The American Journal of Surgery 221 (2021) 435–436

Contents lists available at ScienceDirect

The American Journal of Surgery

journal homepage: www.americanjournalofsurgery.com

My Thoughts/My Surgical Practice

Using a flipped classroom model to enhance learning for the millennial surgical resident

De Virgilio[1] first described a traditional teaching model (TTM) of classroom podium-style didactic lectures, assigned reading, and proctored quizzes to optimally educate surgical residents for the American Board of Surgery In Training Examination (ABSITE). However, millennial learners have been shown to be difficult to engage through a TTM.[2] They learn better with small group interactive sessions[3] and real-time constructive criticism. With this in mind, Salman Kahn pioneered the flipped classroom model (FCM), which reverses the TTM structure, to educate students in schools across the United States. Classroom lecture-based learning is substituted for at home self-study. Teachers provide different resources so that students can use a method best suited to their learning style. Classroom time is used for interactive small-group sessions to foster collaboration, applied thinking and development of leadership and teaching skills among peers. FCM is a novel concept in residency education and has only been sparsely trialed in medicine residency programs with initial promising results.[4,5] To our knowledge, this is the only report of using FCM to educate general surgery residents. We sought to evaluate residents' ABSITE scores after FCM was introduced to supplement the TTM at our institution.

This is a single institution, retrospective cohort study of general surgery residents who took the ABSITE from January 2015 to March 2017. The FCM was introduced after the 2015 ABSITE. Members and non-members cohorts were compared; designated according to FCM participation. Our TTM consisted of weekly PowerPoint-based lectures given by surgical faculty, fortnightly multiple-choice quizzes and extra remedial quizzes for low-scoring residents. Our FCM consisted of four core components: pre-session preparation (weekly email with learning objectives, reading materials and multi-media resources), small group sessions (weekly, interactive, self-chosen resident-led and resident-moderated with suspension of hierarchy), post-session review (email distribution of resident-made Microsoft Word study guide validated from multiple resources) and pre-ABSITE re-review (10-week intensive re-review). Weekly topics for TTM and FCM were paired. TTM attendance was compulsory but FCM attendance was voluntary. Outcomes were the cohorts' ABSITE scores before (2015) and after (2016, 2017) FCM and factors predictive of higher ABSITE scores. This study was approved by the Mt. Sinai School of Medicine Institutional Review Board.

12 members and 16 non-members were included. Both cohorts were of similar age, gender and PGY level distribution. Baseline knowledge was comparable, with similar pre-residency USMLE step 1 scores (mean 239 ± 11 versus 230 ± 14), USMLE step 2 CK scores (mean 244 ± 10 versus 242 ± 12) and pre-FCM 2015 ABSITE scores (mean 50 ± 38 versus 61 ± 23) in the members and non-members cohorts, respectively, $p > 0.05$. In 2016, after FCM, scores were similar between the cohorts (mean 66 ± 25 versus 57 ± 16), $p > 0.05$. In 2017, however, members achieved significantly higher scores (mean 69 ± 19 versus 42 ± 13, $p < 0.01$). Overall, members demonstrated score improvements over time, whilst non-members saw scores fall. On paired t-tests, members achieved significantly higher scores in 2016 (mean 66 ± 25) than in 2015 (mean 50 ± 38); an increase of +19 (±16, 95% CI 7.3–31.4, $t(8) = 3.7$, $p < 0.01$). However, from 2016 to 2017 (mean 69 ± 19), members saw a plateau in scores with a small increase of +2 (±20, 95% CI -10.2–15.1, $t(11) = 0.42$, $p = 0.68$). Non-members had similar 2015 (mean 61 ± 23) and 2016 (mean 57 ± 16) scores with a small decrease of −2 (±34, 95% CI -23.1, 19.6, $t(11) = -0.18$, $p = 0.86$). However, from 2016 to 2017 (mean 42 ± 13), non-members had significantly worsening scores with a decrease of −16 (±20, CI -10.2, 15.1, $t(9) = -2.78$, $p = 0.02$).

On logistic regression analyses, FCM membership was a significant predictor of a higher 2017 score (OR 0.06, CI 0.01–0.41, $p < 0.01$) and of score improvement from 2015 to 2016 (OR 30.64, CI 2.65–354.78, $p < 0.01$) and from 2016 to 2017 (OR 7.10, CI 1.33–38.02, $p = 0.02$). FCM membership was not predictive of 2016 score.

Similar to other studies,[4,5] these authors believe that FCM can be successful in educating millennials provided certain key components are upheld. Self-study at home allows residents to learn at their own pace to maximize baseline knowledge and understanding prior to classroom sessions. However, prolonged independent study time, such as during a protected research year(s), does not appear to be effective in improving ABSITE scores, even in low-scoring residents.[6] Providing structured learning objectives and recommended resources is also helpful to guide self-study. Classroom sessions should be interactive with replacement of traditional podium-style lectures with round-table discussions to allow for more effective learning. Utilizing an array of adjunctive teaching tools[7] (hypothetical cases, digital media, simulation models and videos of surgical procedures) is important to maintain attentiveness and increase absorption of material. The small-group collaborative approach, along with suspension of a rigid hierarchical structure[8] (without "junior" or "senior" topics and encouraging residents of any PGY level to lead discussions) allows for more

https://doi.org/10.1016/j.amjsurg.2020.08.001

effective learning and real-time individualized feedback. An added benefit of this structure is that it helps develop resident teaching skills; something that is important for a surgeon but not formally taught during residency training. A post-session summary of the learning objectives can help consolidate the major take-home points. Online question banks (OQB) can address residual post-session knowledge gaps and provide further in-depth explanations. Imran et al.[9] demonstrated significant ABSITE score improvements of 3% and 20 percentile points in general surgery residents who completed an OQB. 79% of residents also self-reported that this OQB was overall the most helpful study tool. Establishing a benchmark helps screen low-scoring "at-risk" residents into a remediation program. A large 2020 meta-analysis by Cheun and Davies[7] found that the addition of mandatory multimodality remediation programs (typically involving individualized study plans and faculty mentors) and the use of learning management systems/social media (for example web-based platforms, multi-media review courses) are the most effective measures to improve performance in low-scoring residents.

Limitations of our study include the retrospective nature, small sample size and limited time period. There was no data available on self-study time or utilization of pre-session reading materials and resources, therefore the impact of pre-session preparation alone on ABSITE scores is unknown. Lastly, our FCM supplemented, not replaced, our TTM. Hence, a direct comparison between TTM and FCM is not possible. However, our study demonstrates that the addition of FCM may enable more effective education of millennial surgical residents leading to improved ABSITE scores.

Meeting information

Mini-oral presentation at Academic Surgical Congress 1/31/2018.

Conflicts of interest

None.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Acknowledgements

None.

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6 July 2020