is easier to implement for the didactic elements of an Orthodontic residency compared to an Internal Medicine residency.

The PDs viewed the in-class activity more favorably than the preclass component. Interestingly, the PDs gave the least favorable rating of preclass activities to the selection of online modules enhance learning. Technology has encouraged and fueled recent interest in FC Models²³, however, it is not a requirement in its use.⁸ The low favorability may be due to a rejection of the notion that the pre-class work include online modules.

One of the biggest hurdles to implementation of the FC Model amongst educators is concerns over designing the pre-class activity²³. When looking at incentives to encourage resident engagement in the FC Model, the Orthodontic PDs selected instructor provided guided questions as their highest ranking and quizzes as their least favored incentive. This was unexpected as quizzes are the most straightforward and easily translated from traditional to FC classrooms. In addition, a recent meta-analysis by Hew found that quizzes were not only effective as a strong motivator for students to watch pre-class video lectures but allowed the instructors to identify possible misconceptions of pre-class material. In addition, using quizzes allows an opportunity for knowledge recall that forges a stronger memory pathway to the information²⁴.

Orthodontic PDs ranked lack of instructor training as the biggest barrier to implementation of FC Models. This finding is congruent with a study by Westerlaken that found the alignment of online and face-to-face components to be an often-cited critique of participants. Proper alignment is difficult to achieve and having additional education, or perhaps using educational experts in development and implementation of FC Models to adapt their traditional teaching style to fit a FC Model would be helpful²⁵.

CONCLUSION

Based on the results from this study, we can see that the FC Model is being employed in Orthodontic residency settings at a high rate (70% reporting some use). The results of this study are somewhat limited due to the small number of programs (75). We did elucidate information regarding Orthodontic PDs perception regarding barriers and incentives regarding implementation, however our findings indicate a need for further study to examine with increased granularity. It is apparent that the FC Model

has a place in Orthodontic residency programs and further study will help to uncover the most effective ways of delivering education in this setting.

1. Gies WJ. Dental education in the United States and Canada. A report to the Carnegie Foundation for the advancement of teaching. 1926. *The Journal of the American College of Dentists* 2012;79(2):32-49.
2. Kassebaum DK, Tedesco LA. The 21(st)-Century Dental Curriculum: A Framework for Understanding Current Models. *J Dent Educ* 2017;81(8):eS13-eS21.
3. Jenkins S. Review of What's the Use of Lectures? *Journal of Political Science Education* 2009;5(1):87-8.
4. Twenge JM. Generational changes and their impact in the classroom: teaching Generation Me. *Med Educ* 2009;43(5):398-405.
5. Roehl A, Reddy SL, Shannon GJ. The Flipped Classroom: An Opportunity to Engage Millennial Students through Active Learning Strategies. *Journal of Family and Consumer Sciences* 2013;105(2):44-9.
6. Prober CG, Heath C. Lecture halls without lectures--a proposal for medical education. *N Engl J Med* 2012;366(18):1657-9.
7. Chen F, Lui AM, Martinelli SM. A systematic review of the effectiveness of flipped classrooms in medical education. *Med Educ* 2017;51(6):585-97.
8. O'Flaherty J, Phillips C. The use of flipped classrooms in higher education: A scoping review. *The Internet and Higher Education* 2015;25:85-95.
9. Mehta NB, Hull AL, Young JB, Stoller JK. Just imagine: new paradigms for medical education. *Acad Med* 2013;88(10):1418-23.
10. Prober CG, Khan S. Medical education reimaged: a call to action. *Acad Med* 2013;88(10):1407-10.
11. Belfi LM, Bartolotta RJ, Giambone AE, Davi C, Min RJ. "Flipping" the introductory clerkship in radiology: impact on medical student performance and perceptions. *Acad Radiol* 2015;22(6):794-801.
12. Bonnes SL, Ratelle JT, Halvorsen AJ, Carter KJ, Hafdahl LT, Wang AT, Mandrekar JN, Oxentenko AS, Beckman TJ, Wittich CM. Flipping the Quality Improvement Classroom in Residency Education. *Acad Med* 2017;92(1):101-7.
13. Gadbury-Amyot CC, Redford GJ, Bohaty BS. Dental Students' Study Habits in Flipped/Blended Classrooms and Their Association with Active Learning Practices. *J Dent Educ* 2017;81(12):1430-5.
14. McLaughlin JE, Roth MT, Glatt DM, Gharkholonarehe N, Davidson CA, Griffin LM, Esserman DA, Mumper RJ. The flipped classroom: a course redesign to foster learning and engagement in a health professions school. *Acad Med* 2014;89(2):236-43.
15. Missildine K, Fountain R, Summers L, Gosselin K. Flipping the classroom to improve student performance and satisfaction. *J Nurs Educ* 2013;52(10):597-9.
16. Mortensen CJ, Nicholson AM. The flipped classroom stimulates greater learning and is a modern 21st century approach to teaching today's undergraduates. *J Anim Sci* 2015;93(7):3722-31.
17. Park SE, Howell TH. Implementation of a flipped classroom educational model in a predoctoral dental course. *J Dent Educ* 2015;79(5):563-70.
18. Bohaty BS, Redford GJ, Gadbury-Amyot CC. Flipping the Classroom: Assessment of Strategies to Promote Student-Centered, Self-Directed Learning in a Dental School Course in Pediatric Dentistry. *J Dent Educ* 2016;80(11):1319-27.

19. Rowe M, Frantz J, Bozalek V. The role of blended learning in the clinical education of healthcare students: A systematic review. *Medical Teacher* 2012;34(4):e216-e21.
20. Khanova J, Roth MT, Rodgers JE, McLaughlin JE. Student experiences across multiple flipped courses in a single curriculum. *Med Educ* 2015;49(10):1038-48.
21. Formicola AJ. Current State of Dental Education: Executive Summary. *J Dent Educ* 2017;81(8):1008-14.
22. Wittich CM, Agrawal A, Wang AT, Halvorsen AJ, Mandrekar JN, Chaudhry S, Dupras DM, Oxentenko AS, Beckman TJ. Flipped Classrooms in Graduate Medical Education: A National Survey of Residency Program Directors. *Acad Med* 2018;93(3):471-7.
23. Moffett J. Twelve tips for "flipping" the classroom. *Med Teach* 2015;37(4):331-6.
24. Hew KF, Lo CK. Flipped classroom improves student learning in health professions education: a meta-analysis. *BMC Med Educ* 2018;18(1):38.
25. Westerlaken M, Christiaans-Dingelhoff I, Filius RM, de Vries B, de Bruijne M, van Dam M. Blended learning for postgraduates; an interactive experience. *BMC Med Educ* 2019;19(1):289.