

The Impact of Education Reform: An Asian Medical School's Experience

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Abstract

This study assessed the effectiveness of education reforms on student-reported learning outcomes at the end of the 5-year medical school (M5) and 1-year internship (HO) in 2006, 2007 and 2008. A self-administered anonymous survey with 17 learning outcomes assessed, derived from Harden's Three-Circle Outcomes Model for outcomes-based education, was administered to 683 students at the end of medical school (M5) and internship (HO) from 2006, 2007 and 2008. We identified learning outcomes which changed significantly for internship (Cohorts A, B and C) and medical school (Cohorts B, C and D) between cohorts from 2006 to 2008, and compared learning outcomes between medical school and internship within cohorts (i.e. Cohort B which was M5 in 2006 and HO in 2007; Cohort C which was M5 in 2007 and HO in 2008). The proportion of students who agreed that medical school helped them achieve learning outcomes increased significantly from 2006 to 2008 for 15 out of 17 learning outcomes assessed. The proportion of students who agreed that internship helped them achieve learning outcomes increased significantly from 2006 to 2008 for 6 learning outcomes assessed. For Cohorts B and C, internship was more effective than medical school in achieving 8 learning outcomes. Cohort C reported that internship was more effective than medical school in 3 additional learning outcomes than Cohort B: patient management, humility and dedication. We conclude that a successful journey of education reform is an ongoing process that needs to comprehensively address multifaceted components such as faculty, administration and curriculum.

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Key words: Harden's Three-Circle Outcomes Model, Housemanship, Internship

Introduction

The Yong Loo Lin School of Medicine of the National University of Singapore (NUS Medicine) is the first medical school in Singapore and was established 111 years ago in 1905. The medical school has a 5-year undergraduate curriculum and 1-year housemanship, after which its students can then be fully registered.¹

Education Reform (2002 to 2008)

In 2005, the Yong Loo Lin Trust made a transformational

gift of S\$100 million to NUS Medicine which was matched by the government. The gift provided funding to recruit and retain top faculty, develop state-of-the-art facilities and strengthen administrative infrastructure for both research and education.² Later in 2007, additional funding from the Ministry of Education was obtained to support clinical training; and the Centre for Biomedical Ethics (CBmE), South East Asia's first academic centre for biomedical ethics, was established through a donation from the Chen Su Lan Trust.³ In January 2002, the Medical Education Unit (MEU) was created to support medical education in NUS Medicine

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through faculty development programmes, workshops and regional meetings like the Asia Pacific Medical Education Conference. The educational enhancements from 2002 to 2008 are detailed in Table 1 and online supplementary material at <https://www.dropbox.com/s/1oy3hv9io7jhz7m/ONLINE%20SUPPLEMENTARY%20MATERIAL.docx?dl=0>.

Assessment of Learning Outcomes

We assessed the effectiveness of these educational enhancements on medical students' learning outcomes by using student-reported learning outcomes at the end of medical school and housemanship using Harden's Three-Circle Outcomes Model which groups learning outcomes into 3 domains: 1) technical intelligence, 2) intellectual,

Table 1. Educational Enhancements at the Yong Loo Lin School of Medicine, 1999 to 2008

Educational Enhancement	Year of Implementation
Curriculum	
Medical school	
Harmonisation of training of medical students at partner training hospitals	
Standardised structure to medical student training	
Enhancement of professional development and communications programme	
Re-alignment of curricular goals to Accreditation Council for Graduate Medical Education (ACGME) physician competencies	
Introduction of standardised patients earlier in the first year	
Use of patient simulators spanning preclinical to clinical years	1999
Increase in ambulatory training in specialist outpatient and primary care clinics	
Embedding of medical students into healthcare teams in training hospitals	
Expansion of student housemanship programme in the final year	
Increased use of information technology and health information systems in hospitals for training of students	
Clinical Skills Foundation Course in the second year	
Structured Clinical Clerkship in the third year	
Housemanship	
Harmonisation of training of interns at partner training hospitals	
Standardised structure and assessment of intern training	
Re-alignment of intern training to Accreditation Council for Graduate Medical Education (ACGME) physician competencies	2005
Refinement of housemanship specialty postings	
Increased weighting on communication, interpersonal and teamwork skills in intern assessments	
Closer tracking of intern performance using more comprehensive logbooks and 360° feedback from teachers, peers and other healthcare team members	
Faculty (medical school and housemanship)	
Creation of more full time and fractional faculty positions which allowed retention and expansion of talent base	
Targeted appointment of clinical educators	
Protection of time for teaching	
Enhanced provision of resources to train teachers (e.g. medical education rounds, regular pedagogy workshops and conferences)	2005
Increased recognition of good teachers through award systems	
Establishment of Medical Education Unit (MEU) for faculty development, workshops and education research	
Establishment of the Centre for Biomedical Ethics	
Administration (medical school and housemanship)	
Creation of remunerated Associate Dean positions in satellite training hospitals to improve tracking, organisation and coordination of medical student and intern training	
Provision of funding for Associate Deans' offices	
Increased administrative support to monitor student feedback more closely and respond to it in a more timely manner	2005
Increased accountability of Associate Deans and partner institutions for quality of medical student and intern training	
Standardised reporting dashboard for medical education for comparison across clinical training sites	
Funding for medical education in training sites linked to dashboard indicators	

emotional, analytical and creative intelligences, and 3) personal intelligence.^{4,5} We also determined the trends in learning outcomes from medical school between cohorts, trends in learning outcomes from housemanship between cohorts, and the differences in learning outcomes between medical school and housemanship within cohorts, from 2006 to 2008 as we hypothesised that education reforms implemented from 1999 to 2005 would effect changes in cohorts graduating between 2006 and 2008.

A self-administered anonymous survey was administered to all students at the end of medical school (M5) and housemanship (HO, during their end-of-housemanship graduation ceremony) in 2006, 2007 and 2008 which involved 4 cohorts (A, B, C and D). Students from Cohort A were HOs in 2006 (reference baseline group for HO), Cohort B were M5 in 2006 (reference baseline group for M5) and HOs in 2007, Cohort C were M5 in 2007 and HOs in 2008, and Cohort D were M5 in 2008.

The survey had 17 learning outcomes grouped into 3 categories (or “circles”) in accordance with Harden’s Three-Circle Outcomes Model⁵ which were: 1) technical intelligence (the inner circle, i.e. “doing the right thing”), 2) intellectual, emotional, analytical and creative intelligence (the middle circle, i.e. “doing the thing right”), and 3) personal intelligence (the outer circle, i.e. “the right person doing it”). The inner circle of technical intelligence consisted of 6 learning outcomes: a) practical procedures; b) patient investigation; c) patient management; d) health promotion and disease prevention; e) communication; and f) appropriate information handling skills. Harden’s original inner circle also contained a seventh learning outcome—basic clinical skills—but this was removed from our survey as we felt that there was overlap between what is perceived as basic clinical skills and the other domains within the inner circle. In the middle circle of intellectual, emotional, analytical and creative intelligences, we used Harden’s original 3 learning outcomes which were: a) understanding social and clinical sciences underlying principles; b) attitudes, ethical and legal responsibilities; and c) decision-making skills, and clinical reasoning and judgement. We also added 3 new learning outcomes into the middle circle: d) integrity and honesty, as we felt that these were important but understudied values needed a healthy doctor-patient relationship; e) compassion and empathy, as they were essential values which doctors need to possess, especially when informing patients of dreaded diagnoses; and f) approachability, because previous research on our students found that they identified these learning outcomes as uniquely important as they allow patients and colleagues to feel at ease when asking questions or seeking clarifications (Tan CH, Lim J, Koh DR. Intelligences in role model doctor: Harden three-circle model – a survey of final year medical students. Paper

presented at: Association of Medical Education European Conference; September 6, 2004, Edinburgh, Scotland, UK; Lim J, Tan CH. What makes a good doctor? A survey of final year medical students. Paper presented at: Association of Medical Education European Conference; September 8, 2004, Edinburgh, Scotland, UK). In Harden’s original outer circle of personal intelligence, there were only 2 learning outcomes: ‘role of the doctor within the healthcare system’ and ‘personal development’. The first learning outcome of the outer circle was dichotomised into 2 major roles a doctor plays in the healthcare system: the a) role of the doctor as mentor/teacher and the b) role of the doctor as part of multi-professional team. The second learning outcome of the outer circle was expanded into 3 outcomes: c) self-improvement; d) humility, an important quality needed for self-regulation; and e) dedication, because previous research on our students found that they felt these learning outcomes were particularly important in our local Asian context (Tan CH, Lim J, Koh DR. Intelligences in role model doctor: Harden three-circle model – a survey of final year medical students. Paper presented at: Association of Medical Education European Conference; September 6, 2004, Edinburgh, Scotland, UK; Lim J, Tan CH. What makes a good doctor? A survey of final year medical students. Paper presented at: Association of Medical Education European Conference; September 8, 2004, Edinburgh, Scotland, UK). A 4-point Likert scale was used to assess the extent to which participants agreed that their medical school and housemanship experience were effective in helping them achieve each learning outcome: strongly disagree, disagree, agree or strongly agree. The data was collapsed into 2 categories before analysis: “disagree” consisting of strongly disagree and disagree, and “agree” consisting of agree and strongly agree. This study was approved by the National University of Singapore’s Institutional Review Board.

We were unable to match the medical school survey results with the same cohort’s housemanship survey results because the data was anonymously collected. The response rates for M5s and HOs were 76.4% and 80.4% in 2006, 61.2% and 52.4% in 2007 and 88.9% and 40.5% in 2008, respectively. Linear-by-linear association was used to test the trends and Chi-square analysis to compare between cohorts. We used Statistical Package for Social Sciences (Version 20) to perform statistical analyses and statistical significance was set at $P < 0.05$.

Learning Outcomes from Medical School between Cohorts

Fifteen of the 17 learning outcomes had significant increases in proportion of medical students who agreed that medical school helped to achieve them (Table 2). Within the inner circle of technical intelligences, 5 out of the 6 learning

Table 2. Perceptions from Three Cohorts of Final Year Students (M5) on Whether Medical School Helped Them Achieve Learning Outcomes According to Harden's Three-Circle Model

Learning Outcome	n (%)						Total (n = 515)		Rank by Total % Who Agree	P Value (Linear- by-Linear Association)
	M5 2006 (n = 175)		M5 2007 (n = 139)		M5 2008 (n = 201)					
	Disagree	Agree	Disagree	Agree	Disagree	Agree	Disagree	Agree		
1. Inner circle: technical intelligence										
(a) Practical procedures	43 (24.6%)	132 (75.4%)	20 (14.4%)	119 (85.6%)	25 (12.4%)	176 (87.6%)	88 (17.1%)	427 (82.9%)	7/8	0.020
(b) Patient investigation	27 (15.4%)	148 (84.6%)	14 (10.1%)	125 (89.9%)	14 (7.0%)	187 (93.0%)	55 (10.7%)	460 (89.3%)	2	0.008
(c) Patient management	51 (29.1%)	124 (70.9%)	32 (23.0%)	107 (77.0%)	29 (14.4%)	172 (85.6%)	112 (21.7%)	403 (78.3%)	14	0.001
(d) Health promotion and disease prevention	43 (24.6%)	132 (75.4%)	26 (18.7%)	113 (81.3%)	28 (13.9%)	173 (86.1%)	97 (18.8%)	418 (81.2%)	12	0.009
(e) Communication	37 (21.1%)	138 (78.9%)	22 (15.8%)	117 (84.2%)	29 (14.4%)	172 (85.6%)	88 (17.1%)	427 (82.9%)	7/8	0.088
(f) Appropriate information handling skills	58 (33.3%)	116 (66.7%)	39 (28.1%)	100 (71.9%)	31 (15.4%)	170 (84.6%)	128 (24.9%)	386 (75.1%)	17	<0.001
2. Middle circle: intellectual, emotional, analytical and creative intelligences										
(a) Understanding of social and clinical sciences underlying principles	48 (27.4%)	127 (72.6%)	35 (25.2%)	104 (74.8%)	26 (12.9%)	175 (87.1%)	109 (21.2%)	406 (78.8%)	13	0.001
(b) Attitudes, ethical and legal responsibilities	57 (32.6%)	118 (67.4%)	35 (25.2%)	104 (74.8%)	32 (15.9%)	169 (84.1%)	124 (24.1%)	391 (75.9%)	16	<0.001
(c) Decision-making skills, clinical reasoning and judgement	39 (22.4%)	135 (77.6%)	29 (20.9%)	110 (79.1%)	23 (11.4%)	178 (88.6%)	91 (17.7%)	423 (82.3%)	9	0.005
(d) Integrity and honesty	39 (22.4%)	135 (77.6%)	24 (17.4%)	114 (82.6%)	15 (7.5%)	186 (92.5%)	78 (15.2%)	435 (84.8%)	5	<0.001
(e) Compassion and empathy	43 (24.6%)	132 (75.4%)	30 (21.9%)	107 (78.1%)	20 (10.0%)	181 (90.0%)	93 (18.1%)	420 (81.9%)	10	<0.001
(f) Approachability	47 (26.9%)	128 (73.1%)	42 (30.4%)	96 (69.6%)	30 (14.9%)	171 (85.1%)	119 (23.2%)	395 (76.8%)	15	0.005
3. Outer circle: personal intelligence										
(a) Role of the doctor as mentor/teacher	35 (20.0%)	140 (80.0%)	38 (27.3%)	101 (72.7%)	23 (11.4%)	178 (88.6%)	96 (18.6%)	419 (81.4%)	11	0.026
(b) Role of the doctor as part of multiple-professional team	22 (12.6%)	153 (87.4%)	17 (12.3%)	121 (87.7%)	8 (4.0%)	193 (96.0%)	47 (9.1%)	467 (90.9%)	1	0.003
(c) Self-improvement	23 (13.3%)	150 (86.7%)	18 (13.0%)	120 (87.0%)	15 (7.5%)	186 (92.5%)	56 (10.9%)	456 (89.1%)	3	0.067
(d) Humility	32 (18.3%)	143 (81.7%)	27 (19.6%)	111 (80.4%)	22 (10.9%)	179 (89.1%)	81 (15.8%)	433 (84.2%)	6	0.046
(e) Dedication	33 (18.9%)	142 (81.1%)	22 (15.9%)	116 (84.1%)	11 (5.5%)	190 (94.5%)	66 (12.8%)	448 (87.2%)	4	<0.001

Note: Numbers may not add up to total because of missing data. Only valid percentages are shown.

outcomes exhibited significant increases within the 3 years studied. Within the middle circle of intellectual, emotional, analytical and creative intelligences, all 6 learning outcomes exhibited significant increases within the 3 years

studied. Within the outer circle of personal intelligences, 4 out of the 5 learning outcomes demonstrated significant increases within the 3 years studied.

Table 3. Perceptions from Three Cohorts of Post-internship Students (HO) on Whether Internship Helped Them Achieve Learning Outcomes According to Harden's Three-Circle Model

Learning Outcome	n (%)						Total (n = 456)		Rank by Total % Who Agree	P Value (Linear- by-Linear Association)
	HO 2006 (n = 168)		HO 2007 (n = 120)		HO 2008 (n = 92)					
	Disagree	Agree	Disagree	Agree	Disagree	Agree	Disagree	Agree		
I. Inner circle: technical intelligence										
(a) Practical procedures	47 (28.0%)	121 (72.0%)	23 (19.2%)	97 (80.8%)	11 (12.0%)	81 (88.0%)	81 (21.3%)	299 (78.7%)	16	0.002
(b) Patient investigation	25 (14.9%)	143 (85.1%)	10 (8.3%)	111 (91.7%)	4 (4.3%)	88 (95.7%)	39 (10.3%)	341 (89.7%)	4/5	0.005
(c) Patient management	33 (19.6)	135 (80.4%)	25 (20.8%)	95 (79.2%)	10 (10.9%)	82 (89.1%)	68 (17.9%)	312 (82.1%)	15	0.118
(d) Health promotion and disease prevention	51 (30.4%)	117 (69.6%)	18 (15.0%)	102 (85.0%)	15 (16.3%)	77 (83.7%)	84 (22.1%)	296 (77.9%)	17	0.003
(e) Communication	34 (20.4%)	133 (79.6%)	19 (15.8%)	101 (84.2%)	11 (12.0%)	81 (88.0%)	64 (16.9%)	315 (83.1%)	14	0.078
(f) Appropriate information handling skills	34 (20.4%)	133 (79.6%)	17 (14.2%)	103 (85.8%)	9 (9.8%)	83 (90.2%)	60 (15.8%)	319 (84.2%)	13	0.022
2. Middle circle: intellectual, emotional, analytical and creative intelligences										
(a) Understanding of social and clinical sciences underlying principles	27 (16.2%)	140 (83.8%)	11 (9.2%)	109 (90.8%)	6 (6.5%)	86 (93.5%)	44 (11.6%)	335 (88.4%)	8	0.014
(b) Attitudes, ethical and legal responsibilities	29 (17.3%)	139 (82.7%)	15 (12.5%)	105 (87.5%)	12 (13.0%)	80 (87.0%)	56 (14.7%)	324 (85.3%)	12	0.296
(c) Decision-making skills, clinical reasoning and judgement	30 (17.9%)	138 (82.1%)	12 (10.0%)	108 (90.0%)	8 (8.8 %)	83 (91.2 %)	50 (13.2%)	329 (86.8%)	10	0.025
(d) Integrity and honesty	21 (12.5%)	147 (87.5%)	11 (9.2%)	109 (90.8%)	7 (7.6%)	85 (92.4%)	39 (10.3%)	341 (89.7%)	4/5	0.192
(e) Compassion and empathy	20 (11.9%)	148 (88.1%)	13 (10.8%)	107 (89.2%)	10 (10.9%)	82 (89.1%)	43 (11.3%)	337 (88.7%)	6/7	0.778
(f) Approachability	19 (11.3%)	149 (88.7%)	17 (14.2%)	103 (85.8%)	10 (10.9%)	82 (89.1%)	46 (12.1%)	334 (87.9%)	9	0.969
3. Outer circle: personal intelligence										
(a) Role of the doctor as mentor/teacher	25 (15.1%)	141 (84.9%)	13 (10.8%)	107 (89.2%)	15 (16.3%)	77 (83.7%)	53 (14.0%)	325 (86.0%)	11	0.945
(b) Role of the doctor as part of multiple-professional team	19 (11.4%)	148 (88.6%)	10 (8.3%)	110 (91.7%)	9 (9.8%)	83 (90.2%)	38 (10.0%)	341 (90.0%)	3	0.598
(c) Self-improvement	11 (6.6%)	155 (93.4%)	9 (7.5%)	111 (92.5%)	6 (6.5%)	86 (93.5%)	26 (6.9%)	352 (93.1%)	1	0.982
(d) Humility	21 (12.8%)	143 (87.2%)	14 (11.7%)	106 (88.3%)	6 (6.5%)	86 (93.5%)	41 (10.9%)	335 (89.1%)	6/7	0.141
(e) Dedication	15 (9.0%)	152 (91.0%)	13 (10.9%)	106 (89.1%)	5 (5.4%)	87 (94.6%)	33 (8.7%)	345 (91.3%)	2	0.434

Note: Numbers may not add up to total because of missing data. Only valid percentages are shown.

Learning Outcomes from Housemanship between Cohorts

Six of the 17 learning outcomes had significant increases in proportion of interns who agreed that housemanship

helped to achieve them (Table 3). Within the inner circle of technical intelligences, 4 out of the 6 learning outcomes exhibited significant increases within the 3 years studied. Within the middle circle of intellectual, emotional, analytical

and creative intelligences, only 2 out of the 6 learning outcomes exhibited significant increases within the 3 years studied. Unlike medical school, none of the 5 learning outcomes of the outer circle of personal intelligences from housemanship demonstrated any significant increase within the 3 years studied.

Learning Outcomes from Housemanship within Cohorts

Both Cohorts B and C reported that housemanship was more effective than medical school in achieving all 6 learning outcomes within the middle circle (Table 4). Both Cohorts B and C also reported that housemanship was more effective than medical school in learning appropriate information handling skills (inner circle) and the role of the doctor as a mentor or teacher (outer circle). However, the later cohort (Cohort C) additionally reported that housemanship was more effective than medical school in learning patient management (inner circle), and humility and dedication (both from outer circle).

Discussion

We found that the learning outcomes for both medical students and interns progressively improved between and within consecutive student cohorts from 2006 to 2008. We hypothesise that the establishment of the Centre for Biomedical Ethics in 2006 could have been responsible for the improvements in learning “attitudes, ethical and legal responsibilities” and “integrity and honesty” in our medical students. However, it is not possible to objectively attribute which each educational enhancement introduced into medical school and housemanship to each learning outcome as the intervention was a complex one. Instead, the education enhancements probably had varying influences on each other, akin to complexity science, and should be viewed as a whole education ecosystem with elements of dynamic interactions.⁶ Nevertheless, the education reform process was most likely the underpinning driver of these improvements from 2006 to 2008.

For the 2 cohorts who were surveyed on both their medical school and housemanship experience (Cohorts B and C), the students felt that housemanship was better at achieving all the learning outcomes within the middle circle (intellectual, emotional, analytical and creative intelligences) than medical school. We hypothesise that regular supervision and role-modelling over a sustained period and exposure to real contexts and practical situations during housemanship resulted in the houseman being better at achieving the learning outcomes within the middle circle.

Education reform, improvement and refinement are a constant process but many medical schools struggle to find funds to implement these changes. NUS Medicine was in

Table 4. Comparison of Learning Outcomes between Medical School and Internship for Both Cohort B (M5 2006 vs HO 2007) and Cohort C (M5 2007 vs HO 2008)

Learning Outcome	P Value (Chi-square)	
	Cohort B (M5 2006 vs HO 2007)	Cohort C (M5 2007 vs HO 2008)
1. Inner circle: technical intelligence		
(a) Practical procedures	0.313	0.581
(b) Patient investigation	0.089	0.109
(c) Patient management	0.127	0.018
(d) Health promotion and disease prevention	0.056	0.723
(e) Communication	0.244	0.398
(f) Appropriate information handling skills	<0.001	0.001
2. Middle circle: intellectual, emotional, analytical and creative intelligences		
(a) Understanding of social and clinical sciences underlying principles	<0.001	<0.001
(b) Attitudes, ethical and legal responsibilities	<0.001	0.023
(c) Integrity and honesty	0.004	0.032
(d) Compassion and empathy	0.004	0.029
(e) Approachability	0.012	<0.001
(f) Decision-making skills, clinical reasoning and judgment	0.005	0.014
3. Outer circle: personal intelligence		
(a) Role of the doctor as mentor/teacher	0.045	0.048
(b) Role of the doctor as part of multiple-professional team	0.243	0.539
(c) Humility	0.150	0.005
(d) Self-improvement	0.149	0.109
(e) Dedication	0.082	0.015

the fortunate position to have leadership willing to prime the education enterprise with the necessary startup resources and foundation for the change process, and to continually strive for quality improvement. The experience provided much needed impetus to justify a substantial increase in funding from the education ministry. This allowed the school to build on its early successes and establish a sustainable core of clinical educators and administrators for the school. Our findings support the work done by Verstegen and King, who reviewed and analysed 35 years of production functional research, and concurred that resource inputs into schooling

influences the academic educational outcomes of students.⁷ Nevertheless, the aim of this case study was not to be self-laudatory but to share with the medical education community our experience on how properly targeted resource allocation dedicated to educational enhancements in our medical school led to tangibly better learning outcomes as reported by our students. We do not propose that a mere increase in funding will automatically translate to better learning experiences for medical students but emphasise instead that a successful journey of education reform is an ongoing process that needs to comprehensively address multifaceted components such as faculty, administration and curriculum.

Study Limitations

Our study also has limitations. Firstly, the response rates for post-internship surveys in 2007 and 2008 were less than ideal (52.4% and 40.5%, respectively). Secondly, the learning outcomes achieved were self-reported and not assessed with a standardised accrediting examination. We also did not survey HOs who graduated overseas or supervisors for their opinions on the competency of HOs. Lastly, our results were observed for only 3 years and it is uncertain if the improved learning outcomes were sustained after 2008.

Conclusion

Education reforms and sustained education quality improvement over time in a large Asian medical school led to improved learning outcomes from both medical school and housemanship. A successful journey of education reform is an ongoing process that needs to comprehensively address faculty, administration and curriculum.

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