The Flipped Classroom in Medical Education: Engaging Students to Build Competency

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ABSTRACT: The flipped classroom represents an essential component in curricular reform. Technological advances enabling asynchronous and distributed learning are facilitating the movement to a competency-based paradigm in healthcare education. At its most basic level, flipping the classroom is the practice of assigning students didactic material, traditionally covered in lectures, to be learned before class while using face-to-face time for more engaging and active learning strategies. The development of more complex learning systems is creating new opportunities for learning across the continuum of medical education as well as interprofessional education. As medical educators engage in the process of successfully flipping a lecture, they gain new teaching perspectives, which are foundational to effectively engage in curricular reform. The purpose of this article is to build a pedagogical and technological understanding of the flipped classroom framework and to articulate strategies for implementing it in medical education to build competency.

KEYWORDS: competency-based education, educational technology, flipped classroom, formative assessment, active learning

CITATION: Hurtubise et al. The Flipped Classroom in Medical Education: Engaging Students to Build Competency. *Journal of Medical Education and Curricular Development* 2015:2 35–43 doi:10.4137/JMECD.S23895.

RECEIVED: February 5, 2015. **RESUBMITTED:** March 22, 2015. **ACCEPTED FOR PUBLICATION:** March 24, 2015.

ACADEMIC EDITOR: Steven R. Myers, Editor in Chief

TYPE: Review

FUNDING: Authors disclose no funding sources.

COMPETING INTERESTS: Authors disclose no potential conflicts of interest.

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Paper subject to independent expert blind peer review by minimum of two reviewers. All editorial decisions made by independent academic editor. Upon submission manuscript was subject to anti-plagiarism scanning. Prior to publication all authors have given signed confirmation of agreement to article publication and compliance with all applicable ethical and legal requirements, including the accuracy of author and contributor information, disclosure of competing interests and funding sources, compliance with ethical requirements relating to human and animal study participants, and compliance with any copyright requirements of third parties. This journal is a member of the Committee on Publication Ethics (COPE). Provenance: the authors were invited to submit this paper.

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Introduction

For over a decade, medical education has been experiencing a strong call for transformation.[1,2] The current healthcare environment requires competent physicians to coordinate with an interprofessional team to deliver safer, higher quality, and more cost-effective patient care.[3] These factors underlie the growing trend in medical education reform and make possible the implementation of learner-centered models as well as competency-based curricula in which student progression is achieved by demonstration of "mastery of academic content, regardless of time, place, or pace of learning."[1–3]

Disruptive innovations including social networks, cloud-based computing, mobile devices, and video recording are enabling educators at all levels to flip their classrooms to meet the needs of the 21st century.[4] Far from being a fad, the flipped classroom (FC) has been present in medical education as early as the mid-1990s with the introduction of team-based learning. Flipping the classroom, at its most basic level, is the practice of assigning learners didactic material, traditionally covered in lectures, to be learned before class while using face-to-face time for more engaged and active learning. The steps for implementing a flipped classroom include 1) using a backward instructional design to plan your learning activities, 2) creating opportunities for prelearning (eg, short recordings) of didactic materials, 3) developing formative and diagnostic assessments to determine learning gaps, and 4) using active learning strategies and technology to address the learning gaps and develop competency.[5] Additionally, medical educators should be open to opportunities to develop longitudinal and interprofessional learning experiences, while being sensitive to the organizational change required to flip the classroom.

What is the Flipped Classroom

FC is the result of assigning didactic material to learners before class time while using face-to-face time for more active learning strategies such as reflection, group projects, or discussions. Core elements of an FC include assigned preclass content, formative assessment, working on learning gaps, developing competency, and the teachers' role as guide on the side. Each offers multiple educational advantages.[6] For example, online videos or e-learning modules can be used to teach knowledge, skills, and attitudes as well as provide content for learners with various learning styles.[7] Learners gain the ability to control the speed and bookmark sections, as well as review concepts before and after class. Additionally, formative assessments can evaluate the development of multiple competencies and elicit learning gaps. Identifying learning gaps and the developmental stage of students is a pivotal process.[5] Data on learning gaps enable teachers to mitigate the variance in learners' competency and recommend self-directed instructional activities.

Theoretical Foundations

The foundations of the FC lie in time-tested educational theories. According to Dewey's Reflex Arc Concept, teaching and learning do not occur in a closed system where a teacher provides instruction (stimulus) and students simply absorb what they were told (response) in the classroom.[8] Instead, learning experiences in the FC occur beyond the boundary of formal class time and place, and resemble a circular and organic relationship where all activities are connected and become meaningful and enriched by the previous experiences.[8] In this organic learning environment, learners become the owner of the learning process and can actively engage in "the iterative process of building mental models from existing and new information. They can test these models by identifying their learning gaps, seeking resources and assistance, and interpreting information based on their experiences for further development".[9(p6)] Learners stay in the zone of proximal development where they metacognitively manage their learning process through reflection, and cognitively develop their own knowledge and skills with expert scaffolding and guidance on the side.[10] Teachers' lectures, in-classroom activities, and out-of-classroom activities are designed as scaffolding to facilitate learner-centered environments. In an FC, active learning is a mechanism for a learner-centered, organic, collaborative learning environment.

The purpose of the organic learning environment in the healthcare community is to meet the challenges of 21st century practice.[2,11–14] In response, accrediting bodies in graduate medical education and other healthcare professions require competency-based medical curricula, and medical school faculty must ensure "self-directed learning experiences" for their students to foster the development of lifelong learning skills.[15] Visionary medical educators are proposing a system that encourages integrative, organic, and collaborative learning that develops habits of inquiry and improvement and that advances health and wellness in a holistic way for patients and patient populations.[1]

Designing a Flipped Classroom

Medical education, with its year-long courses, hundreds of instructors, interdisciplinary curriculum, and academic support systems, poses unique challenges to flipping the classroom. These challenges require teachers to consider more deeply the instructional design process.[16] Typically, *backward* instructional design models suggest first identifying learning goals, then assessment methods, and finally teaching methods. This process results in an organized sequence of activities so students spend their time and effort learning.[17–19]

One backward design model, Quality Matters© (QM), was developed for teachers creating online and blended courses. QM is valuable for flipping the classroom in medical education because of its consideration of the planning and communication necessary for students working independently on Web-based assignments. The foundation of QM is a comprehensive research-based set of quality standards and annotations. In addition to traditional backward design models, QM covers course technologies, learner support, as well as accessibility and usability.[19] The QM standards can serve both as a formative evaluation in the development of an FC approach as well as a summative evaluation to ensure instructional design factors for success.

Learning goals. When identifying learning goals, instructors should consider the strong movement toward a competency-based model in healthcare education. Recently, the Association of American Medical Colleges (AAMC) completed an effort to identify an initial short list of entrustable professional activities (EPAs) to be expected of all graduates making the transition from medical school to residency.[3] EPAs refer to professional activities that together constitute the mass of critical elements that operationally define a profession and generally require multiple competencies. Similarly, a taxonomy of competency domains for all the health professions has been identified by Englander et al.[14] These competencies include patient care, knowledge for practice, practice-based learning and improvement, interpersonal and communication skills, professionalism, and systems-based practice, interprofessional collaboration, as well as personal and professional development. The agreement, by multiple professions, on the nomenclature of healthcare competence should result in more effective interprofessional education and better care.

Assessment. Competency-based education also requires multiple forms of assessment.[20] In an FC, learners might be assessed on a competency such as "use the knowledge of one's own role and the roles of other health professionals to appropriately assess and address the healthcare needs of the patients and populations served."[14(p1092)] When the assessment measures the development of multiple competencies, which align with EPAs required for practice, the feedback can be more valuable and lead to learning that endures beyond the course.[20,21]

Active learning strategies and tactics. Active learning requires students to have ownership of their learning process for meaningful learning experiences and outcome.[22] The FC provides time for face-to-face engagement, which aligns prior knowledge with experiences and prepares learners for practice. These experiences collectively build learner confidence, provide opportunities to support development of self-efficacy, and create an environment of inquiry and open questioning.[23,24] There are various teaching tactics and strategies that support this approach. Tactics require less coordination than strategies and can be used by individual faculty to engage learners in an FC. Medbiquitous, a standardized vocabulary for medical education developed in collaboration with the AAMC, includes tactics applicable to the FC such as case-based instruction, audience response, peer instruction, as well as small and large group discussions.[20] The FC also provides an opportunity to engage learners by using class time to hear new perspectives. These new perspectives include clinicians

with first-hand experience, patients and families with unique healthcare experiences, and standardized patients trained in the development of communication skills.

Collaborative learning. Medical education reformers and other educational leaders highlight the need to develop collaboration skills.[14,25] Collaborative learning can refer to any instructional method in which students work together in small groups toward a common goal and emphasizes group interactions rather than learning as a solitary activity.[22] Two flipped curriculum-level strategies, requiring more coordination, listed by Medbiqutous, are problem-based learning (PBL) and team-based learning (TBL).

Problem-based learning. PBL is a type of inductive instruction in which relevant problems are introduced at the beginning of the instruction cycle and used to identify learning gaps and provide the context and motivation for the learning that follows. It is always active and usually collaborative.[22] Students determine their own learning gaps and apply newly acquired knowledge to solve the problem. A tutor, in lieu of transmitting expert knowledge, guides the group in their task, monitors the educational progress of each student, and maintains functionality of the group as a whole.[26] In accordance with a flipped model, PBL students can use online didactic materials as a resource for foundational medical knowledge.

Team-based learning. TBL is a model for flipping the classroom and has been used in medical education since the 1990s. It allows a single instructor to conduct multiple small groups simultaneously in one classroom. TBL stresses the importance of out-of-class learning based on learning objectives, emphasizes the importance of holding learners accountable for attending class prepared to participate, and provides guidelines for designing group learning tasks to maximize participation.[27,28] Class time is shifted away from learning facts toward application and integration of information. TBL also encourages the development of high-performing teams of 5–7 learners. These learning teams develop team skills on the path to attaining content and/or clinical knowledge and reasoning skills. A faculty facilitator provides oral feedback and corrective instruction, and guides and encourages learners to articulate their ideas during intragroup work as well as during intergroup discussions.

Educational technologies for a flipped classroom. In an FC, educational technology can be leveraged in the design of engaging prelearning experiences as well as active collaborative face-to-face experiences. There are tools available for content creation, communication, information sharing, collaborative inquiry, ongoing assessment, and metacognition to facilitate teaching and learning.[29,30] The exponential growth of available technologies can prove overwhelming when attempting to identify the appropriate technology to use. Therefore, it is essential for medical educators to focus on competency-based outcomes, interactive learning, and instructional design as the drivers for technology-related decisions.[31] The identification of competencies and outcomes ensures that educators implement technology as a "reliable strategy" versus a "novelty."[29]

Content creation. Medical educators have many options for making prerecorded lectures and distributing on the Internet.[32] Learners use these materials in a variety of ways. They may watch the video the first time while taking notes in the PowerPoint file and later download the MP3 on a mobile device to review materials. Many universities support platforms for recording and distributing lectures, which enable educators to make the recording once, integrate into existing systems, and provide students with file types including video, audio, and PowerPoint.[32]

Another option is to create engaging e-learning modules. These modules offer learners the opportunity to interact with visual content like computed tomography (CT) scans or ultrasound videos. They can also contain built-in quizzes with a variety of question types for formative assessment. While some schools provide the software and equipment for faculty to develop learning modules, others hire instructional designers to work closely with an educator to transform the lecture into a high-quality prerecording and engaging classroom activity. In most cases, instructional designers have expertise in e-learning authoring tools. These authoring tools create interactive modules that are viewable on mobile devices and across operating systems like Windows, IOS, and Android.[33]

Communication, information sharing, and collaborative inquiry. Education technology can be implemented to engage learners in discussion, collaboration, and inquiry to facilitate social knowledge construction and problem-solving. For example, backchannel communication (see Table 1) can be used during didactics, real-time group discussions, or asynchronous discussions to apply knowledge, contribute ideas, and answer questions. Learners can also share resources such as Websites, articles, and visuals to explain concepts and support ideas. Collaborative inquiry, such as brainstorming, affinity diagrams, and concept mapping, is another strategy to facilitate the development of systems-based practice skills used in quality improvement, decision making, and organization learning processes.

Ongoing assessment and metacognition. Education technology can inform both faculty and learners of the acquisition of competencies. Learners can engage in frequent self-assessments to encourage metacognition and acknowledge practice-based learning and improvement to sustain personal and professional development.[14] When determining the technologies to utilize for assessment of competencies, educators pinpoint the appropriate cognitive levels to be assessed. Once pinpointed, the appropriate technologies are utilized for formative assessment and summative evaluation, including examples such as polling, online quizzes, and e-portfolios. Technologies implemented to develop competencies, information sharing, collaboration, communication, and content curation can also be implemented as authentic learner assessments.

Table 1. Flipped classroom technologies.

CONTENT CREATION
Lecture recording: Minimally this includes an audio recording of the lecturers with voice synchronized with a screen and capture; it can include video recording of the instructor as well.[32]
Media Site
Echo 360
Tegrity
Panopto
Camtasia
E-learning module authoring: Minimally this includes an audio recording of the lecturers, with voice synchronized with a screen capture; it can include graphics capability, animations, interactivity, quizzing, ADA/accessibility, mobile, and software simulations.[33]
Adobe Captivate
Articulate Storyline
Articulate Studio
iBooks
Lectora
COMMUNICATING AND INFORMATION SHARING
Backchannel: An avenue for synchronous discussion during didactics, lectures, or presentations in which participants, face-to-face or virtual, can ask questions, post resources, and provide feedback.[34] Faculty can use the backchannel to inform content being presented.
Today's Meet
Twitter
Discussion: Tools are available outside of a dedicated learning management system to promote asynchronous discussion and feedback. These technologies incorporate written text, video, audio, and voting features.
Idea Scale
VoiceThread
Social bookmarking: Web-based process for saving and tagging websites for both individual and collaborative organization of content.[35] Tools vary on extent of annotations, group sharing, and private versus public content.
Delicious
Diigo
Social citation managers: A repository to manage, tag, and annotate scholarly resources.[36] Local and/or Web-based applications allow individual or collaborative sharing of citations.
EndNote
Mendely
Zotero
Social networking: These technologies provide opportunities for information sharing and problem solving with colleagues, access to expertise and mentors, and peer-to-peer education.
Physician only networks (Doximity)
Professional and Personal (LinkedIn, Facebook)
COLLABORATIVE INQUIRY
Brainstorm and affinity diagrams: Virtual "post-its" to share, rearrange, and to prioritize ideas synchronously in class or asynchronously as prec-ourse work.
Memosort
NoteApp
Collaborative workspace: Promotes sharing of resources, accessible on multiple devices, from one central location. Additionally, some workspaces "synch changes from multiple participants" which promotes on-going feedback loops required of competency-based education.[37]
Dropbox
Google Drive
Concept and mind maps: Web-based resources for creation of individual or collaborative graphic representation of content using words and/or images. It "involves integration of knowledge and creation of meaning by relating concepts."[38(p201)]
C-Map
MindMeister
Curate content: Resources for visually aggregating hyperlinked content around a central idea(s) or theme(s).[39]
Pearltrees
Pinterest
ScoopIt

Table 1. (*Continued*).

Note-taking: Learners and faculty can create shared notebooks to facilitate collaborative note-taking, sharing of resources, and data and task management. These tools have exceptional searching capabilities, are accessible on multiple devices, and integrate multiple modes of content (eg, text, audio, video, ink).
Evernote
OneNote
Web/Virtual conferencing: Provide opportunities for synchronous discussion at a distance. Also consider options for using these technologies to engage learners at a distance with those in class or facilitate in-class small group presentations using breakout room features.
Adobe Connect
Google Hangouts
Go To Meeting
Join Me (App)
Skype
WebEx
COLLABORATIVE INQUIRY
Whiteboards: Online whiteboard, which includes synchronous conferencing (chat or video) while collaboratively annotating content. Technologies can integrate pregenerated content, images, or PDFs, as well as facilitate just-in-time teaching and learning.
Baiboard (App)
GroupBoard
Wikis: Content-specific webpages, modifiable by multiple users, utilized for asynchronous collaboration and social content creation.[40] Wikis are a dynamic resource requiring contributors to cite references and create connections with other content specific wikis pages.
Wikipedia
Wikispaces
ONGOING ASSESSMENT AND METACOGNITION
Checking for understanding: Technology can facilitate formative and self- assessment of knowledge and learning. These range from resources in which learners can record content while annotating and flashcards to surveys tools and objective exams.
ePortfolio
ExamSoft
Explain Everything (App)
Google Forms
Mental Case (App)
Online Surveys
Polling: Implemented as a pre-class assessment or face-to-face assessment tool; audience response systems can inform in-class discussion and teamwork. There are a variety of options available given learner devices and budgets.
Poll Everywhere
Socrative
TurningPoint
Feedback: Crucial to competency-based education is ongoing feedback. There are resources available to help facilitate virtual constructive feedback without extensive typing or written communication. Examples include the creation of audio files as well as tracking and annotation features.
Audacity
Google Drive: Documents
iAnnotate PDF (App)

Table 1 is a collection of education technologies for developing content, facilitating active learning, and assessing learner competency in an FC. In consideration of backwards design and QM, the table encourages faculty to integrate technology as a reliable strategy or activity to achieve learning goals and scaffold learning experiences.

Below are the instructional design considerations that are critical for the success of an FC.

- Consider your learners and how they learn. For example, millennials may have different strengths and needs.
- Make learning goals explicit. Try to cover multiple competencies.
- Consider the learners' cognitive load including all their assessments and assignments.
- Accurately estimate and communicate the amount of time you expect students will spend on didactic materials

outside of class. Some schools reserve preparation time on student schedules.
- Provide an online schedule and make learning materials easy to find and easy to use.
- Ensure assessment methods are competency-based and match your goals. Use formative assessment and feedback to identify learning gaps and develop competency during "richly interactive, compelling, and engaging" sessions.

Plan to "strengthen connections between formal and experiential knowledge gained across the continuum of medical education, and promote learners' ability to work collaboratively with other health professionals."[4]

Flipping the Classroom to Develop Competency Example

The flipped model provides opportunities for additional competencies to be addressed during class time. For example, if the learning goal is the EPA "managing a patient with diabetes," there are a variety of competencies to be addressed. Leveraging technology to transmit knowledge for practice before class enables class time to be spent developing the competency to "apply established and emerging principles of clinical sciences to diagnostic and therapeutic decision-making, clinical problem-solving, and other aspects of evidence-based health care."[14(p1091)]

Table 2 demonstrates how the FC can enable new cohorts of learners to assemble for collaborative learning. Starting with a traditional TBL, Table 2 suggests modification to build and assess a variety of competencies associated with the EPA "managing a patient with diabetes" as well as the related competencies.[41] While the additional or alternative methods offered leverage technology, Nishimoto et al suggest an effective TBL using low-tech assignments and teaching strategies. The Type 2 Diabetes TBL for M1 students by Nishimoto et al was downloaded from MedEdPortal, a peer-reviewed clearinghouse of health education tools.[41]

Change Management and the Flipped Classroom

Medical education curricula have had the same structure since Flexner.[16] Our teaching practices with their accompanying support structures are well established. Flipping the classroom requires changing these patterns of working and communicating. Perhaps the biggest change for medical education is the initial increase in the amount of administrative coordination needed. Curricular development teams must facilitate communication with students and all instructors teaching in the course. Additionally, including technology and curriculum support units in the development process is critical to sustaining any change effort in medical education.

The additional administrative coordination needed to successfully implement an FC suggests the need for a change management process. In medical education, the core elements of FC can be applied to lectures, courses, or an entire curriculum. Kotter's[42] eight-step process for leading change has proven to be helpful for organizations seeking to change in a dynamic environment. Table 3 outlines the success factors inspired by Kotter's steps with recommendations for flipping the classroom, course, and/or curriculum in medical education.[3] The recommendations are cumulative as the scope of change increases.

Implications for Practice and Research

The movement to an FC model has many implications for educational practice and research. In addition to opportunities for building and assessing competency for learners, an FC model also provides opportunities to acquire and assess medical educator teaching competencies, to implement multifaceted continuous learner assessment, and to collaborate across the continuum with multi-institutional colleagues.

The "Teaching as a competency framework," introduced by Srinivasan et al in 2011, presents the competency for program design and implementation, and focuses on a learner-centered approach in which fundamental principles of education, learning environment, and advances in instructional modalities (technologies) are coupled with ongoing assessment of learners' needs and effectiveness in achieving outcomes.[43] An FC model affords medical educators the opportunity to build competency in program design and implementation by 1) utilizing situational factors to establish the learning environment,[20,24] 2) sequencing content for appropriate cognitive load,[24,29] and 3) scaffolding learning experiences for early application to scaffold practice.[23,24,29] The program design and implementation competency applied to FC approaches can be assessed by using course design frameworks including the utilization of the QM rubric as a formative checklist. A flipped approach also provides educators the opportunity to engage in multifaceted, continuous learner assessment. Deliberate assessment has been identified as a shortcoming in medical education.[30,44] Developing educator competency in FC design and implementation is one avenue to address this. The flipped model challenges educators to think differently about assessment, given the availability of analytics to assess performance. Finally, the FC model affords medical educators opportunities to develop and integrate recursive, longitudinal, competency-based education to facilitate and assess teaching and learning across the continuum of UME, GME, and CME.[14,30]

For both teaching and learning competency, the FC model promotes opportunities for multi-institutional collaboration, mentorship across the continuum, and sharing experiences through education research and scholarship.[4,44] Repurposing of instructional material across the continuum would result in enabling opportunities for learning when and where it may not have been otherwise possible. With this, educators can focus on role-modeling, facilitating active learning experiences, and providing feedback to promote a longitudinal learning experience.[24]

Table 2. Flipping the classroom to develop competency example.

TBL COMPONENT	TYPE 2 DIABETES TBL FOR M1 STUDENTS	ADDITIONAL/ALTERNATIVE FC DESIGN	RELATED COMPETENCIES
Team formation	Organize learners according to advanced degrees, medical experience, undergraduate college, geographic origin, gender	Include interprofessional team members	Interprofessional communication; collaboration
	Divide into teams of six with equal representation of the above learner characteristics	Utilize asynchronous discussions technologies to form interprofessionally balanced teams around common interest or experiences	
Pre-class: learner preparation for TBL module	**Advanced preparation (made available 2 weeks prior to module):** Pertinent chapters in biochemistry and anatomy text; Current evidenced-based journals and Web-based resources	**Enable learners to prepare:** Integrate pre-recorded lectures, podcasts, or e-learning modules **Engage students with formative assessment and collaborative note-taking technologies:** Use content curation technologies and information-sharing resources that enable learners to use and contribute to the resources before and after the FC	Knowledge for practice
Readiness assurance test (RAT)	**Individuals (iRAT)** Audience response system to capture iRAT scores	**Capitalize on in-class time by providing data to instructors:** Use online forms to assess learner's prior knowledge and preparation as well as to inform in-class session	Knowledge for practice; practice-based learning and improvement; systems-based practice; patient care
	Team (tRAT) Scratch off sheets for immediate feedback and to capture scores	Implement online testing to capture scores and integrate into student information systems	
Instructor feedback and written appeals	Only team filing appeal is eligible for rescore	Facilitate collaborative inquiry, using wikis or concept maps, to develop and share rationale	
In-class team work and discussion	**Intra-team** Clinical case and application questions—team discussion, progressive reveal of questions	Develop an interprofessional, practice-based learning and improvement project related to the case	Knowledge for practice; professionalism; systems-based practice; patient care; interpersonal and communication skills
	Inter-team Faculty facilitated minimal discussion of questions when consensus among teams	Use brainstorming and affinity diagramming technologies to facilitate collaboration and participatory decision making; use online whiteboards and backchannel technologies to enable an interprofessional panel to participate and to facilitate inter-team communication	
Peer evaluation	Surveys requiring students to rank participants	Assess interprofessional teams and case: conduct student-conceived evaluation using polling technologies to measure contributions and interprofessional communication; Utilize collaborative workspaces to facilitate feedback on case and project from interprofessional panel	Interpersonal and communication skills; practice-based learning and improvement; patient care
Assessment and self-assessment	RAT only; assessment of application-level objectives not indicated	**Evaluate core competencies:** Rate the efficacy of the project using asynchronous discussion tools; utilize online forms as critical incident questionnaire to assess FC experience and identify opportunities for continued learning	Professionalism; practice-based learning and improvement; professional and professional development

Table 3. Change management success factors.

CHANGE STEP	LEVEL OF CHANGE		
	LECTURE	COURSE	CURRICULUM
Create the guiding coalition	Consult technology support and faculty development leaders. Consider the students other assignments, assessments	Include faculty in a course design team. Consult all those whose work supports medical education for example student affairs and assessment	Include curricular leaders from across the continuum of medical education and interprofessional educators
Communicate the vision as broadly as possible	Share the intent and value of FC with students. Provide detailed instructions regarding prework. Be available for student feedback and be ready to make changes	Provide a detailed orientation to the block. Make sure all instructors have talking points to reinforce the importance of the change and provide specific details	Be aware of constituencies who are interested in your curriculum. Plan medical education scholarship projects
Generate short-term wins	Start with a lecture conducive to developing "richly interactive, compelling, and engaging activities	Carefully choose a few people to pilot flipping their lectures	Engage a broad group of faculty in projects like developing curricular goals, defining assessment standards, and selecting technology tools
Increase credibility to change systems needed to support effective FC	Develop faculty and staff expertise in the technologies used in an FC	Modify evaluations, assessments, and technology to support new teaching methods	Consider how you will develop, retain, and recruit new skill sets as faculty and staff roles change
Incorporate changes into the culture by doing the medical education research projects on your efforts and disseminating the results[10]	Gather feedback from students about the process, technology, and impact on their learning. Share locally with other instructors	Compare assessment data from the FC with previous years. Share in education and technology publications and conferences	Gather longitudinal data on curricular outcomes and share with national and international medical education community

Conclusion

Flipping the classroom is a building block of curricular reform in medical education. It can be implemented in an educational unit as small as a lecture and as large as the entire curriculum. It enables educators to learn about competency-based education while holding promise as a strategy to build bridges across traditional curricular boundaries to develop meaningful competency. Effectively implementing the model requires being cognizant of overall curricular goals, the underlying theories of education, the active learning strategies they suggest, and the development of new education technologies. However, to fully realize the potential of the FC will require significant change management strategies including conducting rigorous medical education research around new teaching methods and competency-based educational outcomes.

Author Contributions

Wrote the first draft of the manuscript: LH, EH, LS, HH. Contributed to the writing of the manuscript: LH, EH, LS, HH. Agree with manuscript results and conclusions: LH, EH, LS, HH. Jointly developed the structure and arguments for the paper: LH, EH, LS, HH. Made critical revisions and approved final version: LH, EH, LS, HH. All authors reviewed and approved of the final manuscript.

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