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ORIGINAL RESEARCH

Faculty's Attitudes Toward a Reformed Curriculum at a Medical School in China

Hongmei Dong · Renslow Sherer · Jingyi Fan · Brian Cooper · Ivy Morgan

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Abstract
Purpose Wuhan University Medical School in China launched a pilot project to reform its education by adapting the medical curriculum of the University of Chicago. Students in the pilot were educated in the new curriculum while the rest remained in the traditional one. This study assessed the reform by exploring and comparing faculty participants' perceptions of the reform and traditional curricula.
Methods A survey was administered to faculty members who taught both curricula, asking them to assess each curriculum with respect to the following categories: overall content and structure, basic science courses, instruction, and assessments. Each category consisted of a set of questions. Frequency distributions and Wilcoxon signed ranks tests were used in data analyses.
Results Participants' (N=72) views of the reform curriculum and pedagogy were more positive than their views of the traditional counterpart. Significant differences between participants' views were revealed in all the curricular categories. Item-by-item comparisons found many significant differences, suggesting an overall preference for the reform.
Conclusion Study results suggest that the reform has been implemented effectively and has been well received by faculty participants. These findings have implications for similar reform initiatives in China as well as other developing countries.

Keywords Medical education reform · Medical education in China · Curriculum change · Participant perception · Curriculum reform based on Western model

H. Dong (✉) · R. Sherer · B. Cooper · I. Morgan
Department of Medicine, The University of Chicago, 5841 S. Maryland Ave. MC 5065, Chicago, IL 60637, USA
e-mail: hdong@bsd.uchicago.edu

J. Fan
School of Medicine, Wuhan University, Wuhan, China

Introduction

For the past several decades, researchers in the West have been criticizing and debating about the quality of medical education, pointing out medical schools' lack of effectiveness in preparing their students to be physicians [1]. In response to the criticism, new educational foci and goals have been proposed and many innovations have been implemented [2, 3].

A similar trend of critiquing medical education for improvement has been present in China in more recent years. Chief shortcomings of the traditional ways of education include a curriculum that has been stagnant for the past 40 years or so, a lack of clinical relevance in the basic sciences, courses based on traditional subjects as opposed to organ systems, and curricular fragmentation resulting in weak connection among basic sciences and between basic sciences and clinical medicine [4–6]. The traditional pedagogy is characterized by a predominance of didactic teaching, passive learning, and poorly developed assessment systems [6, 7]. These weaknesses are now being addressed by reform efforts in some medical schools in China [7, 8]. Current reform initiatives have focused on a move toward curriculum integration and a pedagogy that promotes small group and independent learning and the development of analytical and problem-solving abilities in students [9]. In the process of reform, Western medical education practices have often been borrowed to use as frameworks for change [8, 10, 11].

Another recent development in medical education in the West is the application of the principles of evidence-based medicine to the measurement of educational effectiveness [12, 13]. When applied to curricular reform, these principles suggest that curriculum evaluation should be an integral part of the change process. Curriculum evaluation helps ensure the quality of learning and teaching experiences and informs curriculum refinement and delivery [14]. This evaluation process should include faculty, students, and graduates and obtain

these participants' perceptions as evidence on the basis of which to measure curriculum and instruction [12]. Such evaluations can provide feedback for the reform process and evidence for the effectiveness (or the lack thereof) of reform.

Based on a medical curriculum reform project at Wuhan University Medical School, China, this survey study is an attempt to assess the results of the curricular innovation by using faculty's evaluation of the preclinical portion of the traditional and the reform curricula. We also sought to fill in a gap in literature on China's comprehensive medical education reform at the level of the entire curriculum. Finally, our findings may be of interest to international readers, as many countries' medical schools are still confined to traditional curricula and teaching methods and in need of change, according to academic leaders from diverse countries [15].

Background of this Study

The traditional curriculum and pedagogies at Wuhan University Medical School (WU) in China displayed the shortcomings of medical education in China as previously described. Realizing the need for change, WU launched the Wuhan University Medical Education Reform (WUMER) project in 2008 with assistance from the University of Chicago School of Medicine (UC). As a partnership between the two universities, this project aimed at reforming WU medical education by modifying and adapting the UC curriculum and pedagogies. The current medical curriculum at UC was the result of a thorough curricular and pedagogical renovation [16]. Key elements of the preclinical education at UC include integrated courses in basic sciences, as opposed to the previous departmentally-based course structure; a comprehensive clinical medicine course called Clinical Pathophysiology and Treatment (CPPT) that integrates pathology, physiology, clinical reasoning, and treatment; the use of clinical cases for teaching basic sciences and clinical medicine; coursework in social and humanitarian aspects of medicine; earlier patient contact; small group and independent learning; and an emphasis on formative assessment.

Based on the UC model and informed by WU's assessment of its needs, WU implemented a pilot reform curriculum (RC) alongside its traditional curriculum (TC). Each year since 2009, freshmen volunteered to be in RC, and 50 were randomly selected to join the reform curriculum. The rest of the freshmen (about 250) remained in the TC. At the time of this study, about 200 students were in the reform program, the first class of whom had recently completed their preclinical years' study (note that WU's undergraduate medical education is a 5-year-long program, with the first 3 years focusing on preclinical coursework and the final 2 years on clinical clerkships). Faculty members were not randomly selected to join the reform; some were assigned to teach the reform classes, some volunteered, while others were chosen by reform course directors based on their past teaching performance. All faculty members at the school were informed about the reform and encouraged to join.

WU's reformed curriculum and pedagogy had the following main characteristics. First, lecture time was considerably reduced, with a corresponding increase in small group learning and self-directed study. Second, basic science courses were integrated where appropriate and their relevance to clinical medicine was made apparent with the use of brief clinical vignettes selected to illuminate basic science concepts and mechanisms of disease pathogenesis. Third, UC's clinical medicine course (CPPT) was adapted and first implemented at WU in 2011 with year-three students. Fourth, coursework in community medicine, medical ethics, and humanitarian aspects of medicine was increased and strengthened. Fifth, educational goals emphasized not only students' acquisition of knowledge but also the development of their independent and collaborative learning dispositions, positive attitudes toward learning, and higher-level thinking abilities. Finally, formative assessments were used to inform teaching and learning. Traditionally, assessments of students consisted of summative tests only, namely midterm and final exams, the purpose of which was to assign students grades. All reform courses now added formative assessments—such as frequent quizzes with multiple choice or short answer questions, ongoing evaluation during small group sessions, and conferences with individual students—to give students feedback during the leaning process and to guide faculty as they made adjustments to teaching. In addition, both formative and summative assessments in the RC reflected the new curricular goals of integration, clinical relevance, collaborative learning, and the development of higher-order thinking. For a description of the new curriculum, pedagogy, and assessment practice, please refer to the results of a student survey conducted at WU previously [17]. The reform reflected the key features of medical education innovation in China mentioned earlier in this article. The main content and sequence of the new curriculum is presented in Appendix. This chart displays compulsory, medical courses only. Electives and general education courses (in year 1) are omitted. Features of new courses (including integrated blocks) are explained in parentheses, as are newly added features of traditional courses. New courses' names are in italics. All new basic and clinical science courses used case discussion in small groups to illuminate clinical application.

Methods

Research within WUMER has been approved by the Wuhan University Health Science Center Ethics Committee and the University of Chicago Biological Sciences Division Institutional Review Board.

Study Design and Instrument

To evaluate the results of the curriculum reform after 3 years' implementation, we conducted a survey of faculty's perceptions of the new curriculum's preclinical portion and its traditional counterpart in May 2012, when the first class of reform students as well as their traditional curriculum counterparts were just about to begin clinical rotations. These faculty members had taught courses and students in both curricula. We intended to understand and to compare (when possible) their views of the two curricula regarding the following main categories: overall curricular content and structure, basic science courses, clinical medicine courses, instruction, and assessment. Participants were asked to evaluate TC first and then RC.

The same sets of questions were asked about either curriculum, except for the "clinical medicine courses" category. The TC portion of the survey asked participants to evaluate all their clinical medicine courses, whereas the RC portion had participants evaluate only one clinical medicine course called "CPPT", because these students would be offered more clinical medicine courses concurrently with their first semester of clinical clerkships (in year four). For this reason, the questions about TC clinical medicine courses and the questions about RC's CPPT were different, and a comparative analysis between the two curricula regarding this category was not feasible.

The survey instrument used Likert-type items that asked participants to respond on a five-point scale (1=strongly disagree, 2=somewhat disagree, 3=neither agree nor disagree, 4=somewhat agree, 5=strongly agree). All survey items focused on key curricular and pedagogical aspects. At the end of the survey, participants were also asked to express their satisfaction with the overall quality of education offered in each curriculum's preclinical portion.

Participants and Data Collection

All faculty members who had taught one or more preclinical courses to both RC and TC students were eligible to participate in the study. An invitation to participate was distributed to all eligible faculty members (80 on campus at the time of this study, not including those individuals who were out of town or abroad) by WU department chiefs explaining the purpose of the study.

Both the invitation to participate and the "Instructions" section of the survey made it clear that participation was voluntary and anonymous. WU Teaching Office secretaries assisted the authors in distributing and collecting the surveys at different departments. Because all faculty members were not available at the same time, the data collection took 3 days. The survey instrument was in participants' native language, Chinese.

Data Analyses

Each category of scale items was tested for internal consistency—RC basic sciences, RC's CPPT course, RC instruction, RC assessment, TC basic sciences, TC clinical medicine, TC instruction, and TC assessment. All the categories appeared to have good internal consistency, their Cronbach's alpha values ranging from 0.81 to 0.94 (inclusive). Since acceptable values of alpha are between 0.70 and 0.95 [18], we considered all items worthy of retention for further analyses.

The following types of analyses were employed. First, for participants' evaluation of the RC and the TC, ratings of "somewhat agree" and "strongly agree" were combined into "agree", and ratings of "somewhat disagree" and "strongly disagree" were combined into "disagree," in order to obtain frequency distributions for each variable.

Second, faculty's views of the two curricula were compared. When applicable, item-by-item comparison between the two curricula was done using Wilcoxon signed ranks test (two-tailed). In addition, for each RC construct and its TC counterpart (such as "RC basic sciences" and "TC basic sciences"), mean scores were obtained, respectively and Wilcoxon signed ranks test (two-tailed) was used to compare the respondents' attitudes. Because the individual items were measured with ordinal data and because tests for homogeneity of variance and normality of distribution revealed that these assumptions for parametric tests were violated in many cases, we therefore considered the nonparametric equivalent of *t* tests to be appropriate.

Results

The response rate was 90 % (72/80). About 51 % of the respondents were basic scientists, and the rest were clinicians from the medical school's two teaching hospitals. Because 98.6 % of the participants had been teaching at WU for three or more years, we assumed their familiarity with TC. Their teaching experience with the RC varied, with 36.6 % having taught one semester and the rest having taught two or more semesters.

Results of frequency and comparative analyses showed that faculty members were more satisfied with the new curriculum than the traditional one. Specifically, RC's overall content and structure, basic science component, instruction, and assessments were more favorably regarded than their TC counterparts, and RC's CPPT course was deemed a success. Because the TC clinical medicine coursework and RC CPPT were not exact curricular counterparts, comparison between them was not possible. Hence, TC clinical medicine evaluation is not reported here. CPPT evaluation results are described in a separate subsection below.

Table 1 shows participants' evaluation of the old and new curricula's overall content and structure. Satisfaction rates for RC were higher than those ratings for TC except for two items (3 and 4). Question by question comparison revealed eight significant differences: items 1, 5, 6, 7, 8, 9, 10, and 11. In all these instances, RC mean scores were found to be significantly higher than TC mean scores. Of the eight items, one (item 1) concerns the clarity of curricular objectives, three (items 5–7) concern organizational coherence, and four (items 8–11) concern content. Family and community medicine, medical ethics, and community service and humanitarian care were found to be more apparent in the RC.

Evaluation of Basic Sciences in the Two Curricula

As far as the basic science courses were concerned, faculty participants' evaluation of RC was generally more positive than TC. Table 2 shows the satisfaction rates of six aspects of basic science teaching. Three differences were significant—items 2, 3, and 4. All these items pertain to the application of basic sciences to clinical medicine, one of the key foci of the reform.

Evaluation of CPPT Course in the Reform Curriculum

Clinical Pathophysiology and Treatment (CPPT; see description in Introduction) constituted a major part of the clinical medicine coursework in the RC. The RC also included some clinical medicine courses to be offered in the fourth year concurrently with clerkships (which had not yet started at the time of this study). This portion of the survey used questions borrowed and adapted from UC's CPPT course survey. Most participants (86.5 %) believed this course to be "outstanding". Between 92 and 95 % of the participants expressed satisfaction with the course's content, believing that it provided useful skills and insights, had apparent clinical relevance, and was appropriately challenging. Clarity of objectives and accomplishment of the objectives also yielded high satisfaction rates—92.7 and 81.6 %, respectively. Case discussions were believed to be well integrated in the course (94.7 %), well organized (80 %), and contributed to learning (89.2 %).

Satisfaction rates were relatively low for the following areas. About 72.5 % of faculty participants thought the course texts were valuable and 76.5 % believed lab manuals were well organized. Although 85 % considered the course "well organized", only 79.4 % thought that different instructors' lectures were well integrated. Finally, respondents' satisfaction rates with exam question types and lengths were also relatively low (65.7 and 78.8 %, respectively).

Evaluation of Instruction and Assessment in the Two Curricula

Survey participants were asked to evaluate instruction in the RC and TC. RC mean scores were found to be significantly higher than TC mean scores for ten items (see Table 3). These

Table 1 Overall evaluation of the reform curriculum (RC) and the traditional curriculum (TC)

Items	Percentage of participants who "agree"		Mean (SD)		Wilcoxon test results z (p)
	RC	TC	RC	TC	
1) Educational objectives of the curriculum meet the needs of society	87.5	70.9	4.08 (0.73)	3.69 (0.96)	−3.002 (0.003)*
2) The curriculum is well structured	69.4	61.1	3.72 (0.81)	3.46 (0.96)	−1.835 (0.067)
3) Courses are sequenced in logical order	74.3	79.2	3.79 (0.80)	3.86 (0.78)	−0.777 (0.437)
4) Courses are appropriately scheduled	58.5	63.8	3.61 (0.82)	3.57 (0.84)	−0.304 (0.761)
5) There is no unnecessary duplication among courses	68.1	50.0	3.78 (0.84)	3.24 (1.14)	−3.182 (0.001)*
6) Lab sessions are properly connected with lectures	78.9	55.6	3.94 (0.74)	3.49 (0.98)	−3.036 (0.002)*
7) Necessary connections are made clear among related disciplines	78.9	61.1	3.93 (0.74)	3.51 (1.02)	−3.362 (0.001)*
8) Content is up-to-date	66.2	29.2	3.70 (0.73)	2.81 (0.99)	−5.647 (<0.0001)*
9) Instruction in family/community medicine is sufficient	62	16.9	3.70 (0.74)	2.45 (1.05)	−6.096 (<0.0001)*
10) Courses prepare students to become ethical physicians	70	36.6	3.83 (0.68)	3.10 (0.94)	−5.046 (<0.0001)*
11) Courses prepare students for community service and humanitarian care	70.4	22.5	3.80 (0.73)	2.77 (0.99)	−5.719 (<0.0001)*
12) Level of difficulty is appropriate	82	77.2	3.96 (0.66)	3.81 (0.82)	−1.687 (0.092)

Mean scores on a 5-point scale (1=strongly disagree, 5=strongly agree)

SD standard deviation

*Difference is significant at the $p<0.05$ level

Table 2 Evaluation of basic science courses in the reform curriculum (*RC*) and the traditional curriculum (*TC*)

Items	Percentage of participants who "agree"		Mean (SD)		Wilcoxon test results z (*p*)
	RC	TC	RC	TC	
1) Course objectives are made clear to students	80.0	73.9	4.01 (0.79)	3.87 (0.86)	−1.333 (0.182)
2) Content has sufficient illustrations of clinical relevance	90.0	35.7	4.17 (0.70)	3.01 (1.01)	−5.757 (<0.0001)*
3) Content provides relevant preparation for clerkships	88.8	62.9	4.11 (0.73)	3.60 (0.94)	−3.36 (0.001)*
4) Relevant basic science content is/will be integrated in teaching during clerkships	79.4	40.6	4.03 (0.77)	3.16 (1.02)	−4.477 (<0.0001)*
5) Courses prepare students adequately on the scientific basis of diseases	85.7	74.3	4.09 (0.85)	3.83 (0.85)	−1.880 (0.06)
6) Examination content and course objectives match closely	78.8	73.9	3.97 (0.81)	3.88 (0.92)	−0.895 (0.371)

Mean scores on a 5-point scale (1=strongly disagree, 5=strongly agree)

SD standard deviation

*Difference is significant at the $p<0.05$ level

items reflected new instructional approaches that were advocated during the reform, such as the use of group and independent learning (as opposed to the dominance of didactic lectures), students' participation in the learning process, development of higher-level thinking abilities, and faculty mentorship.

Concerning assessments of students in RC and TC, faculty members appeared to be more satisfied with the former than the latter (see Table 4). Five significant differences were found, all of which showed a more positive attitude toward RC's practice. These items were related to the reform's beliefs about the role of assessment in teaching and learning.

Overall Satisfaction with the Two Curricula

For each curricular category (i.e., overall curricular content and structure, basic sciences, instruction, and assessment), RC mean scores were obtained, as were TC mean scores. Take the seven item "assessment" category as an example. For each participant, the mean of the seven item scores was calculated for the RC. Then the same procedure was repeated for TC. Finally, RC means and TC means were compared. Group means, standard deviations, and Wilcoxon tests results comparing means are shown in Table 5.

At the end of the survey, participants were asked to indicate their overall satisfaction with the quality of education offered

Table 3 Evaluation of instruction in the reform curriculum (*RC*) and the traditional curriculum (*TC*)

Items	Percentage of participants who "agree"		Mean (SD)		Wilcoxon test results z (*p*)
	RC	TC	RC	TC	
1) Lecture-group-independent study ratio is appropriate	78.5	28.7	3.82 (0.73)	2.86 (1.01)	−4.588 (<0.0001)*
2) Courses make effective use of technology	70.1	40.0	3.66 (0.91)	2.97 (1.19)	−3.963 (<0.0001)*
3) Course materials (textbooks, etc.) are appropriate	47.8	55.4	3.40 (0.78)	3.52 (0.79)	−0.995 (0.32)
4) Learning objectives are made clear to students	83.8	74.2	4.12 (0.70)	3.79 (0.76)	−2.556 (0.011)*
5) Instruction is engaging	91.1	60.6	4.12 (0.66)	3.59 (0.76)	−3.985 (<0.0001)*
6) Instructors make effective use of class time	85.1	72.7	4.04 (0.59)	3.77 (0.72)	−2.535 (0.011)*
7) Instructors encourage student participation in classroom activities	89.6	53.0	4.16 (0.64)	3.44 (0.90)	−4.510 (<0.0001)*
8) In labs, students have sufficient opportunities to do hands-on	76.5	60.6	4.01 (0.74)	3.67 (0.88)	−2.562 (0.01)*
9) Students receive adequate guidance in labs	86.8	60.7	4.07 (0.58)	3.67 (0.85)	−3.233 (0.001)*
10) Instruction emphasizes development of higher-level thinking abilities	86.8	40.9	4.13 (0.71)	3.26 (0.90)	−4.912 (<0.0001)*
11) Instruction emphasizes development of independent learning abilities	82.4	40.9	4.04 (0.76)	3.18 (0.93)	−5.251 (<0.0001)*

Mean scores on a 5-point scale (1=strongly disagree, 5=strongly agree)

SD standard deviation

*Difference is significant at the $p<0.05$ level

Table 4 Evaluation of assessment in the reform curriculum (*RC*) and the traditional curriculum (*TC*)

Items	Percentage of participants who "agree"		Mean (SD)		Wilcoxon test results z (*p*)
	RC	TC	RC	TC	
1) Exams fairly evaluate what students should know	76.1	63.7	3.96 (0.79)	3.70 (0.91)	−1.752 (0.08)
2) Instructors evaluate students on clear objective criteria	78.0	63.7	3.99 (0.70)	3.71 (0.89)	−2.088 (0.037)*
3) Instructors use periodic quizzes to give students timely feedback	81.5	48.5	4.08 (0.76)	3.33 (0.97)	−4.364 (<0.0001)*
4) Instructors make grading criteria clear to students	81.8	63.1	4.03 (0.72)	3.63 (1.01)	−3.156 (0.002)*
5) Assessments closely reflect what is actually taught	89.5	83.3	4.19 (0.70)	4.00 (0.72)	−1.986 (0.047)*
6) Assessments closely reflect teaching/learning objectives	88.1	83.1	4.16 (0.67)	4.00 (0.69)	−1.68 (0.093)
7) Exams include sufficient number of questions that measure higher-level thinking abilities	80.3	58.1	3.98 (0.77)	3.50 (0.86)	−3.048 (0.002)*

Mean scores on a 5-point scale (1=strongly disagree, 5=strongly agree)

SD standard deviation

*Difference is significant at the $p<0.05$ level

in each curriculum's preclinical portion. Frequency analyses found that 76.8 % expressed satisfaction with RC, whereas 48.5 % were satisfied with TC. Mean scores were 3.86 and 3.31 for RC and TC, respectively, with standard deviations of 0.65 and 0.87, respectively. This difference was significant, $z=-3.494$, $p<0.0001$.

Discussion and Conclusion

Our data suggest that the reforms have brought about comprehensive and profound changes in teaching and learning approaches at WU Medical School. Overall, this study has presented evidence that the main components of the RC (overall curricular content and structure, basic science courses, instructional methods, and assessment of students) were all favored by the faculty over their TC counterparts. These findings indicated that key emphases of the reform were prominent in the new curriculum and that the new teaching, learning, and assessment methods were used effectively and appreciated by faculty.

RC received a more positive rating than TC with respect to curricular objectives, organizational coherence, and content. Family and community medicine, ethics, and community service and humanitarian care, which were weak in TC, were found to be significantly better in RC, indicating faithfulness of reform implementation. Content in RC courses was believed to be more up-to-date. However, satisfaction with RC's curricular structure, course sequencing, and scheduling of sessions was relatively low, pointing out areas for improvement.

Concerning basic sciences in the two curricula, faculty members considered RC to be stronger than TC in three areas related to the application of basic sciences to clinical medicine, a key focus of the reform. Thus, it can be said that this focus had been at least somewhat effectively accomplished. RC's clinical medicine course CPPT was evaluated favorably, with most of its main aspects having satisfaction rates of 80 % or above, including clarity of objectives, content (clinical relevance and usefulness), organization, and the use of case discussion. Areas needing improvement included exam

Table 5 Comparing the reform curriculum (*RC*) and the traditional curriculum (*TC*) on main categories

Categories	Mean (SD)		Wilcoxon test results z ($p<0.0001$)
	RC	TC	
1) Overall curricular content and structure	3.83 (0.53)	3.32 (0.63)	−5.272*
2) Basic sciences	4.07 (0.67)	3.56 (0.68)	−4.411*
3) Instruction	3.96 (0.49)	3.43 (0.58)	−5.195*
4) Assessment	4.04 (0.59)	3.70 (0.67)	−3.773*

Mean scores on a 5-point scale (1=strongly disagree, 5=strongly agree)

SD standard deviation

*Difference is significant at the $p<0.05$ level

question types, course texts, and integration among different instructors' lectures.

It was found that the pedagogical principles valued during the reform were more prominent in the new curriculum. It can be inferred that these principles were effectively applied in the instructional process. Assessment practices in RC reflected tenets that are currently believed to be sound, including assessment of higher-level thinking and the use of assessment to inform learning [19].

Faculty members' views on the two curricula suggest that the reform implementation has been at least somewhat effective and faithful to the original objectives, and that the majority of the faculty participants supported the content and directions of the reform. Our findings have filled in a gap in literature about comprehensive curricular reforms in China. Although some medical schools in China have been engaged in innovations, existing literature usually describes changes at the level of instructional techniques, such as the use of the PBL format of teaching, or innovations at the level of individual courses or course clusters. To the authors' knowledge, there are no reports of comprehensive curricular overhauls such as the one carried out at WU.

It is worth mentioning that the results of this study corroborated findings from a student survey conducted at WU earlier which asked RC and TC students to evaluate their respective curriculum [17]. The student survey found that key features of the reform (such as interdisciplinary connections and relevance of basic sciences to clinical medicine) were prominent in the new curriculum and welcomed by students, and that RC students were generally more positive about their curriculum content than their peers were about the TC. In addition, RC students were more satisfied with their teaching and learning methods including case discussion, group and independent learning, and the use of formative assessments to inform and guide learning [17].

A clinical science exam that was given in January 2014 by WU's two teaching hospitals to their fourth year students also yielded evidence supporting the reform. These students had completed most of their preclinical training and were about to start rotations. Faculty members of the hospitals were responsible for offering clinical science courses, with each hospital teaching approximately half of the students. One hospital had 24 RC and about 120 TC students, and the other hospital 23 RC and about 130 TC students. The same exam consisting of subject tests for internal medicine, surgery, obstetrics and gynecology, and pediatrics was given to students from both hospitals. RC students did not take the internal medicine test because they had not yet finished all course material. Each subject test had general knowledge questions and clinical case analysis questions. Each hospital's faculty ran analyses of their students' scores. Results showed that for each hospital and for each subject test, RC students' means scores were higher than those of TC students with regard to general knowledge, case analysis, and total scores. Differences between RC and TC in each subject's total scores were significant ($p \leq 0.013$, independent samples *t*-test), and so were differences in case analysis scores for each subject ($p \leq 0.033$). With the exception of obstetrics and gynecology knowledge questions, in which no significant difference was found for one hospital, RC students did significantly better than TC students on knowledge questions for all instances ($p \leq 0.01$). These outcomes suggest that the new curriculum and pedagogy had a positive impact on knowledge retention and clinical thinking, though more comprehensive academic and clinical assessments are needed to establish the advantage of RC over TC.

The WU experience shows that a Western curriculum can be effectively implemented and readily embraced by medical faculty and students in a different culture. Two factors were essential in this process—faculty training and modifications to the UC curriculum. First, training introduced WU faculty to all aspects of the reform, enlisted their buy-in, and enhanced their teaching expertise. All WU reform course directors and key faculty members visited UC to observe and learn about teaching and learning in action. UC course directors also visited WU to train WU faculty regarding the new courses and related teaching methods. In addition, WU faculty leaders gave training sessions to the rest of the faculty. Such training enhanced WU faculty's teaching competency and helped them appreciate the nature and importance of the reform. In WU's traditional climate of stagnation and departmentally-based teaching practice, a new culture of change and collaboration developed, facilitating the effective implementation of the reform.

Second, modifications of the UC model were made in order for it to work in a new context. Among other factors, WU considered the following points when adapting the UC curriculum: (1) WU students were high school graduates with limited prior knowledge in basic sciences, and thus more instruction hours than UC were needed for many subjects. (2) Common diseases in the USA and in China are somewhat different. Thus, WU faculty supplemented or replaced UC cases with ones collected from their teaching hospitals. (3) Teaching was traditionally teacher-centered with students as passive recipients of knowledge. Measures were taken to help students become more active, independent learners. The course *Cells*, *Molecules*, *and Genes* provides an illustration of the above points. At UC, this course was a one-quarter block offered to first year students. WU expanded it to two semesters long and offered it in the second half of year one and the first half of year two. A bank of 50 cases, mostly from WU's teaching hospitals, was developed for use in small group discussions. Faculty rotated new cases each year to prevent students from copying previous years' answers. In addition to the UC style case discussions in student small groups, the students-directed "Special Topics Workshops" (not a part of the UC course) was used to encourage students to grasp challenging material

through self-guided study in teams. The course director once stated that a shift in students' role as learners was crucial for the success of his course and other reform courses. He and his team conscientiously helped students adjust to their new roles. Over time, the cultural tradition of passive students receiving the wisdom of their teachers gave way to a new culture where students took on greater responsibilities in their learning process and where the teacher's role expanded from a lecturer to being a responsive mentor as well. Students' response to a curriculum survey [17] indicated that they appreciated their new learner roles and were rather satisfied with the effectiveness of the new learning method.

WU's reforms addressed similar issues identified by other researchers in medical education in China as well as some other countries in the world. The concepts in medical education adopted by WU are relatively new in many developing countries including China, though they are no longer so in developed Western countries with advanced medical education systems. Medical schools in many developing countries still rely on traditional curricula and teaching methods, with an inability, even resistance, to change [15]. Thus, in the current global context, this study may offer some useful lessons for reformers in China and abroad. WU's experience shows that comprehensive changes based on the state-of-the-art curricular and pedagogical principles can gain faculty buy-in and have the potential of improving the quality of education in a cross-cultural context.

Limitations

Evaluation of WU reform is still at a relatively early stage. By the time of this reported survey, faculty participants had had up to 3 years' experience with their new curriculum. Their teaching experience with the RC varied and their assessment of the new curriculum and pedagogy could not be considered thorough. In addition, the survey only obtained faculty's perspectives on the preclinical portion of their 5-year-long curriculum. The first class of RC students was just about to start clinical clerkships at the time of the survey. Furthermore, faculty members were not randomly selected to teach the reform curriculum; it was possible that their passion for reform influenced their views. Finally, research into students' learning and competence is necessary to better determine the merit of the reform.

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Appendix

Table 6 Content and sequence of the reform curriculum

Year	Semester 1	Semester 2
1	• *Human Body 1* (anatomy course incorporates radiology and surgery lectures to emphasize clinical application; continued into Human Body 2)	• *Human Body 2* • *Cells, Molecules and Genes (CMG) 1* (integrates cell biology, biochemistry, and genetics; continued into CMG 2) • *Early Patient Contact 1* (workshops in doctor-patient communication; offers patient contact experience; continued into Early Patient Contact 2)
2	• *CMG 2* • *Tissue Structure and Functions* (incorporates histology into physiology) • *Pathogenic biology* (integrates microbiology, virology, and parasitology)	• *Response to injury* (integrates cellular pathology and immunology) • Clinical skills 1 (increased emphasis on professionalism) • Medical statistics • Public health • *Early Patient Contact 2*
3	• *Clinical pathophysiology and treatment (CPPT) 1 and 2* (introduction to clinical pathophysiology and therapeutic modalities of diseases linked to 10 physiological systems; continued into CPPT 3 and 4) • *Neuroscience* (integrates neuroanatomy, neurophysiology, and neuropsychology) • Pharmacology (increased focus on therapeutics; uses clinical cases) • Epidemiology	• *CPPT 3 and 4* • Clinical skills 2 (increased emphasis on professionalism) • *Scholarship and discovery* (introduction to research methods)
4	• Clinical ethics (more focus on current issues and professional conduct; uses problem-based modules for small group and individual work) • Clinical lectures by department: in surgery, ob-gyn, and pediatrics (complement to CPPT; uses case analyses and problem-based learning) • Clinical Skills 3 (increased emphasis on professionalism)	• Mandatory clerkship rotations and lectures (new features include: ○ a more systematic and sophisticated structure; ○ orientation session at the beginning of each rotation; ○ learning objectives more specifically defined; ○ increased time for teaching clinical reasoning; ○ evaluation of students on multiple dimensions)
5	• Clerkships continued • *Comprehensive Clinical Skills Training* (Capstone) (helps students consolidate clinical reasoning skills through case discussions)	• Clerkships continued, including ○ *Community Medicine Clerkship*

New courses' names are in italics

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