



# A Medical Innovation and Entrepreneurship Curriculum at HMS

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**Scholarly Report submitted in partial fulfillment of the MD Degree at Harvard Medical School**

**Date:** 03 February 2019

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**Scholarly Report Title:** A Medical Innovation and Entrepreneurship Curriculum at HMS

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## A Medical Innovation and Entrepreneurship Curriculum at HMS

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***Purpose:***

Medicine is a rapidly-evolving field with frequent shifts in scientific understanding, care delivery systems, and technological capabilities. It is our belief that medical students should be prepared not only to adapt to shifts in medical landscape, but also actively participate in scientific, technological and systems-level innovation. Thus, we set out to develop a sustainable medical innovation and entrepreneurship curriculum to prepare medical students to be active drivers in scientific, technological, and systems-level innovations in medicine.

***Methods:***

We originally proposed to develop a two-part curriculum, with one part occurring in the first year of medical school and the second part occurring post-PCE. We planned to measure our success through surveys in order to measure the medical students' perceived value of the curriculum towards their education. Due to time constraints and various other logistical issues, we focused our efforts on the first part of this curriculum, refining it to a much shorter time period and adapting to meet unforeseen challenges. Our curriculum is outlined below. We have thus far only completed two sessions. We collected feedback from our first official session to measure perceived value.

***Results:***

Unfortunately we were unable to recruit enough participants to achieve statistically significant results in any of our metrics. For the following metrics, our results were as follows for our first session: "I enjoyed this session" had an average score of 7 out of 9 (standard deviation of 2.52), "Overall, I found this session valuable to me" had an average score of 7 out of 9 (standard deviation of 2.52), and "I would recommend integrating this session into the core curriculum at HMS" had an average score of 5.3 out of 9 (standard deviation of 3.2).

***Conclusions:***

Unfortunately, we are not able to make any firm conclusions regarding the curriculum given our small sample size of participants. However, feedback was largely quite positive and with a larger sample size, we may see statistically significant results. Interestingly, some students strongly recommended against integrating into the core curriculum. In conclusion, further studies are needed to validate the potential value of an entrepreneurial curriculum for medical students, but preliminary results are promising. Even so, integration into the core curriculum may not be the optimal approach, and the timing of the course may be of more critical importance than originally anticipated.

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## Introduction

Medicine is a rapidly-evolving field. Over the course of a career, the modern physician will be faced with fundamental shifts in scientific understanding, technological capabilities and care-delivery systems. However, separation of expertise into the traditional silos of academia, clinical medicine and industry has long been a barrier to innovation. Engineers often innovate to solve problems without fully understanding how their product will fit into the medical system, and physicians, who frequently identify key problem areas, rarely feel they have the skills necessary to act out and build their own solutions.

It is the authors' belief that medical students should be prepared not only to adapt to shifts in the medical landscape, but also to actively participate in scientific, technological and systems-level innovation. Furthermore, we believe that medical schools are uniquely situated to train the next generation of physicians to bridge these divides in order to drive effective, patient-centered innovation.

Medical schools traditionally do not provide any education specifically regarding medical innovation. While more schools are beginning to see the value in entrepreneurial education for their students<sup>1</sup>, these programs are still few and far between. Offering a curricular component that specifically addresses medical innovation and entrepreneurship could provide students with essential skills and knowledge they might otherwise never obtain. Education regarding medical innovation and entrepreneurship would empower students to be drivers of positive change rather than passive participants as medicine rapidly changes over the next several decades. Physicians have an essential role and a voice that needs to be incorporated as new systems innovations and digital technologies are incorporated into regular medical practice.

The HMS Makerspace Initiative, founded in 2015, has spent the last few years attempting to address the gap in medical student education regarding innovation and entrepreneurship. The initiative, which has consisted of a prototyping lab located in TMEC 250b on the Harvard Medical School campus and a Venture Creation and Ideation (VIC) curriculum, has been entirely student run since its inception. The VIC program in particular has attempted to equip medical students

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<sup>1</sup> Blake A Niccum and others, 'Innovation and Entrepreneurship Programs in US Medical Education: A Landscape Review and Thematic Analysis', *Medical Education Online*, 22.1 (2017) <<https://doi.org/10.1080/10872981.2017.1360722>>.

with the knowledge and skills necessary to be active drivers of innovation within the medical community, while the prototyping lab has served as an outlet for medical students to test ideas and experiment.

The HMS Makerspace Initiative has greatly benefited from grass-roots origins as a 100% student-run program. The freedom to iterate rapidly over the years with constant student input and feedback has allowed for experimentation and significant learnings from the last three pilot runs of the VIC program. However, this student-run design has also presented significant challenges. With the redesign of the medical school curriculum at HMS it has become much more difficult to pass on student leadership to the next class year, largely due to the repositioning of the clinical year from year three to year two. The year two students find it difficult to lead a student group while enduring the demands of their clinical clerkships.

Furthermore, through multiple iterations, VIC program has revealed several foundational gaps in medical student knowledge regarding innovation and entrepreneurship that the program was not originally designed to address. Namely, students with little to no background in innovation were having difficulty with the loose, open structure of the program. Without any prior experience, students were having trouble evaluating potential medical needs and ideas.

Thus, with these challenges in mind, we set out to address the aforementioned gaps in medical student knowledge, solve the challenges of student leadership transition, and empower students to become active drivers of scientific, technological, and systems-level innovations in medicine.

**Student Role:**

With the help of the Center for Primary Care, I led the re-design of the curriculum, our launch event for student recruitment, helped with selecting speakers/educators, sourced ideas for students to evaluate, and designed and distributed our feedback surveys. Previously, I raised funding for the Makerspace prototyping lab, worked with the administration to secure a space, bought all materials in the lab, and set them up for student use.

### Methods:

Our goal was to develop a medical innovation and entrepreneurship curriculum that would empower medical students to become active drivers of change. In order to empower students, we need to teach entrepreneurial skills that enable one to identify a clinical need, properly verify it, develop a solution to that need, verify the solution's viability in both clinical and economic senses, and develop that solution into a product that effectively fills the need. Furthermore, students must then feel comfortable applying these skills so that they may use them throughout their careers. Thus in order to do this successfully, we needed to address three challenges: student engagement, effective use of experiential learning to drive skills application, and challenges regarding student time constraints given the demands of the current medical school curriculum.

#### *Engagement and Student Time Constraints:*

Student engagement was addressed through a variety of ways. First, we had a launch event in which entrepreneurial speakers were invited to discuss their ventures and provide advice. We planned to use this event to generate excitement and as a launching pad for the curriculum. We also required an application process to enter into the curriculum, which encouraged only students truly interested in and motivated by the subject matter to pursue it. Furthermore, we screened applications prior to acceptance in order to avoid students that demonstrated a low commitment to engagement via their application. Our application is shown in figure 1.

We also designed our lectures and assignments to be as relevant and interesting as possible, incorporating as much experiential learning as possible. We have modeled several of our sessions to run similar to a Harvard Business School case-style discussion, which, in the authors' opinion, produces a higher level of engagement than traditional lectures. The classroom desks are organized into a U-shape, with the lecturer occupying the space in the center of the "U." The session is then largely based around student discussion, with the educator performing a facilitative role. When training our educators to hold sessions in the HBS-style, we ask them to focus on several key items. One is creating movement. Educators that

move around the room, in the authors' opinion, are more dynamic and engaging. Two is striking the "right" balance when guiding discussion. Instructors are asked to avoid allowing discussion between two students to occur without any guidance. If two students have a discussion and the facilitator does not direct them towards key insights, the students may not recognize the salient points of the lecture. Conversely, if the facilitator simply states the objectives without allowing students to arrive at conclusions through discussion, the salient points may not resonate. Thus, instructors are asked to summarize student comments, focusing on key learning objectives for the session in order to direct students to the desired learnings. This style of discussion is similar to the flipped classroom<sup>2</sup>, which is already employed in the HMS curriculum.

Given the nature of the current medical school curriculum, students are already frequently stretched for time. Thus, designing a curriculum that students are able to handle given their current course load is essential to success. One way of addressing this issue for the second stage of the curriculum occurring after the clinical year is to offer it as a one month intensive for credit. Offering the second stage as a one month intensive would allow students to simultaneously progress with medical school requirements and carve out specific time to engage in the innovation curriculum. To address time commitment during the first stage of the curriculum, we decided to require students to meet only once per week similar to the time commitment required for the VIC program pilots. We generally found that students were able to carve out one night per week if interest and engagement remained high.

#### *Curriculum:*

The curriculum was designed to draw on experiential learning in both the first and second stages of the curriculum. Studies have demonstrated that experiential learning improves learning and retention, and given the application-based nature of entrepreneurship, experiential

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<sup>2</sup> Helen Morgan and others, 'The Flipped Classroom for Medical Students', *The Clinical Teacher*, 12.3 (2015), 155–60 <<https://doi.org/10.1111/tct.12328>>.



learning is likely the best educational modality<sup>3,4,5</sup>. After running the VIC program for three consecutive years, we found that not all students had the educational foundation necessary to jump right into an application-based approach to learning. Thus, in order to address this gap while simultaneously taking advantage of the benefits of experiential learning, the first stage of the curriculum was designed to include a class-wide, instructor-guided project through which students would have a chance apply the skills they are learning. The instructor would then use this project as a tool for both teaching and for students to practice skills application.

The second stage of the curriculum was envisioned to look similar to the current VIC program. Students would form groups of 3-5 that will choose a project to pursue. Over the course of the program, students will meet regularly, leaning on the skills they learned in the first stage of the curriculum to validate a clinical need and ultimately develop a solution. The project would

The image shows two pages of a Google Forms application. The left page is the title page, and the right page contains the main questions.

**Page 1 (Left):**

- Title:** Makerspace Application
- Message:** Thanks for applying to the Makerspace's VIE (Venture Ideation and Exploration) program. We're looking for students excited about solving big challenges in healthcare – no prior experience in innovation or entrepreneurship required.
- Ideal candidates are:**
  - Dedicated, hardworking, and committed
  - Willing to step outside their comfort zone
  - Naturally curious about the world
  - Passionate about helping people in big ways
  - Fun and enthusiastic
- \* Required**
- 1. Name \*** (Text input field)
- 2. Preferred email address \*** (Text input field)
- 3. Year (eg MS1, MS2, G1 etc) \*** (Text input field)
- 4. Which day(s) would you prefer to meet? \*** (Check all that apply)
  - Monday
  - Tuesday
  - Wednesday
  - Thursday
  - Friday
- 5. Which evening time slot works best? Most of our sessions will be led by entrepreneurs and guest speakers who prefer to meet in the early evening. \*** (Check all that apply)
  - 5:00 - 6:00pm
  - 5:30 - 6:30pm
  - 6:00 - 7:00pm

**Page 2 (Right):**

- 6. What makes you tick? Tell us what you're passionate about. What drives you? (It doesn't have to be entrepreneurship or medicine) \*** (Text input field)
- 7. Name one person you admire and why. \*** (Text input field)
- 8. When was the last time you broke a rule/law and why did you do it? \*** (Text input field)
- 9. Why are you interested in this program? \*** (Text input field)
- 10. Optional: Any other information you would like to share with us (100 words max)** (Text input field)

Powered by Google Forms

Figure 1

<sup>3</sup> Anju Saraswat and others, 'A Pilot Study Examining Experiential Learning vs Didactic Education of Abdominal Compartment Syndrome', *The American Journal of Surgery*, 214.2 (2017), 358–64 <<https://doi.org/10.1016/j.amjsurg.2016.07.011>>.

<sup>4</sup> Lian K. Ti and others, 'Experiential Learning Improves the Learning and Retention of Endotracheal Intubation', *Medical Education*, 43.7 (2009), 654–60 <<https://doi.org/10.1111/j.1365-2923.2009.03399.x>>.

<sup>5</sup> Sarah Yardley, Pim W. Teunissen, and Tim Dornan, 'Experiential Learning: AMEE Guide No. 63', *Medical Teacher*, 34.2 (2012), e102-115 <<https://doi.org/10.3109/0142159X.2012.650741>>.

serve as a way to for students to apply their skills, further cementing their learnings, increasing confidence in skills application, and also introducing more advanced learnings as students are pushed to problem solve and navigate challenges with less guidance. Unfortunately, due to time constraints, we were unable to pilot this portion of the curriculum; however, we hope to do so in future works.

The first stage of the curriculum was originally designed as a 28-session curriculum with one, 1-hour session occurring per week. It was broken into 4 blocks, each with specific aims and goals. The blocks were as follows:

Block 1: How to screen for high-impact needs in medicine (sessions 1-8)

Block 2: How to effectively generate concepts and solution ideas (sessions 9-14)

Block 3: How to screen solution ideas for economical and implementational feasibility (killer experiments) (sessions 15-20)

Block 4: How to set milestones for implementation and generate a pitch deck (sessions 21-28)

An entrepreneur would be chosen to lead each of these blocks, drawing on their previous experiences and backgrounds to more effectively manage the classroom. The original curriculum is outlined in figure 2.

Unfortunately, we encountered several logistical issues. The most challenging hurdle was scheduling entrepreneurs. It was extremely difficult to schedule entrepreneurs for a consecutive 6-8 week period, and in fact, we had several entrepreneurs ultimately cancel what we believed was scheduled time. This ultimately delayed the start of our curriculum from a targeted November 2018 start to a January 2019 start. Furthermore, after discussions with the entrepreneur, we found that there was a resistance to teaching specific materials developed by our team. The entrepreneurs were used to getting a topic and presenting their own materials on that topic in their own format and style. This created a particularly difficult challenge because one of our main goals was to create a sustainable curriculum over the long term. If we allowed

entrepreneurs to present their own curriculum, then each year the material could change dramatically if we replaced any given entrepreneur, and thus, the quality of the program could not be ensured.

Another challenge we uncovered during our discussion with entrepreneurs was the timing of the curriculum. Some entrepreneurs felt the curriculum was too ambitious and that some concepts could not be taught in the time allotted. With our start date delayed to January, this became a definite reality. We no longer had a comfortable amount of time to complete our curriculum before the students proceeded to their PCE year. Thus, we had to do a complete redesign of the curriculum.

The redesign of the curriculum shortened the number of sessions from 28 to 16. Furthermore, we focused the sessions on fewer educational objectives. Namely, we decided the most important learning goal was to provide students with the skills to evaluate challenges in medicine with a skeptical eye and properly identify opportunities. With this in mind, we introduced several more HBS-case-style discussions focused around simply evaluating ideas/problems. The revised curriculum is outlined in figure 3.

One of the challenges of the revised curriculum is breaking it into clearly delineated blocks, and unfortunately, we are still facing challenges with scheduling entrepreneurs to teach sessions. We are currently working with entrepreneurs to reach an acceptable solution for all parties.

<b><u>Original Curriculum</u></b>	
<i>Session</i>	<i>Description</i>
<b><i>Block 1: How to screen for high-impact needs in medicine (sessions 1-8)</i></b>	
1. Needs presentations	Present three needs identified by care providers, Harvard's OTD, or OTD at nearby hospitals (physicians, nurses, etc). Present these needs to the class with relevant info and background.
2. Assess needs with current knowledge	Discussion-based session where students discuss what makes a need "good" or "bad." Google X's moonshot factor needs are presented. Students discuss why google chose these needs and ultimately decide what they value and which needs criteria they would like to use as a class.

3. Generating customer interview questions	All assumptions and questions about the problem at hand are discussed throughout the session. Special attention is given to questions that might answer how a user interacts in or with the area of interest in order to develop empathy for the end-user. The end-deliverable is a list of customer interview questions.
4. Find who you're going to interview	Recommendations about where to meet people and who students could contact are given. No meeting this week. Allow students 2 weeks to contact people and set up meetings.
5. Interview check-in / Refine customer interview questions	Help address issues with customer interviewing. Use information from interviews to refine questions and develop more empathy and better understanding. Share findings from first round of interviews with class.
6. Present Findings (groups that feel prepared)	For groups that have mostly finished, present findings of interview process. Present conclusions/general thoughts about the needs addressed.
7. Present Findings (remaining groups)	Continued presentations from prior week.
8. Screening needs	Use previously identified criteria for screening needs (session 2) and any other criteria to screen out needs and focus on a single one.
<b>Block 2: How to effectively generate concepts and solution ideas (sessions 9-14)</b>	
9. Introduction to design thinking	Demo day of design thinking concepts. This session will be taught by David Janka, who has run prior sessions at the Center for Primary Care centered around design thinking.
10. Assessing general concept feasibility	Class discussion centered around assessing concept feasibility by thinking through hurdles (economic, market sizing, technological, etc)
11. Ideation day 2/MVP prototyping/storyboarding to show to customers	Students are given time to ideate further and storyboard top ideas. They will proceed to customer concept testing over the next 2 weeks. Split groups up as they were split in prior customer interviews.
12. Customer concept testing	Outside class: Test top ideas by asking customers how they feel about them, continue to develop empathy.
13. Ideation day 3/refinement	Create ranked list of top 3-5 important criteria from interviews. Refine ideas after customer concept testing and revise storyboards
14. Customer concept testing day 2	Retest revised ideas with potential customers
<b>Block 3: Screen solution ideas for economical and implementational feasibility (killer experiments) (sessions 15-20)</b>	
15. Assessing implementational feasibility	Hone in on feasibility regarding technical viability – what is the killer experiment needed to test? Create a milestone. If students have arrived at a problem/need that is too technically complicated to assess within the given time constraint, the facilitator will focus on how one might go about assessing technical feasibility.
16. Assessing economic feasibility and market size	Hone in on feasibility regarding economic viability – what data do you need to know economic viability? This session will be example-based to understand basic market sizing and economic concepts.
17. Research/answer economic viability questions and market sizing	Perform research to generate economic viability answers and use to screen concepts.
18. Prep work for implementation workshop	If it's reasonable to do a demo workshop based on the student problem/idea, use this session to prepare for it (get computers set up, etc)
19. Prototyping workshop day 1	Build a prototype, or build an example project if the student project is not amenable to a prototype.
20. Prototyping workshop day 2	Continue building prototype.
<b>Block 4: Block 4: How to set milestones for implementation and generate a pitch deck (sessions 21-28)</b>	

21. Synthesize milestones (implementational, economic)	Discussion session focused on generating milestones necessary to carry forward the idea
22. Parts of a pitch deck	High level overview of the parts of a pitch deck – divide up into groups to start making pitch decks.
23. Generating a pitch deck	Groups each continue making a pitch deck.
24. Generating a pitch deck	Continue generating a pitch deck
25. Presentations (1.5hr session)	Groups present to each other, provide critique, vote on favorites.
26. Final presentation refinement	Group focuses on one presentation team. Helps refine presentation further.
27. Pitch day	Group pitches to venture capitalists as a cap-stone to the course. Receive feedback.
28. Starting a company as a resident	Guest lecture from local resident who has started multiple companies during residency.

Figure 2

<b><u>Revised Curriculum</u></b>	
<b><i>Session</i></b>	<b><i>Description</i></b>
1. David Janka's session	Design thinking session. Five problems were selected for students to choose from and evaluate using the steps of design thinking.
2. Ways to assess needs/problems	Discussion-based session where students discuss what makes a need "good" or "bad." Google X's moonshot factor needs are presented. Students discuss why google chose these needs and ultimately decide what they value and which needs criteria they would like to use as a class.
3. Practice assessing a need/problem via case-based discussion	A case-style discussion around one of the needs from session 1. The discussion will touch attempt to touch on elements of market size, why the problem hasn't already been fixed, stakeholder needs, identifying the buyer and his/her incentives, regulatory hurdles, and switching costs.
4. Generating customer interview questions	This session begins with an overview of basic principles when generating customer interview questions when vetting a need. If time allows, students will identify all assumptions and questions in order to generate interview questions based on the need/problem discussed in session 3.
5. Practice assessing a need/problem via case-based discussion	A case-style discussion around a different need from session 1. The discussion will touch attempt to touch on elements of market size, why the problem hasn't already been fixed, stakeholder needs, identifying the buyer and his/her incentives, regulatory hurdles, and switching costs.
6. Basic market math (market sizing, economic feasibility)	Example-based session teaching students basic market sizing principles and economics. The session will cover total addressable market, customer acquisition cost, churn, and customer lifetime value. If time allows, we may discuss some of these metrics in the context of taking VC money and the expectations that come with doing so.
7. Practice assessing a need/problem via case-based discussion	A case-style discussion around a different need from session 1. The discussion will touch attempt to touch on elements of market size, why the problem hasn't already been fixed, stakeholder needs, identifying the buyer and his/her incentives, regulatory hurdles, and switching costs.
8. Case based discussion around selecting a need	A case-style discussion around three possible projects to work on. Students are given time at the beginning of the session to present their own potential projects. Students will have an open discussion about which idea is best, having multiple votes throughout.

	At the end of the session, the students will narrow down to 2 ideas based on votes and identify additional questions to answers.
9. Case based discussion to select final need	Continuation of the last session in order to select 1 final need.
10. Generate customer interview script	As a class, generate a customer interview script for the need identified in session 9 using skills learned in session 4.
11. Customer interview	Someone relevant to the need selected for session 9 will have a phone discussion or in-person discussion with the students where they will conduct an interview and learn more about their selected need.
12. Research/answer economic viability questions and market sizing	As a class, students will apply the economic and marketing principles learned in session 6 to the need selected in session 9. The session will again, be a case-style discussion where students should discuss, agree, and disagree.
13. Design thinking day based on selected problem/need	The students will apply design thinking principles learned in session 1 to the need selected in session 9. The goal of this session is to ultimately ideate on possible solutions.
14. Building a prototype/MVP/Storyboarding	Students will use this session to storyboard possible solutions (try to limit to 2-3), think about how they might come up with killer experiments, and think about how they might start prototyping.
15. Shu lecture about starting a company as a resident	Guest lecture from local resident who has started multiple companies during residency.
16. Wrap up	Celebratory session.

Figure 3

*Measuring Success:*

In order to evaluate the success of our curriculum, we aimed to measure the perceived value the developed curriculum provides to medical students regarding self-exploration, preparedness for future careers, enjoyment, and self-defined value. Unfortunately due to logistical issues, we were unable to complete the first or second stage of the curriculum in order to administer this survey. However, we did measure our success with the first session by administering a survey. The students were asked various questions regarding areas of perceived value and asked to rate their satisfaction on a quantitative scale of 1-9. Students were also asked whether or not they would recommend permanent integration of the curriculum into the HMS core curriculum. The feedback survey for our sessions is shown in figure 4.

In order to measure success, the survey was defined on a scale of 1-9, with 5 being “neutral” (i.e. not particularly satisfied but also not dissatisfied). In order to assess the statistical significance of satisfaction with the curriculum across various dimensions, we would need to employ a

student's t-test. Assuming our "control" population would give "neutral" ratings, our intervention population would have a mean rating of 7, and our sigma would be 2, we would need 16 survey participants for a power of 80% and an alpha of 5%. Unfortunately, we were unable to recruit 16 survey participants for our curriculum.

**Results:**

As discussed in the methods section, we unfortunately have been limited in our ability to obtain our original intended results. In October we held a launch event for students as planned. Nisarg Patel spoke about Memora Health, and David Mou spoke about Valera Health. We also explained the rationale for starting the HMS Makerspace Initiative. Following our event, we received a total of 9 applications, of which 8 were accepted. The 9<sup>th</sup> application, which was not accepted, provided several one word answers in response to our application questions, and thus, we felt there was a risk of low student engagement if accepted. An example of our session 1 feedback is outlined in figure 5. These results are unfortunately, statistically insignificant and will require further study to validate.

The image shows two side-by-side screenshots of a Google Forms survey titled "Session 1 Feedback".

**Left Screenshot:**

- Title:** Session 1 Feedback
- Introductory text:** "This survey will help us determine the value of this session and how we can improve it. Please consider a rating of 5 to be neutral (no feelings either way). Your feedback is very valuable to us!"
- Question 1:** "I enjoyed this session \*". A 9-point Likert scale from "I hated this session" to "I loved this session".
- Question 2:** "Overall, I found this session was valuable to me \*". A 9-point Likert scale from "I did not find this course valuable" to "I found this course very valuable".
- Question 3:** "I would recommend integrating this session into the core HMS curriculum \*". A 9-point Likert scale from "I would not recommend integrating this into the HMS curriculum" to "I would highly recommend integrating this into the HMS curriculum".

**Right Screenshot:**

- Question 4:** "Please explain why you think this session should or should not be integrated into the HMS core curriculum \*". Open-ended text input.
- Question 5:** "Which aspects of this session did you find most valuable? What were the session's strengths? \*". Open-ended text input.
- Question 6:** "Which aspects of this session did you find least valuable? What were the session's weaknesses? \*". Open-ended text input.
- Question 7:** "Please rate the effectiveness of your instructor \*". A 9-point Likert scale from "Not at all effective" to "Extremely effective".
- Question 8:** "Please elaborate on your rating (direct, specific feedback, both positive and constructive, is VERY helpful) \*". Open-ended text input.
- Buttons:** "SUBMIT" and "Never submit passwords through Google Forms."
- Footer:** "This content is neither created nor endorsed by Google. Report Abuse - Terms of Service" and "Google Forms".

Figure 4

## Session 1 Feedback

Participant	I enjoyed this session	Overall, I found this session was valuable to me	I would recommend integrating this session into the core HMS curriculum	Please explain why you think this session should or should not be integrated into the HMS core curriculum	Which aspects of this session did you find most valuable? What were the session's strengths?	Which aspects of this session did you find least valuable? What were the session's weaknesses?
1	7	8	2	At least based on what we've learned so far in the first year, it would seem out of place to have a course analyzing whether ideas are good enough to take to market. Need to train physician mindset before innovator mindset	I found it most valuable to realize that even if an idea is good enough, it might not be worth seeing through because the market share might be too small	Everything was valuable, but I was expecting it to be shorter and we ran a while over and had a test the next day. I typically enjoy the slower pace, let's analyze this together type class, but a little stressful when it drags on longer than expected.
2	9	9	5	Cool ideas, not terribly related to clinical practice so most students may not find this useful or interesting	Encouraging participation and thinking was valuable	We occasionally went off topic
3	2	2	1	This session could be integrated into the HMS core curriculum at the very end stage, i.e., after students have real, tangible knowledge far past the introductory Pathways curriculum but take advanced classes and then rotate. Throwing around superficial ideas about "innovating" complex clinical problems with no idea of the science, pathophysiology of disease, or clinical treatment is not useful or instructive.	The broad idea of thinking like a consultant, observing, criticizing, and innovating, are interesting.	This session sought to attack base medical problems through a case based approach. Much more medical experience and knowledge is necessary for this session to be at all intellectually or creatively productive. The process is useful to teach once as it is instructive of how to think and generate ideas, but then topics around how to translate these ideas in the real world and get them heard and sold by firms or employers are more useful than reformatting case based exercises. Otherwise, the exercise is mired and halted by its own superficiality and by quibbling over details.
4	8	7	8	Provided a different way of approaching a problem to general clinical skills, though with a similar focus on not tunneling in on a solution too soon	The hands on tooth brush design exercise	There was too much time spent on the last part of the session during which we went over ideas for medical problems. Seemed like an awkward middle ground in which it either should've been shorter with the same amount of material, or another activity should have been started
5	8	8	8	Not everyone may be interested in seeing these problems from an HBS perspective	Case learning was fun	N/A
6	8	8	8	Should be; it's important to know how to vet ideas.	Interactive!	Could have been longer!

Figure 5

### Discussion:

#### *Launch Event:*

In general, we believed our launch event to be successful. Students seemed engaged, and our speakers did a (subjectively) excellent job with their respective time speaking. Unfortunately, we received fewer applications than anticipated. While we do not have any quantitative data to point to why this might be, there are several possible factors to consider. The timing of the event coincided with other events around campus, which may have made it difficult for some



students to attend and learn about our program. Furthermore, we did not have our launch event until October, which is 2 months after the first year students arrive to campus. In future years, holding our launch event earlier in the year may be beneficial because students have already made several other time commitments 2 months into the year.

#### *Application Process:*

We believe the application process was successful and were happy with the results, aside from the low number of applications received. We were able to select for students willing to invest a significant amount of time in the application process, which we believe has resulted in a very engaged group. Furthermore, the types of questions we asked created responses that were very fun to read. In future years, we would like to use a similar application process.

#### *Curriculum:*

As discussed in methods above, we ran into several logistical issues when building and executing the curriculum. While we are happy with where we ultimately landed, there are still several challenges that remain. Scheduling entrepreneurs has proven very difficult. The ideal solution would be a highly motivated faculty member with entrepreneurial experience to teach the entire series of sessions. However, we have not been able to successfully identify such an individual, nor pay an individual if we were to find one. We are still working on scheduling entrepreneurs at present. As mentioned in the methods section, there are also concerns with entrepreneurs teaching material that is given to them. Most entrepreneurs prefer to be given a topic to present and use their own material to teach a given session. However, this presents challenges with quality control and material continuity between years in the even that we have to find a different entrepreneur to teach a session in a given year. We are still actively working with entrepreneurs to find an ideal solution. At present, an optimal solution may involve a “teaching guide” with specific learning objectives while still allowing entrepreneurs significant freedom and flexibility to achieve those objectives in the manner they find most comfortable.

Unfortunately, we were unable to carry out the surveys as originally planned to measure our success. However, we were able to administer a survey with regards to the first two sessions. The results, while not statistically significant, were positive and encouraging. We hope that with more data we can gain confidence in the value such a curriculum provides to medical students. Interestingly, our survey indicated that several students felt integration into the core curriculum should not be undertaken. Students expressed several concerns including that the material may not appeal to many students who simply wish to learn clinical medicine and that integration in the first year would be too early given the lack of clinical skills and knowledge at this point in medical training. It is unclear whether this sentiment was a function of our session 1 material, which included topics such as market sizing and stakeholder analyses, or a function of a greater sentiment resisting incorporation of general business and management practices into medicine. Further exploration of students' sentiment towards learning and applying business principles to medicine may be warranted.

It should also be noted that there is limitation in the subjectivity of the survey results, even if they had been fully completed. There are multiple potential sources of bias that may lead students to rate the course and/or sessions higher or lower. For example, an affinity towards the instructor may lead students to rate the curriculum higher than if they had purely rated it on the material and learnings alone. Additionally, surveys are inherently subjective rather than objective measurements. Because there are so many sources of potential bias in student survey ratings, it may be difficult to truly assess the course effectiveness and conferred learnings. However, we feel that surveys do provide valuable insight and are time and cost-effective means of evaluating our curriculum.

Future work will include completion of the first stage of the proposed curriculum, as well as execution and completion of the second stage of the curriculum. We hope to measure results in the future to better understand the value such a curriculum can provide to students.

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