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Original Research

Flipping the switch: The feasibility of a "think aloud" flipped-classroom approach to clinical reasoning instruction

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ABSTRACT

Background: Clinical reasoning is a fundamental skill in medical and allied health professions. Implementation of the evidence-based "think aloud" method (i.e. describing cognitive processes through verbalization) for teaching clinical reasoning has been variable due to time and resource constraints in healthcare education. **Materials & Methods:** To explore the feasibility of implementing the *think aloud* method for teaching clinical reasoning, we piloted a flipped-classroom model of instruction to free live-synchronous educational time in a medical school clerkship. Two asynchronous web-based videos were implemented prior to synchronous case-based discussion applying the *think aloud* method. Performance was assessed by baseline and end-of-clerkship examination and NBME shelf exam; clinical skills by clinical evaluation; satisfaction and student learning styles by survey. **Results:** The flipped-curriculum was piloted in 38 students; mean age 25±2.2 years; 63% male. Baseline knowledge was low (mean baseline score 43±21%) and improved significantly (mean final score 70±23%; increase 29%, 95%CI 20-37%, $p<0.0001$) with 91% having higher end-of-clerkship scores. Greater improvement was observed in students who achieved clerkship goals (42% vs 24%, $p=0.04$) or possessed greater commitment to lifelong learning (39% vs -7%, $p=0.02$). **Conclusion:** Flipping the classroom in the neurology clerkship was feasible and provided a time efficient approach to implementing an evidence-based, *think aloud* approach to clinical reasoning instruction. Given the central role of clinical reasoning in managing the neurological patient and the pedadgoical trends toward standardized patient-instruction and active learning, this model provides an important example for maximizing educational opportunities for medical and allied health trainees.

KEY WORDS: Medical education; Flipped classroom; Think aloud method; Clinical reasoning; Neurology

INTRODUCTION

Clinical reasoning is a fundamental aspect of professional medical practice and represents a core skill for all healthcare providers. It comprises a core competency in undergraduate and graduate medical student training [1], and has also been deemed critical in the instruction of physical and occupational therapists, athletic training students, and other allied health trainees [2–5]. Clinical reasoning refers to the cognitive process of gathering, synthesizing, and analyzing medical data (e.g. signs, symptoms, testing results, clinical response to therapy, etc.) to make decisions regarding patient care [6]. Studies show that approaches to this complex process can vary widely by healthcare provider, level of training, pre-existing knowledge, clinical experience, and patient presentation [7,8].

Numerous strategies have been utilized to teach clinical reasoning to medical trainees. A process-oriented approach which employs active learning to motivate students to dissect, analyze, and understand their thought process has been highlighted as a favored approach in medical education [9,10]. Numerous strategies have been considered including case-based approaches [11], concept mapping, inquiry-based learning, and others with varying degrees of evidence basis [10]. The "think aloud" method is an evidence-based approach to teaching and assessing clinical reasoning which has been studied extensively in nursing care [6,12,13]. This technique employs active learning as students verbalize aloud their approach to a case, test question, or other cognitive problem through interactive group discussion [6,8]. It has been proven to be effective in improving clinical reasoning knowledge and skills in nursing education for decades [6,12,14]. To date, this evidence-based approach has been variably implemented in medical student education potentially due to constraints on classroom, faculty, and student time [15,16].

Recently, interest has increased in flipping the traditional classroom by replacing live lectures with a self-directed, asynchronous learning activity followed by live synchronous group discussion [17]. This instructional strategy packages content acquisition into a self-directed pre-class learning activity freeing classroom time for interactive strategies to apply content. Studies implementing a flipped model have often focused on the asynchronous pre-class component and demonstrated the feasibility and effectiveness of the asynchronous self-direct learning component of the flipped classroom [18-21]. However, the live synchronous session is an equally critical component of the flipped model and evidence-based approaches to this aspect of the flipped model have been inconsistently explored [22]. In this proof of concept study, we focus on the live, synchronous group component of the flipped classroom and demonstrate how

this instructional strategy allowed us to implement an evidence-based, interactive method of learning, the *think aloud* method and explore student learning styles that may be conducive with this method.

METHODS

We developed a flipped curriculum modeled after a conventional classroom-based course which consisted of two web-based videos developed by the authors (RS, AK) and formatted similar to the popular Khan Academy® lectures (www.khanacademy.org) [23]. Students viewed video lectures independently prior to a live seminar applying the *think aloud* method of interactive, instructor-guided (RS), case-based discussion on clinical reasoning using previously published principles [6,12,13]. In each session, students were guided by semi-structured facilitator supervision through a series of patient cases in neurology and prompted to explore aloud amongst small groups of 6-10 peers their clinical reasoning in four parts: synthesis of medical data from the history and physical, localization of the problem within the neuro-axis, development of a differential diagnosis, and initial steps in the diagnostic investigation. The curriculum was implemented and all 2nd-4th year medical students rotating through the required 4-week Neurology Core Clerkship (NCC) at Johns Hopkins School of Medicine were followed prospectively. The study was reviewed by the institutional review board and determined to be exempt.

The primary objective was to determine the feasibility of the flipped curriculum. Knowledge acquisition was assessed by 5 single-answer-best multiple choice questions completed at baseline and end-of-clerkship (Supplemental Table 1). The secondary objective was to identify student learning styles which were most strongly associated with improved performance in the flipped-*think aloud* model. Student learning styles were assessed by student and faculty/resident report. Students self-reported their commitment to lifelong learning (5-point Likert scale from 1=not at all important to 5=very important); generated three clerkship goals and were required to rate self-perceived achievement (5-point Likert scale from 1=strongly disagree to 5=strongly agree). Three faculty or residents evaluated clinical performance for all students which included a rating of each student's tendency to conduct self-directed learning (SDL, 5-point Likert scale from 1=strongly disagree to 5=strongly agree).

Demographic data including age, gender and race (categorized as white, black, Asian, and other) were collected. Student satisfaction with the clerkship (1=poor to 5=excellent), interest in neurology (1=very unlikely to 5=very likely), and self-reported improvement in assessing the need for a neurology consult, performing a history and physical, and generating a differential diagnosis (1=no improvement to 5= substantial improvement) were assessed at clerkship end. Performance on the National Board of Medical Examiners (NBME) neurology shelf examination was collected. Comparative data on student demographics and performance on the NBME was also retrospectively collected for students completing the clerkship in the same academic year but prior to flipping the classroom.

Statistical analysis was performed using Stata/IC v13.1 (Stata Corp. 2014). Descriptive statistics were performed of the groups before and after incorporation of the flipped-*think aloud* curriculum. Unpaired student t-tests were used to compare continuous variables; chi-square, Fisher's exact test and ANOVA for categorical variables. Comparison of baseline and follow up clinical reasoning knowledge exams was performed by paired student t-test. Faculty and resident assessment of self-directed learning (SDL) by 5-point Likert scale was dichotomized as high (agree or strongly agree) and low; lifelong learning as high (important or very important) and low; and achieving clerkship goals as high (strongly agree) or low. Univariate linear regression was used to determine variables which were significantly associated with differences in NBME shelf exam performance pre- and post-flipping ($p<0.10$) and included in a multivariate model.

RESULTS

The flipped-*think aloud* curriculum was piloted in 38 students; mean age 25+2.2 years; 24 male (63%); 46% white, 11% black, 27% Asian, and 16% another race (Supplemental Table 2). Baseline performance was 42.6+21.4% and this increased significantly to 69.7+23.4% (28.6% increase, 95% confidence interval 20.4-36.9%, $p<0.0001$, Table 1). Improvement in score (e.g. from baseline to end-of-clerkship) was observed in 91% of flipped students (n=34). Baseline performance was not different by tendency toward SDL ($p=0.99$), goal achievement ($p=0.26$), or commitment to lifelong learning ($p=0.56$). However, significantly greater improvement in clinical reasoning scores from baseline to final exam was observed for those reporting goal achievement (n=37, $p=0.04$, Table 2) and a stronger commitment to lifelong learning (n=26, $p=0.02$).

Table 1. Impact of a flipped-classroom intervention on clinical reasoning exam scores

	Baseline Exam (n=38)	Follow Up Exam (n=37)*	Difference in Scores (n=37)	P-Value
Raw Score (mean, stdev)	21.3 +/- 10.7	34.9 +/-11.7	-14.3 (12.4)	<0.0001
Percent Score (mean %, stdev)	42.6% (21.4%)	69.7% (23.4%)	-28.6% (24.7%)	

Raw and percent score on the institutionally generated baseline and follow up single-answer best multiple choice examinations.
Abbreviation: standard deviation, stdev.
* One student who completed the baseline examination did not complete the final exam.

Unfortunately, due to a technical malfunction in the computer software system used for survey distribution, the commitment to lifelong learning question was not distributed to 2nd year students and responses were limited to the twenty-six 3rd year students. However, no significant difference were observed in baseline (p=0.52), final examination (p=0.30), or change in scores (p=0.26) by medical school year. Improvement in scores was not different by SDL tendency, though improvement was higher in the low SDL group (16.8 point improvement vs 10.7, p=0.14). NBME shelf exam scores were not different by learning style either before or after flipping the classroom (all p>0.15).

Table 2. Impact of student learning styles on performance in a flipped classroom model of instruction

	Percent Change in Exam Scores (mean, stdev)	P-Value
Self-Direct Learning		
- **Low SDL Rating**	33.6% (21.7)	0.14
- **High SDL Rating**	21.3% (27.7)	
Lifelong Learning*		
- **Low Lifelong Rating**	-6.7% (30.5)	0.02
- **High Lifelong Rating**	29.5% (24.0)	
Achieved Goals		
- **Not Achieved**	23.7% (24.8)	0.04
- **Achieved**	42.0% (19.9)	

Mean percent change from baseline to final clinical reasoning exam score by different learning characteristics. Self-directed learning was assessed by faculty and resident clinical evaluations (5-point Likert, strongly disagree to strongly agree) and then dichotomized as high (agree or strongly agree) and low. Lifelong learning was assessed by student self-report (5-point Likert, not important at all to very important) and dichotomized as high (important or very important) and low. Student attainment of clerkship goals was determined by self-report (5-point Likert, strongly disagree to strongly agree) and dichotomized as high (strongly agree) or low. P-values were determined by Student's t-test.

Abbreviation: standard deviation, stdev.

*Note: due to a technical malfunction this question was not distributed to and 2nd year medical students and thus only 26 students completed this question.

Student satisfaction and performance was compared to 83 consecutive students rotating through the clerkship in the same academic year prior to flipping the classroom (Table 1). No differences in age, gender, or race were observed. Significantly greater 4th and fewer 2nd year students (p=0.0003) rotated pre-flipping. Overall quality of the neurology clerkship remained high with >75% rating the clerkship as "very good" or "excellent" in both groups (p=0.72). No differences were observed in interest in neurology (p>0.82), recognizing the need for a neurology consult (0.96), history and physical examination (0.34), or differential diagnosis (0.28). Mean unadjusted scores on the NBME shelf examination were slightly higher pre-flipping (78.1+7.3 vs 75.4+8.6, p=0.074); however, no difference was observed when adjusting for baseline differences in medical school year (p=0.34) and in a model adjusting for other factors impacting shelf performance (age, gender, level of training, race, and rotation group, p=0.71).

DISCUSSION

As flipped curricula are increasingly incorporated into medical teaching, educators not only face the challenge of developing pre-classroom asynchronous lectures and activities but also implementing evidence-based methods for live, synchronous discussion. In this study, we show that implementation of a flipped-curriculum on clinical reasoning in the NCC allowed us to incorporate an evidence-based *think aloud* method of instruction in clinical reasoning. Overall student impression of the clerkship remained high and scores on the NBME shelf examination, an accepted objective measure of student knowledge, did not significantly decline.

Flipped-classroom curricula are increasingly being reported in the education literature for medical, nursing, and other allied health trainees [18]. While studies have suggested benefits to student satisfaction [18][19], impact on performance has varied. Knowledge acquisition was not significantly improved in a flipped-study in veterinary medical education [20] or in public health [21]. Test scores were improved with a flipped curriculum on cardiovascular and respiratory physiology for first-year medical students [24] and in a study of pharmacy students [25]. Experiences with flipped curricula are increasingly described in nursing education but impact on knowledge acquisition, test scores, and clinical application to patients has not been widely studied [26,27]. Differences in the curricula employed, instructor experience, and requirements for participation may drive some of this variability. Ultimately, evidence-based methods of promoting active learning may provide the most robust benefits [28].

Studies show that optimal teaching of clinical reasoning is iterative incorporating recurring opportunities to think and rethink the processes of assimilating data towards a diagnosis. While clinical rotations for medical students are designed to provide these opportunities through repetition in patient exposure, standardizing clinical experiences is challenging in the dynamic clinical environment. The flipped-*think aloud* curriculum reported in the current study freed an estimated 10 hours of annual classroom time from instructor-led didactics and offered an opportunity to standardize the review of clinical cases (Figure 1). Given existing limitations to student and faculty time, maximizing in-class instruction and standardizing the application of knowledge to patients may prove particularly appealing to educators in medicine. In the academic year reviewed in this study, only 2 of our other 8 core clerkship lectures (e.g. physical exam, neuroimaging, peripheral nerve neurology, movement disorders, stroke, pediatric neurology, emergency neurology, and neurovestibular) were offered every rotation. Due to scheduling conflicts and others demands on faculty time, overall these core lectures were provided in an average of only 68% of the clerkship rotations (range 30 - 100%). The flipped curriculum implemented in this study, however, was able to be offered every rotation providing content standardization and consistency for all rotating students.

Supplemental Table 2: Example of Clinical Reasoning Examination Questions

Clinical Reasoning Examination Baseline Test Questions

1. A middle-aged man with PMHX of bariatric surgery and diabetes mellitus presents with a five month history of progressive sensory complaints in his bilateral hands and feet. He describes numbness in the hands and feet extending in a stocking-glove distribution to the calf and wrist. He has trouble showering as he begins to fall when closing his eyes to wash his hair. Examination shows reduction of sensation to vibration and proprioception in the legs bilaterally from below the knee distally and in the hands bilaterally. *If you are thinking that that patient may be suffering from a nutritional deficiency in vitamin B12 as opposed to diabetic polyneuropathy, what physical examination finding would MOST support this thinking?*
    a. Normal muscle tone and bulk
    b. Brisk deep tendon reflexes in the bilateral lower extremities
    c. Flexor plantar responses in the bilateral lower extremities
    d. Normal extraocular movement examination

2. In a patient presenting with generalized weakness, *what part of the neurologic exam and/or history are most helpful in differentiating between a generalized neuromuscular junction process and a generalized muscle disease?*
    a. Mental status examination and questioning
    b. Assessment of muscle bulk
    c. Evaluation for cranial nerve dysfunction or symptoms
    d. Comprehensive gait examination

3. A middle-aged person with past medical history of hyperthyroidism presents with a 3 month history of gradually worsening weakness. The patient reports that he/she has noticed difficulty with getting up out of the bed in the morning or out of a chair when sitting. The patient also reports difficulty with reaching up to top cabinets and has had to limit daily activities due to this weakness. The patient has no dysarthria, dysphagia or ptosis. There are no reported issues with numbness or tingling in the hands or feet. Deep tendon reflexes are 1+ throughout. *If you are considering polymyositis or hyperthyroid associated myopathy as leading diagnoses, what finding would favor polymyositis?*
    a. Absence of muscle pain
    b. Complaints of comorbid swallowing difficulty
    c. Elevated serum creatinine kinase
    d. Myopathic findings on electromyography (EMG)

4. In evaluating a patient with abrupt onset of hemibody weakness and numbness, *what part of the neurologic exam and/or history is most helpful in localizing the specific region of the neuro-axis that may be responsible for symptoms?*
    a. Mental status examination to evaluate for aphasia and neglect
    b. Assessment of muscle tone and muscle bulk
    c. Evaluation of deep tendon reflexes
    d. Comprehensive gait examination

5. A 65 year-old man is brought to the hospital after having been found by Emergency Medical Services (EMS) to be poorly responsive. No further history is available; however, you are told that empty bottles of Metoprolol, Lisinopril, Aspirin, Lovastatin, and carvidopa-levodopa (i.e. Sinemet) was found next to the patient and that he had last been seen normal about 24 hours prior. You are concerned that this patient may be suffering an akinetic parkinsonian crisis after having run out of his medication. *What physical examination finding would support an akinetic parkinsonian crisis as opposed to brainstem stroke?*
    a. Extensor plantar responses bilaterally
    b. Flexor plantar responses bilaterally
    c. Increased muscle tone that is velocity and angle dependent (i.e. more resistance when you passively move the joint more quickly and with a larger angle)
    d. Increase muscle tone that is NOT velocity and angle dependent (i.e. resistance throughout the entire passive range of motion)

Clinical Reasoning Examination End-of-Clerkship Test Questions

1. A middle-aged person with no other past history and currently not taking medications presents with a 3 month history of weakness. The patient reports that he/she has noticed difficulty with getting up out of the bed in the morning or out of a chair when sitting. The patient also reports difficulty with reaching up to top cabinets and has had to limit daily activities due to this weakness. There are no reported issues with numbness or tingling in the hands or feet. Deep tendon reflexes are 1+ throughout. Systemic evaluation including pulmonary and cardiac examination is normal. There is no family history of similar symptoms. *If you are thinking that the patient may be suffering from a muscle as opposed to neuromuscular junction disorder, what physical exam finding would MOST support this thinking?*
    a. Reduced generalized muscle tone
    b. Absence of ptosis, diplopia, dysarthria, dysphagia
    c. Presence of tongue fasciculations
    d. 0/3 items at 5 minutes on remote recall testing

2. In evaluating a patient with a left-sided (i.e. unilateral) limping gait, *what part of the neurologic exam is most helpful in differentiating between a "limp" resulting from a spastic hemiplegic gait and a "limp" from a foot drop?*
    a. Mental status examination to evaluate for aphasia
    b. Assessment of extraocular movements
    c. Evaluation of deep tendon reflexes
    d. Cerebellar testing with finger to nose and heel to shin testing

Supplemental Table 2: Resume

1. An 18 year-old woman presents on referral from a local health clinic after suffering a new seizure. The patient was in her normal state of health until a few days ago in the middle of her mid-term exams when she awoke from sleep and apparently suffered a seizure. Her roommate said that she found her "unresponsive and shaking in the bed". EMS was called and found the patient "coming to" but confused and disoriented. She declined transfer to the local Emergency Department but did agree to go to student health that day where routine labs including CBC, CMP, alcohol level, and urine drug screen were normal. Her mother reports that she has always been a bit of a "day dreamer" and growing up was diagnosed with ADD which did not improve despite treatment. Recently, her friends have also described episodes where her behavior will arrest and she appears to be day dreaming. *If you are thinking that the episodes of "day dreaming" are actually complex partial seizures and not absence seizures, what historical details would MOST support this suspicion?*
    a. Tachycardia and flushing of the face
    b. Lip smacking
    c. Postictal confusion last 15-20 minutes
    d. Inability to get her attention with brisk tactile stimulation during an event
2. In evaluating a patient with new onset weakness and numbness from the waist distally, *what part of the neurologic history would be MOST helpful in differentiating between a myelopathy and a polyneuropathy?*
    a. Bowel and bladder function
    b. Muscle wasting and loss of muscle bulk
    c. Presence of tingling or burning
    d. Problems with falling late at night or in the shower

3. A 65 year-old with migraines, long-standing hypertension, poorly-controlled hyperlipidemia, and known carotid stenosis presents to the Emergency Department for evaluation of speech difficulty. The patient was in her normal state of health until about 5 hours ago when she developed difficulty producing speech. She has only subtle right facial asymmetry and drift but otherwise normal cranial nerve, motor, and sensory exams. There is evidence of a left carotid bruit on neurovascular examination. *If you are thinking that the patient's stroke is a result of hypoperfusion from critical stenosis of the left carotid, what finding on language testing would MOST support this suspicion?*
    a. Broken speech with an inability to speak in full sentences or repeat a sentence but able to follow commands
    b. Inability to read a written sentence but able to write a sentence and follow commands
    c. Broken speech with intermittent use of unintended phrases and words that do not make grammatical sense
    d. Broken speech with an inability to speak in full sentences but able to repeat phrases and sentences accurately

Test questions from the baseline and end-of-clerkship clinical reasoning examination. The questions present a brief clinical vignette or scenario and require students to select a feature of the clinical history, examination, or laboratory findings to differentiate between diagnostic possibilities or management approaches. Correct answers in **bold**.

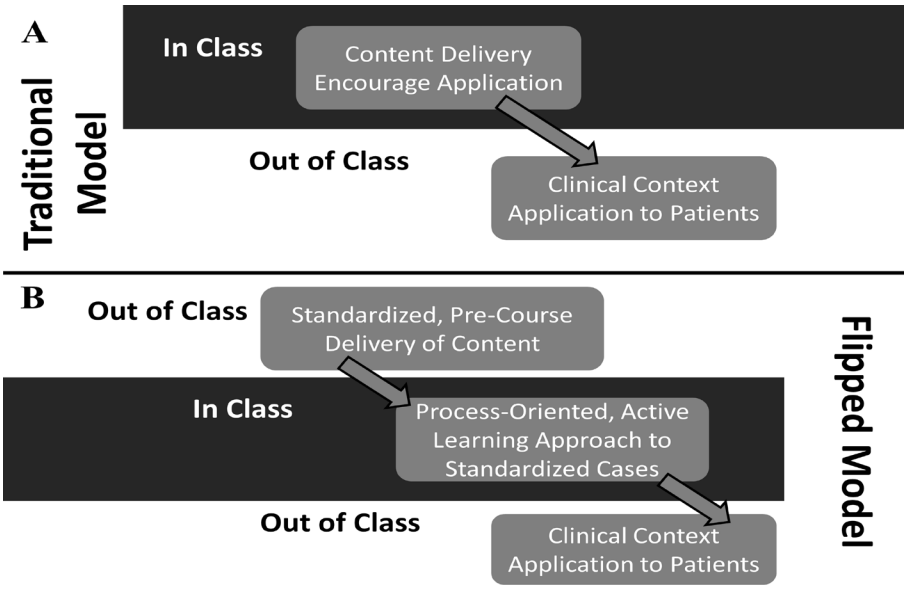

Figure 1. Schematic for Flipping the Classroom in Medical and Allied Health Education

Schematic diagram of the typical cycle of content acquisition and application in the "traditional" and "flipped-classroom" models of teaching in healthcare. Flipping the classroom allows for additional standardization of content delivery and application, increases faculty time spent actively applying knowledge, and in this study freed time for incorporating a process-oriented "think aloud" method to case-based review.

Supplemental Table: Comparison of student characteristics and performance before and after flipping the classroom

Characteristic	Pre-Flipped (n=83)	Post-Flipped (n=38)	P-Value
Age (years, mean, stdev)	25.9 (2.7)	25.4 (2.2)	0.34
Gender (n, % male)	43 (52%)	24 (63%)	0.25
Race*			0.64
- **White**	40 (48%)	17 (46%)	
- **Black**	12 (14%)	4 (11%)	
- **Asian**	14 (17%)	10 (27%)	
- **Other**	17 (21%)	6 (16%)	
Medical School Year (n, %)			0.0003
- **Second**	7 (8%)	8 (21%)	
- **Third**	55 (66%)	30 (79%)	
- **Fourth**	21 (26%)	0 (0%)	
Overall educational value (median, range)	4 (2-5)	4 (1-5)	0.94
Overall value as "Very Good" or "Excellent" (n, %)	63 (76%)	30 (79%)	0.82
Initial interest in neurology as career (median, range)	2 (1-5)	2 (1-5)	0.85
Ability to assess the need for neurology consult (median, range)	4 (1-5)	4 (3-5)	0.70
Ability to perform the H&P (median, range)	5 (1-5)	5 (3-5)	0.34
Ability to develop differential diagnosis (median, range)	4 (1-5)	4.5 (2-5)	0.28
Resident and faculty overall clinical rating	34.7 (2.9)	34.6 (3.1)	0.86
Achieved clerkship goals (median, range)	4 (2-5)	4 (2-5)	0.93
NBME shelf exam score (mean, 95%CI)	78.1 (76.5,79.7)	75.4 (72.6,78.2)	0.07

Student impressions were based on response to 5-point Likert scale assessed at the end of the clerkship according to the following scales: overall rating of clerkship (1=poor, 2=fair, 3=good, 4=very good, 5=excellent), change in interest in neurology as a career (1=no improvement, 3=moderate improvement, 5=substantial improvement), and change in ability to assess for a neurology consult, perform history and physical, and develop a differential diagnosis (1=no improvement, 3=moderate improvement, 5=substantial improvement), achieved clerkship goals (1=strongly disagree, 5=strongly agree).

Abbreviation: standard deviation, stdev; confidence intervals, CI.

* Race data available for all students except 1 in the post-flipping group (n=37).

Interestingly, the degree of knowledge acquisition observed in this study tended to be different by student learning style. Improved performance was greatest in those who set and achieved clerkship goals and who reported a greater commitment to lifelong learning. Differential responses to flipped curricula have been suggested in other studies. In an abstract describing the incorporation of a flipped curriculum in an emergency medicine residency, residents who disagreed with limiting the "traditional" lecture performed more poorly [29]. In another study where review of video-lectures was non-compulsory, participation was low and performance suffered [30]. Medical trainees, like all learners, incorporate varying learning styles and study strategies. A "one size fits all" approach may under-estimate the diversity of student approaches to learning. Identifying and capitalizing on motivation to learn is fundamental.

This study does have limitations. It was performed at a single institution, in a single clerkship, and over a short duration of follow up. While this short duration limits other curricular changes that could explain the study results, the findings do not generalize to other institutions or other fields. A larger sample size is necessary to explore the differences observed by student learning style. Comparative data on clinical reasoning examination performance was not available prior to the implementation of the flipped curriculum and limits comparison of clinical reasoning exam performance. Inclusion of NBME shelf exam scores provided one comparison, and while the groups did not differ in several key factors that could impact scores, differences in year of training were observed and controlled. Finally, data on commitment to lifelong learning was only available for 3rd and 4th year medical students due to a technical malfunction with survey generating software. Exam scores were not significantly different between students by year of training; however, we caution that further confirmatory study including this important subgroup is necessary to confirm this finding in this and other field of healthcare education.

CONCLUSION

Flipped classroom approaches to medical education which replace traditional didactic lectures with a self-directed, self-paced video followed by active instructor-guided discussion are increasingly attractive for medical and other allied health professions. While many studies have focused on the pre-classroom component of the flipped model,

the live, synchronous activity is equally critical and can be challenging for resource and time-limited educators. In this study, the flipped model facilitated the implementation of an evidence-based method, the *think aloud* method, for teaching clinical reasoning. This approach offers promise to health educators seeking to overcome an increasingly decentralized education system in which students are spread across large institutions with numerous demands on time and highlights the ability of flipped curricula to facilitate the incorporation of evidence-based strategies into medical teaching.

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