Flipped Classrooms in Orthodontic Residency Programs

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INTRODUCTION

Re-examining dental education curriculum and methods is an ongoing process dating back to the original transformative Gies report in 1926[1]. A more recent look concludes that dental education is at a crossroads and new models of dental education are required [2]. Traditional lectures, while proven to be successful at conveying information are no longer seen as the most effective or efficient models[3]. Today's students benefit from collaborative learning and respond better to videos and interactive formats than traditional book reading[4]. In addition, millennials reared on technology throughout their education have less tolerance for traditional lectures[5]. 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 interactions [6].

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 out side 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 activities[7]. 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 time[8].

The FC model can be seen in K-12 education with the popularity of the Khan academy[9]. Prober was the first to propose the FC model could be equally effective in Graduate Medical Education[10]. 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 future [11]. Increased knowledge gains due to the FC model have been seen in medicine, dentistry, pharmacy, nursing, and veterinary medicine[12-16]. 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 careers[17].

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 a given course[14]. 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 first[18]. Another pitfall can be the over-emphasis of technology without being in based in sound pedagogical teaching strategies. Technology must be used in support of the material and not the other way around[19]. Lastly,

students have expressed frustration at an increased workload due to additional after-hours time being required[20].

Currently 25% of dental schools have reported that their basic sciences curriculum uses active learning such as case based group work and guided questions to replace lectures[21]. 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, it was 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 [22]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 a 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).

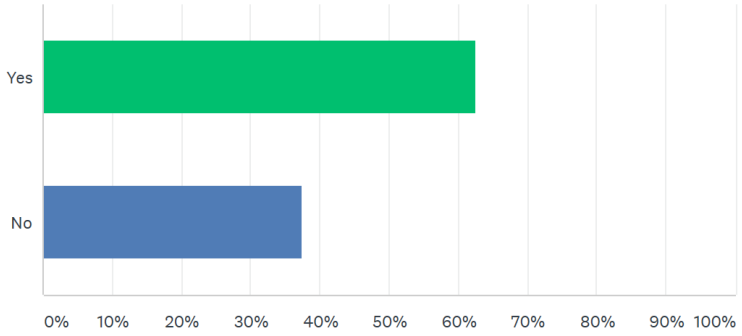
RESULTS

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 (Figure 1). 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 (Figure 2).

Are you aware of an educational model known as the flipped classroom?

Answered: 40 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	62.50%	25
No	37.50%	15
TOTAL		40

Figure 1.

Indicate how often your program utilizes flipped classroom sessions.

Answered: 38 Skipped: 2

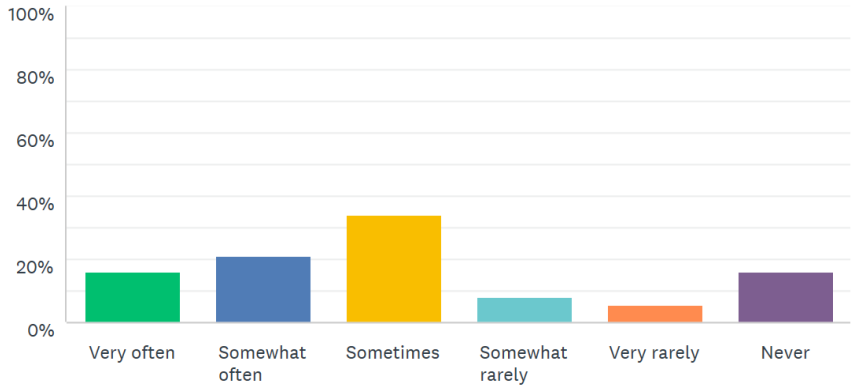
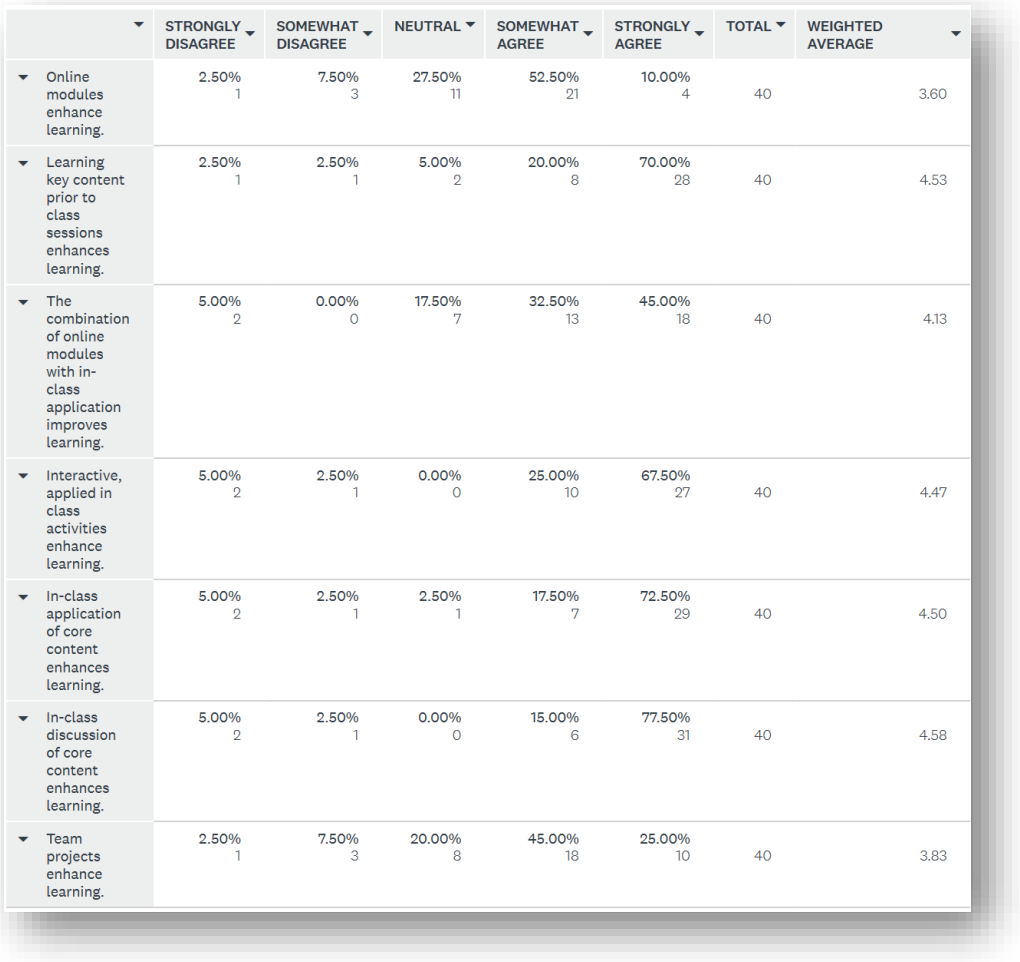


Figure 2.

The FCPI scores ranged from 3.6 (online modules enhance learning) to 4.58 (in-class discussion of core content enhances learning)(Figure 3). 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).



	STRONGLY DISAGREE	SOMEWHAT DISAGREE	NEUTRAL	SOMEWHAT AGREE	STRONGLY AGREE	TOTAL	WEIGHTED AVERAGE
Online modules enhance learning.	2.50% 1	7.50% 3	27.50% 11	52.50% 21	10.00% 4	40	3.60
Learning key content prior to class sessions enhances learning.	2.50% 1	2.50% 1	5.00% 2	20.00% 8	70.00% 28	40	4.53
The combination of online modules with in-class application improves learning.	5.00% 2	0.00% 0	17.50% 7	32.50% 13	45.00% 18	40	4.13
Interactive, applied in class activities enhance learning.	5.00% 2	2.50% 1	0.00% 0	25.00% 10	67.50% 27	40	4.47
In-class application of core content enhances learning.	5.00% 2	2.50% 1	2.50% 1	17.50% 7	72.50% 29	40	4.50
In-class discussion of core content enhances learning.	5.00% 2	2.50% 1	0.00% 0	15.00% 6	77.50% 31	40	4.58
Team projects enhance learning.	2.50% 1	7.50% 3	20.00% 8	45.00% 18	25.00% 10	40	3.83

Figure 3.

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 (Figure 4).

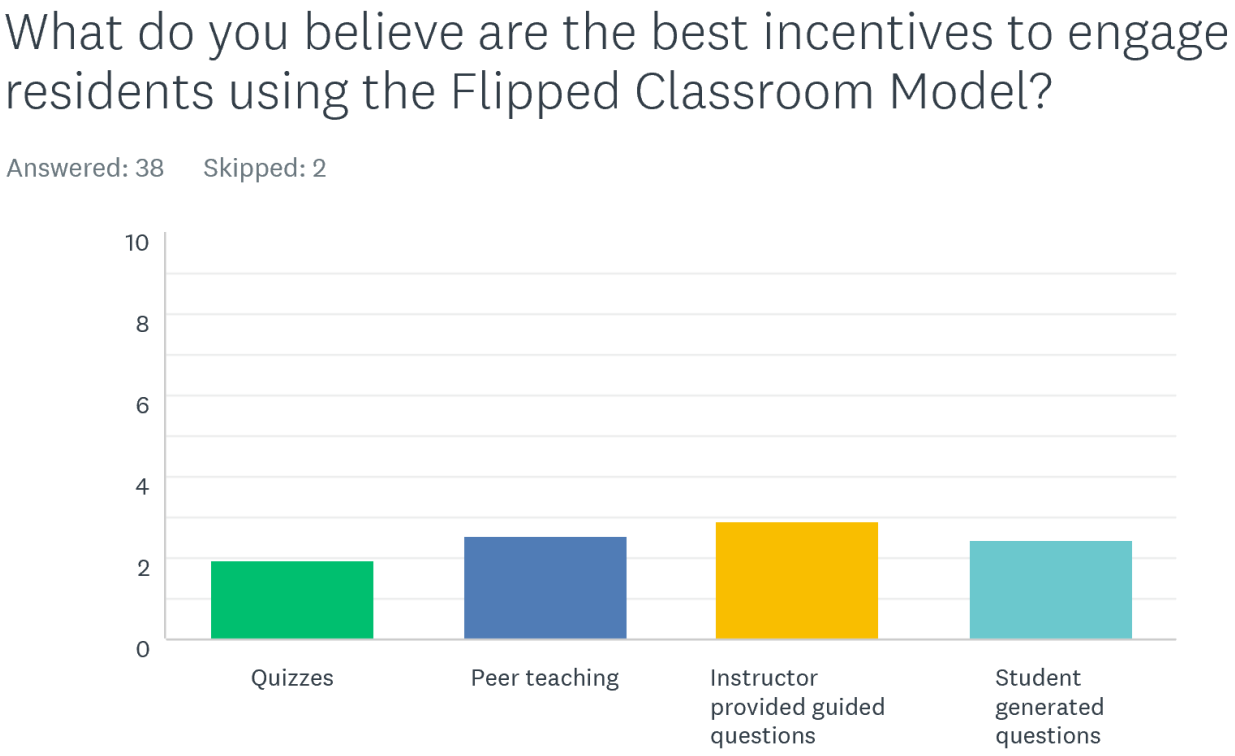


Figure 4.

37 respondents answered the question asking “what are 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.

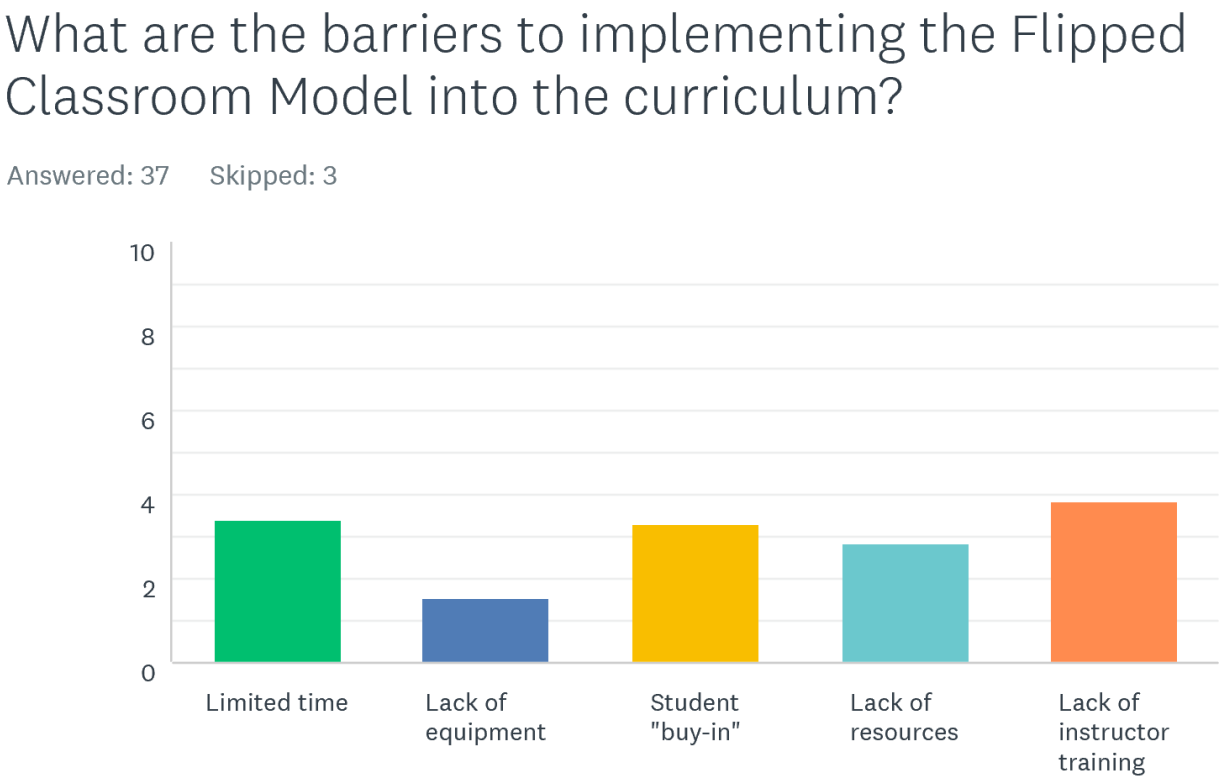


Figure 5.

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 Wittich[22]. 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 Models[23], 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 activity[23]. 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 straight-forward 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 information[24].

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 additonal 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 helpful[25].

CONCLUSION

The results of this study indicate 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 provide 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 utilizing this pedagogical model to deliver educational content.

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