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Introducing healthcare innovation concepts during medical education improves graduate medical student self-awareness regarding design thinking concepts

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Study Design

Background

As healthcare costs skyrocket and our population ages, clinicians are increasingly challenged to think outside the box to addressing medicine's greatest problems. As illustrated in Figure 1, design thinking, a human-centric, open approach to problem solving, aims to equip clinicians with the skills and mindsets necessary to tackle increasingly complex healthcare problems with a patient-centric approach that rapidly tests multiple ideas to produce far-reaching, innovative solutions. However, implementation of design thinking into the medical school curriculum is not well characterized and its effect on medical student perceptions towards problem solving and comfort with risk is not understood.

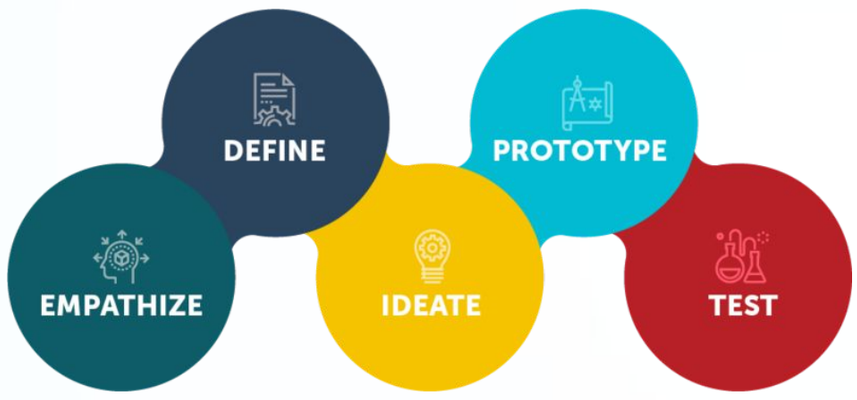

Figure 1. Design Thinking. As illustrated in the above schematic, design thinking is a creative problem solving process that focuses on empathizing with the user to better define a problem with the aim of rapidly creating and testing solutions to create more human-centered solutions.

Purpose

To identify the efficacy of a design thinking and healthcare innovation course on improving graduate medical students' self awareness regarding key design thinking concepts, including embracing risk, human-centeredness, empathy, mindfulness, and multidisciplinary collaboration.

Materials & Methods

The inaugural Innovation and Design Thinking course was held in December 2018 for second year medical students at the Duke-NUS Medical School. The course spanned two and a half days, with the first half-day comprising of lectures covering design thinking and innovation in healthcare, the second day comprising of a full day design sprint, and the last day inclusive of guest lectures by clinician-innovators, as well as a shark tank pitching competition for the top idea, as shown in Figure 2. As part of the course, student teams were given a list of two dozen unmet clinical needs sourced locally and internationally from a broad range of topics, including acute care, post-operative management, cardiovascular and metabolic diseases, women and children's health, and global health, as problem statements. A sample need statement from the maternal and pediatric health category is shown in Figure 3.

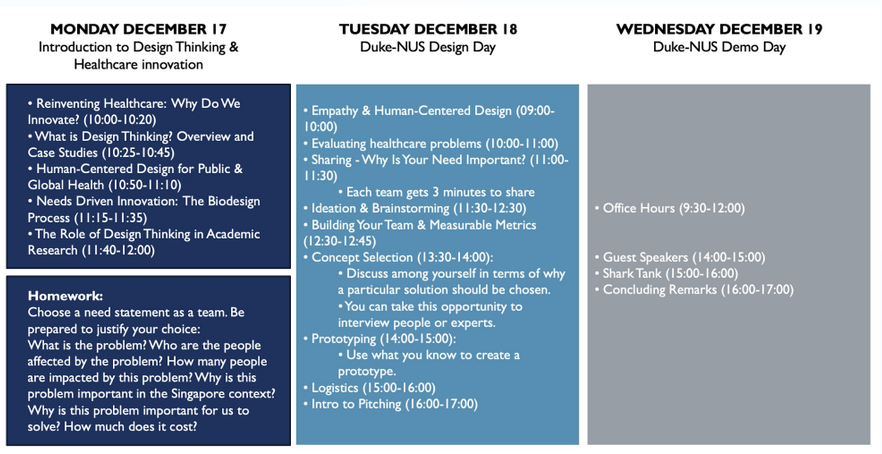

Figure 2. Course Curriculum (left). The three day course was designed to bring medical students through the design thinking process and learn how to pitch their ideas to potential stakeholders and investors.

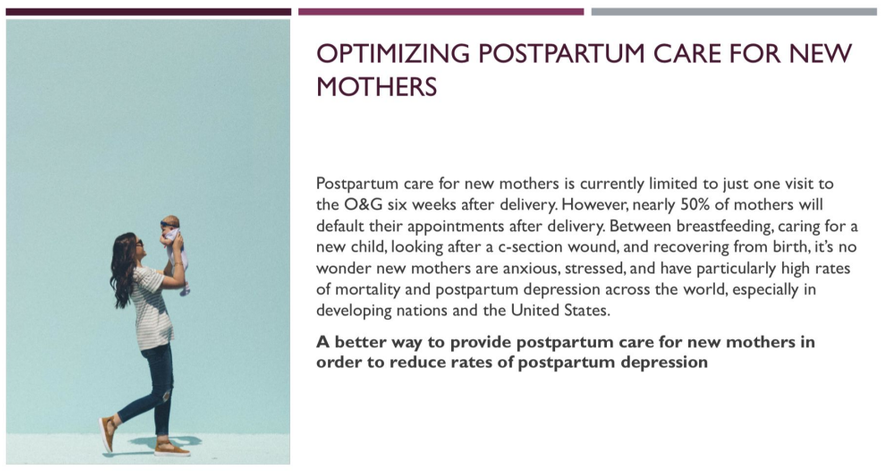

Figure 3. Need Statement (right). Each student team was allowed to select from a range of unmet clinical needs from a wide range of categories, including acute care, post-operative management, cardiovascular and metabolic diseases, women's and children's health, and global health

IRB approval was obtained from the National University of Singapore. The assessment of the design thinking mindset was measured at baseline and post-intervention. The instrument contains 71 validated, Likert psychometric scale items (1- extremely uncomfortable to 5- extremely comfortable) [1], as shown in Figure 4.. The target population included 68 second-year medical students at the Duke-NUS Medical School participating in the Innovation & Design Thinking (IDT) course. Incomplete data were removed from the analysis. All statistical analyses were performed using STATA (StataCorp. 2017. Stata Statistical Software: Release 15. College Station, TX: StataCorp LLC). A paired t-test was used to compare scores from before and after taking the course with p-value set at < 0.05.

Table 3. The validated questionnaire measuring the Design Thinking mindset

A. Tolerance for - Being comfortable with Ambiguity - Uncertainty		
	D1	I feel comfortable with what is unknown.
	D2	I prefer new contexts rather than familiar ones.
	D4	I am comfortable in dealing with unsolved problems.
	D6	I enjoy the fact that a solution can result from unexpected directions.
	D7	I am comfortable in dealing with problems with which I cannot predict if they will be successfully solved
B. Embracing Risk		
	D10	I am comfortable in taking risks
	D11	I like taking many chances, also if it leads me to make mistakes
C. Human centeredness		
	D13	I actively involve users in diverse phases of the design process
	D14	People are source of inspiration while identifying the direction of the design solution
	D15	During the design activity I dedicate a considerable amount of time to understand what users need
D. Empathy / Empathic		
	D17	I can tune into how users feel rapidly and intuitively
	D18	I am comfortable to see problems from the users point of view
	D19	I am comfortable to put myself into the shoes of user
	D20	I easily empathize with the concerns of other people
E. Mindfulness and awareness of process		
	D21	I am capable to recognize when there is the necessity to iterate one phase of the process
	D22	I trust in the process to find new discoveries, rather than focusing on where the outcomes may fall
	D23	I am able to recognize when we are in a divergent or convergent phase of the process
F. Holistic view / consider the problem as a whole		
	D24	I am able to consider what I am doing from a broader perspective
	D25	I am able to understand which are the impacts on the external environment of the solution we are proposing
	D26	I am comfortable to insert into the final solution factors coming from a broader vision
G. Problem reframing		
	D27	I think it is important to reframe the initial problem in order to achieve a good result
	D28	I am interested in better understanding the problem that is given to us
	D29	I am capable to reframe the initial problem statement
H. Team Working		
Ha. Team knowledge		
	D31	I am comfortable to accept the group's decision even if I have a different opinion
	D32	I prefer to work in a team rather than working alone
Hb. Team members' interactions		
	D33	I am comfortable to share my knowledge with my team mates
	D34	I am comfortable to develop new knowledge with other team mates
I. Multi-/ inter-/ cross-disciplinary collaborative teams		
	D35	I am comfortable working with people from outside of my organization
	D36	I think in team is preferable having different competences
	D37	I am comfortable to work with people having diverse perspectives and abilities from mine
	D38	I like to spend time with people doing different work than mine
J. Open to different perspectives /diversity		
	D39	I am comfortable to change my opinion
	D40	I am open to collaborate with people having different backgrounds
	D43	I find value in other people's diversity (perspectives, abilities)
	D44	I believe that teams with diverse perspectives result in superior outcomes
K. Learning oriented		
	D47	I am comfortable to see a problem like an opportunity to learn
	D48	I am comfortable to implement what I learn
	D49	I am comfortable to learn from experiences
	D50	I am comfortable to learn from observations
	D51	I am comfortable to receive feedbacks and learn from them
	D52	I look for something that I don't know
L. Experimentation or learn from mistake or from failure		
La. Experimentation		
	D53	I continually try new things
	D54	I am comfortable to try new approaches to solve problems
	D55	I am comfortable to experiment
Lb. Learn from mistake		
	D56	I recognize the importance of failing in order to learn
	D57	I am comfortable to make prototypes in order to explore
	D58	I am capable to discuss mistakes and learn from them
M. Experiential intelligence / Bias toward action		
Ma. Bias for action		
	D59	It is easier to gain knowledge through hands
	D60	I prefer doing rather than thinking
Mb. Transforming in something tangible what's not		
	D61	I am comfortable transforming ideas into something tangible
	D62	I am comfortable transforming hypothesis in something to be tested
N. Critical Questioning ("beginners mind", curiosity)		
	D63	I look for something new in a new situation
	D64	I am curious about what I don't know
	D65	I generally seek as much information as I can in new situations
O. Abductive Thinking		
	D66	I am comfortable to invent or simulate alternative contexts of use of the solution
	D67	I am comfortable to invent new conditions for future possibility of the project
	D68	I am comfortable to build conclusions from incomplete information
	D69	I am comfortable to take decisions from a plausible hypothesis
P. Envisioning new things		
	D71	I am capable of keeping multiple options open at the same time
	D72	I can foresee different outcomes of a project
	D73	I am comfortable to use prototypes to represent new ideas
Q. Creative confidence		
	D74	I think I can use my creativity to efficiently solve even complicated problems
	D75	I am comfortable to think something new, different from what already exists
	D76	I am sure I can deal with problems requiring creativity
	D77	I believe in my abilities to creatively solve a problem
R. Desire to make a difference		
	D78	I have the desire to change the status quo
	D80	I desire to create value with the final solution
	D81	I desire to have an impact on people around me
S. Optimism to have an impact		
	D82	I think I can overcome difficulties
	D83	I am comfortable to see a problem like an opportunity
	D84	I am comfortable to positively think and act

Figure 4. Validated questionnaire measuring the Design Thinking Mindset. Before and after taking the Innovation and Design Thinking course, students were asked to fill out the survey[1].

Study Findings

Results

Tolerance for uncertainty became more positive between successive surveys (mean improvement in questionnaire score 0.360, p-value 0.022). Students were also more comfortable in embracing risks (mean improvement score of 0.380, p-value 0.046). The largest improvement post the IDT course was in the awareness of process (mean improvement score of 0.467, p-value 0.016). No notable change in mindset was observed in constructs such as human-centeredness, empathy, holistic view, reframing a problem, teamwork, multi-disciplinary collaboration, critical questioning, abductive thinking, envisioning new things, creative confidence, desire to make a difference, and optimism to have an impact.

Outcome Categories	Tolerance for Uncertainty	Embracing Risk	Human Centeredness	Empathy	Awareness of Process	Holistic View	Reframing a Problem	Teamwork
Baseline	2.768 ±0.547	2.620 ±0.833	3.133 ±0.553	3.130 ±0.451	2.680 ±0.557	2.893 ±0.622	3.093 ±0.436	3.070 ±0.597
Post- Course	3.128 ±0.702	3.000 ±0.878	3.320 ±0.748	3.270 ±0.760	3.147 ±0.721	3.200 ±0.745	3.120 ±0.738	3.160 ±0.718
Difference	0.360 ±0.735	0.38 ±0.905	0.187 ±0.694	0.140 ±0.754	0.467 ±0.903	0.307 ±0.763	0.027 ±0.700	0.090 ±0.863
T-statistics	2.450	2.100	1.344	0.929	2.585	2.009	0.191	0.522
P-value	0.022	0.046	0.192	0.362	0.016	0.056	0.851	0.607

Figure 5. Relevant Design Thinking Mindset Measurements.

Conclusions

Instructing graduate medical students on the principles of design thinking and their potential applications in healthcare increase their comfort with risk and uncertainty and improve their self-reported scores on awareness of the design thinking process.

References

1. Dosi, C., Rosati, F. and Vignoli, M., 2018. Measuring Design Thinking Mindset. In DS92: Proceedings of the Design 2018 15th International Design Conference (pp. 1991-2002).

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