This thesis, “Evaluation of the first curriculum year of the new Integrated and Interactive Curriculum at the University of Medicine and Pharmacy at HoChiMinh city (UMP), Vietnam”, presented by Bao Khac Le, and submitted to the faculty of the Harvard Medical School in partial fulfillment of the requirements for the Master of Medical Sciences in Medical Education has been read and approved by:

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EVALUATION OF THE FIRST CURRICULUM YEAR OF THE NEW INTEGRATED AND INTERACTIVE CURRICULUM AT THE UNIVERSITY OF MEDICINE AND PHARMACY AT HOCHIMINH CITY (UMP), VIETNAM

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Evaluation of the first Curriculum Year of the new Integrated and Interactive Curriculum at the University of Medicine and Pharmacy at HoChiMinh City (UMP), Vietnam

Abstract

Purpose: The University of Medicine and Pharmacy at HoChiMinh city (UMP), Vietnam launched a new integrated and interactive curriculum of medical education in 2016. This study aims at evaluating the new curriculum by determining whether the new curriculum successfully affected the teaching and learning activities in the first curriculum year and if so, how.

Method: We conducted a one-year single-center observational prospective cohort study using mixed methods and a historical control as the comparison. We used online surveys and focus groups to collect feedback from the UMP's faculty and students. We applied a modified Bloom's taxonomy to evaluate the cognitive levels of test questions. We analyzed the students' summative scores.

Results: 89% of the faculty and students indicated that the teaching content was integrated across basic sciences and with clinical applications. All faculty and 80% of the students rated that the instructional methods were interactive. The integrated content and interactive methods promoted the learning activities. 77% of the students and 59% of faculty answered that the students prepared pre-reading materials. 85% of the students and 75% of faculty assessed that the students interacted with their peers. Only 41% of the students and 61% of faculty rated that the students contributed in class. The passive faculty-student interaction might be due to the oriental hierachical collective culture. 84% of the faculty and students responded that the test questions integrated basic sciences and clinical applications. 100% questions reflected the learning objectives. In comparison to the traditional curriculum, the new curriculum was more integrated across basic sciences (84% vs. 72%) and with clinical applications (89% vs. 78%). The faculty provided pre-reading materials more frequently (84% vs. 72%), encouraged students to contribute ideas more often (90% vs. 50%), and gave more test questions at high cognitive levels (21.5% vs. 12.3%).

Conclusions: The new curriculum at UMP has achieved most of its stated objectives. The data provide evidence of integrated teaching content, interactive instructional methods, valid and reliable assessment instruments. Students are committed to self-learning, interacted effectively with peers, and achieved integrated high cognitive knowledge. Further study is planned to evaluate the new curriculum's long-term impacts.

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Chapter 1: Background

1 Overview of curriculum reform in medical education in the world:

Curriculum reform in medical education is a worldwide and ongoing trend.

In 1910, Abraham Flexner presented a report on medical education in USA and Canada, which indicated wide gaps between the quality of medical education and society demands for healthcare [1]. His report initiated a trend of curriculum reform in medical education which has sustained until now in the world.

Papa and Harasym summarized five consecutive curriculum reforms through the 21st century in North America: apprenticeship-based, discipline-based, system-based, problem-based, and clinical presentation curricula [2]. In 1985, Harvard Medical School (HMS) began the "New Pathway" curriculum [3], integrating psychosocial, humanistic concepts and biologic principles in patient care, and applying self-directed, interactive methods in medical education [4]. In 2006, HMS upgraded its "New Pathway" curriculum in the form of a more integrated curriculum based on four principles: (1) integration of basic sciences and clinical applications, (2) meaningful interaction between faculty and students, (3) longitudinal continuity of patient experience, cross disciplinary curriculum, faculty mentoring, and student evaluation, and (4) realization of in-depth, faculty-mentored scholarly project [5]. In 2015, HMS adopted another new curriculum called "Pathways" with three major innovations: (1) educational content: more integrated, multiple topics and disciplines were integrated into individual course, (2) instructional method: "flipped classroom", students were expected to watch lectures out of class and apply concepts in class, (3) earlier exposure to clinical rotations or core clerkships [6].

Similar to North America, medical curricula in Europe integrated educational content and promoted interactive instructional methods. From 1970, all medical schools in the Netherlands, led by Maastricht Medical School, reformed their medical education models and came up with curricula characterized by student-based, problem-based, content-integrated, and community-oriented features [7]. In 1996, the Faculty of Medicine of University of Geneva introduced an integrated problem-based medical curriculum [8]. After 2002, Germany radically reformed its medical curriculum in which the medical schools adopted problem-based learning, computer-based training, seminar-based work, skills-laboratory, standardized patients, role play, patient demonstrations, and on-ward patient visits to deliver practical-integrated content [9].

Curriculum reform in medical education in Asia also followed the trend toward an integrated, interactive curriculum. In the 1990s, medical schools in Japan gradually converted the traditional discipline-based to the new organ-based curriculum, and they adopted problem-based learning as an additional new instructional method and objective structured clinical examination (OSCE) as a new assessment instrument [10]. In 2009, Wuhan University Medical School in China, adapted the curriculum of the Medical School in the University of Chicago which also included integration between basic sciences and clinical medicine through clinical cases, encouraged team-based and self-directed learning, and emphasized formative assessments [11].

Zooming in on the Association of Southeast Asian Nations (ASEAN) where Vietnam is a member nation, Zubair indicated that few medical schools had a fully integrated curriculum, half of schools applied problem-based learning embedded in a hybrid curriculum, and multiple choice questions and oral examination were the most frequently used assessment instruments [12]

In summary, the worldwide trend of reform in medical education has aimed at an integrated, self-directed and interactive curriculum. It is reasonable to ask how the integrated, self-directed and interactive curriculum in medical education has been effectively implemented, and how the expected outcomes can be documented with its curriculum evaluation data.

Evaluation of integrated, self-directed, interactive curriculum in medical education

Many medical schools have been applying integrated, self-directed and interactive curricula. However, formal and comprehensive evaluation data of the curricula in medical education are available in only a relatively small number of medical schools in the world.

Moore et al reported the short-term effect of the "New Pathway" curriculum which had been launched at HMS in 1985 [3]. Students in the new curriculum applied problem-based learning to study basic sciences in clinical context; while students in the traditional curriculum largely learned from discipline-based lectures and syllabi [3]. In the preclinical years, the students in the new curriculum reflected more, memorized less, "demonstrated greater psychosocial knowledge, better relational skills, and more humanistic attitudes" than the students in the traditional curriculum, even though they were not statistically different in biomedical base knowledge and problem-solving skills [3].

Peters et al described the long-term effects of the "New Pathway" curriculum on behaviors and attitudes related to humanistic medicine, lifelong and social learning [4]. They telephoned to interview students in the two curricula [4]. Results showed that there were statistical differences on only five (three humanism; two social learning) out of the twenty two measures on the survey, in which "New Pathway students rated their preparation to practice humanistic medicine higher than did traditional students and expressed more confidence in their ability" [4]. Since the "New Pathway", HMS has twice reformed curriculum into "New Integrated Curriculum" in 2006 [5] and "Pathways curriculum" in 2015 [6]. Unfortunately, their curriculum evaluation data have not been published yet.

Chastonay et al described the evaluation data of the longitudinal community-based program within year 1 to 3 of the whole integrated problem-based medical curriculum at the University of Geneva Faculty of Medicine [13]. Results indicated that students' overall satisfaction with the new curriculum was globally high over the years; and their performance at local and national certifying exams was globally as good as in clinical competencies exams and in basic life sciences tests [13]. More than 75% of the students felt that they had achieved the learning objectives and faculty generally shared students' feelings [13].

In terms of study method in curriculum evaluation, Moore et al used a randomized controlled trial used to evaluate the effect of the New Pathway curriculum at HMS on the students' preclinical knowledge, skills, personal characteristics, learning approaches and educational experiences [3]. The University of Geneva Faculty of Medicine of used a prospective cohort study to see if the goals and features designed for their curriculum had been achieved [8]. Designs comparing the new versus traditional curricula are not very popular in the published literature. Some believe that comparative data are not useful, whereas others believe that they are useful but that practical considerations make useful comparison difficult or impossible.

As described by Spiel et al, there are five phases of the curriculum evaluation process: phase 1 – baseline evaluation of the traditional curriculum; phase 2 – prospective evaluation of the new curriculum feasibility; phase 3 – formative evaluation of the new curriculum implementation; phase 4 – summative evaluation of the new curriculum short-term results; and phase 5 – impact evaluation of the new curriculum long-term results [14]. The purposes and tasks of curriculum evaluation might be diverse among different phases.

In reality, similar concepts in curriculum reform might be applied differently among different medical schools in the world. Therefore, we might need to consider the cultural, socioeconomic contexts of new curricula, the preparation and implementation of a curriculum, and the schools' purposes when they evaluate their curricula to interpret accurately their curriculum evaluation data. This idea is particularly relevant in considering the evaluation of the new curriculum in medical education at the UMP in Vietnam.

2 Curriculum reform in medical education at UMP, Vietnam

Mismatch between the UMP's traditional curriculum and the new healthcare system

UMP was established in 1947. Its traditional medical curriculum was built on Flexner's principles of medical education as first introduced in 1910 [1]. The teaching content is covered in six years including two years dedicated to basic sciences and four years to clinical rotations. Didactic lecture is the main instructional method to teach biomedical sciences while the two main instructional methods to train practice are laboratory work and bedside teaching. The school's purpose is to provide students with solid knowledge and sound skills in medical sciences. Since 1947, UMP–graduated physicians have been greatly appreciated in Vietnam.

However, the healthcare system in Vietnam has experienced many changes. The disease model has rapidly shifted from "acute, communicable" to "chronic, non-communicable". The new model can be framed as involving patients with multiple chronic co-morbidities. Progress in medical sciences has been fast and impressive. As a result, the healthcare system has been pushed to transform towards deep specialization, wide interdisciplinary integration. Many different stakeholders are involved in patient care: physicians, nurses, medical technicians, family members, healthcare payers, all of which challenge the competence of a physician in dealing with various complicated interactions. Nowadays, Vietnamese physicians should have integrated knowledge to resolve multiple co-morbidities. They should commit to self-directed and life-long learning to catch up with fast progress in medicine. They should adequately develop interactive skills to collaborate with peers and to communicate with patients and their family members.

The traditional curriculum does not match well with changes in the healthcare system. The educational purposes overemphasizing medical knowledge and skills do not allow the adequate development of interpersonal skills and behaviors expected for physicians in the new healthcare system. The separation in teaching between basic medical sciences and clinical practice prevents knowledge integration. The passive didactic lectures discourage self–directed and long–life learning. Newly graduated physicians have been criticized for inadequate quality of care and ineffective communication. Medical schools have been accused of not fulfilling their social responsibility in training physicians. The Ministry of Health has been blamed for an inability to maintain the care quality.

As mentioned by Frenk et al, medical education has a fundamental relationship with healthcare system, in which the medical education is expected to provide health professionals with enough competencies to address the demands from the healthcare system [15]. Medical curriculum reform becomes a must.

Preparation for curriculum reform at UMP

In 2010, UMP started the preparation phase with meetings between some school progressive leaders and international experts on medical education to draft a new vision. UMP invited experts from several of the worlds' leading medical schools: Ludwig–Maximilians–Universität in Germany, HMS in USA, and University of Geneva Faculty of Medicine in Switzerland to visit UMP and exchange their experiences. They spoke to the global necessity of curriculum reform and showed evidence on effectiveness of innovative concepts and new models in medical education. They also shared their experience on the barriers and solutions to overcome during their own curriculum reform process. The meetings ignited intense but fruitful discussions and debate on the new curriculum's general purposes among school leadership and faculty members. UMP finally decided to build a new medical curriculum which was integrated and interactive, competence-based with early exposure to clinical experiences from the second curriculum year.

After achieving a consensus on the new curriculum's general purposes, we discussed specific plans to realize the new curriculum. Upon recommendations of experts, UMP introduced a new organization structure in order to develop and implement the curriculum reform. We created a curriculum reform committee and several integrated modules under this committee. In the first curriculum year, we combined biology, chemistry, physics, biochemistry, and microbiology into module 1; anatomy, histoembryology, and anapathology into module 2; and physiology, pharmacology, and nuclear physics into module 3. In the second and third curriculum years, we integrated separated disciplines into system-based modules for example cardiovascular system, respiratory system, digestive system, and immune system. We organized regular meetings within the curriculum reform committee and educational modules to make decision on the reform of teaching content, instructional methods, and assessment instruments for the new curriculum as a whole and every individual module.

We continued our preparation phase with a program to develop faculty members for the first curriculum year. We introduced three key educational concepts of the new curriculum: integrated content, interactive methods, and valid assessment. Specifically, teaching content should be integrated, rather than separated by discipline; instructional methods should be interactive, not passive nor directive; outcome assessment should include overall competence, not only knowledge, and promote high cognitive levels (application, analysis, evaluation and creation), not only low ones (description and explanation).

We organized conferences on teaching content in which faculty members could apply the new key concepts in developing their lessons. In contrast to the traditional curriculum when faculty members worked individually, faculty members collectively designed their lectures in the new curriculum. The usual development process from teaching content to outcome assessment was replaced by a backward process from outcome assessment to teaching content. In this backward process, faculty firstly specified which concepts in basic sciences to keep or drop depending on their alignment to learning objectives and their relevance to clinical applications.

Next, faculty mapped the selected concepts and allocated them to different disciplines to avoid redundancies. The concept map suggested possible relationships among disciplines and clinical applications. Faculty structured their multiple choice question (MCQ) items by collectively determining the cognitive levels, integrated content, and learning objectives of MCQ items in summative tests for each discipline and integrated module. Finally, they developed the relevant lecture content. They collaborated with physician colleagues in writing integrated clinical cases to illustrate key concepts.

We organized international seminars on interactive instructional methods in which international educational experts showed their inclusion of clicker questions in lectures, and their use of guiding questions for the discussion of integrated clinical cases during team-based learning session. Faculty tried some lectures with clicker questions and team-based learning sessions on their own in several local workshops which followed the international seminars. They received feedback from local experts and peers to improve their instructional methods.

We organized workshops on assessment instruments: Multiple Choice Questions (MCQ), Objective Structured Clinical Examinations (OSCE), and Standardized Oral Examinations (SOE). A required goal of these workshops was to have faculty able to apply these techniques for their own lessons, not just to understand the techniques. In the workshop on MCQs, for instance, we asked faculty members to submit their MCQ items before the workshop. At the workshop, their MCQ items were used as learning materials. Tutors and peers gave feedback on the content validity of each MCQ item by judging whether it was at the required cognitive level, assessed the required learning objectives, and integrated content. Faculty members then discussed with peers how to improve their own items to meet the predetermined requirements.

The products of the above trainings and follow-up sessions were lectures with clicker questions, integrated clinical cases with guiding questions, and MCQ items possibly used in the new curriculum. We asked educational experts for feedback on the outputs and made necessary improvements before approving the outputs as official teaching and assessing materials for the new curriculum.

We completed the preparation phase with the upgrade of school website so that the teaching content in the new curriculum could be uploaded on website. We upgraded the school library to assure the availability of literature resources necessary for the new curriculum. We built one "smart" classroom with adequate facilities for in class interaction.

After six years of continuing efforts from 2010 to 2015, the school concluded its preparation phase in early 2016 when UMP finalized its 6-year framed curriculum and 1^{st}-year specific curriculum. UMP was ready for the official launch of new curriculum in September 2016.

Implementation of the new curriculum at UMP

In the academic year 2016 – 2017, we implemented the new curriculum with the first year medical students. Faculty uploaded teaching materials to the school's website to help students to prepare lessons at home. The materials included syllabi with learning objectives and relevant references, lecture PowerPoint presentations, clinical cases with guiding questions used in team-based learning sessions. We grouped 11 separated disciplines into 3 integrated modules: module 1 (biology, chemistry, physics, biochemistry, microbiology), module 2 (anatomy, histoembryology, anapathology), and module 3 (physiology, pharmacology, nuclear physics). The different disciplines within a module were taught simultaneously to promote the integration among disciplines. Faculty used clicker questions and integrated clinical cases to enhance their interaction with students during lectures and team-based learning sessions. We continued traditional hands-on laboratory work to maintain real experience exposure.

We asked students to prepare lessons at home: viewing pre-reading materials, looking up references, answering clinical cases' guiding questions. We requested them to interact effectively with faculty and peers.

In terms of student assessment, we gave one summative examination for each module using structured MCQ items.

We hoped that students would achieve the expected learning outcomes. First year medical students should obtain integrated, high cognitive knowledge; they should be highly committed to self-directed and life-long learning, and they should interact effectively with faculty and peers. Second year medical students should leave a good impression on health professionals and patients; and graduate physicians should create good impacts on the healthcare system.

In summary, UMP's curriculum reform has gone through 6 years in preparation and 1 year in implementation. A study to evaluate the new curriculum at UMP was deemed to be essential.

Curriculum and program evaluation at UMP

We planned comprehensive program to monitor and evaluate the curriculum development, implementation process and outcomes. We believed that the program could have practical implications at the local and international levels: identifying room for curriculum improvement at UMP; sharing our experience with other medical schools in Vietnam; and adding to the world data on the medical curriculum reform process in countries of socioeconomic characteristics similar to Vietnam. The overall program aimed at assessing the new curriculum processes, outcomes and impacts along its implementation journey.

In this thesis, we present the results of the first part of this comprehensive program. We aim at providing evaluation data on the teaching activities of faculty, the learning activities of students, and the knowledge achievement of students during the first year of curriculum implementation. Specifically, we wish to determine whether faculty members actually did develop and teach integrative content, use interactive methods, and give valid and reliable MCQ items of high cognitive levels; whether students achieved the curricular learning objectives including integrated content, commitment to self-directed learning, and effective interaction with peers and faculty. We were also interested in the underlying reasons for strengths and weaknesses of the new curriculum. Finally, we attempt to make a relative comparison between the new and traditional curricula.

We summarize the study objectives in the two following questions:

1. Did the new curriculum successfully affect faculty development, teaching content, instructional methods, and assessment instrument of the first curriculum year at UMP and if so, how?
2. Did the new curriculum successfully affect learning attitudes, learning behaviors, and knowledge achievement of the first year medical students at UMP and if so, how?

Chapter 2: Method

1 Study design and subjects:

We conducted a prospective observational cohort study. We used a mixed methods design which combined quantitative measurements with qualitative interviews to clarify and help explain the quantitative results. To determine the extent of change accomplished, where possible, we compared the evaluation data of the new curriculum versus the traditional one.

All 393 UMP first year medical students in academic year 2015 – 2016 constituted the control group. They attended the traditional curriculum, characterized by separated instructional content, passive didactic teaching methods, and assessment with unstructured MCQ items. The faculty members in the academic year 2015 – 2016 did not participate in the control group.

All 392 UMP first year medical students and their 48 faculty members in the academic year 2016 – 2017 constituted the intervention group. They attended the new curriculum, characterized by integrated instructional content, interactive teaching methods, and assessment with MCQ items structured by predetermined learning objectives, integrated content and cognitive levels.

2 Data collection

In early June 2016, when the traditional curriculum students had finished their first year, we collected quantitative feedback from the first year medical students on teaching and learning activities, all MCQ items and test scores of the summative examinations of the traditional curriculum.

In early June 2017, when the new curriculum students had finished their first year, we collected quantitative and qualitative feedback from the first year medical students and their faculty on teaching and learning activities, all MCQ items and test scores of the summative examinations of the new curriculum.

Online survey questionnaires:

We developed online questionnaires to collect anonymous quantitative feedback from students (**Appendix 1**) and from faculty on three constructs of the new curriculum: preparation of lessons before class, interaction between faculty and students inside and outside of class, and integration in teaching and student assessment. Two questionnaires included 30 similar four-level (*strongly disagree* **|** *disagree* **|** *agree* **|** *strongly agree*) questions in Likert scale equally distributed into 3 constructs: preparation of lessons before class, interaction between faculty and students inside and outside class, integration in teaching and student assessment. The questions in each construct were divided into teaching and learning activities so that faculty and students could self-assess and assess each other. Exclusively in the faculty questionnaire (**Appendix 2**), we added another construct on faculty development activities including 10 questions so that faculty could give feedback on the faculty training program of the new curriculum.

We sent the two questionnaires to collect comments from internal and external experts. We then revised the questionnaires accordingly. We randomly piloted the questionnaires on 10 faculty members and 20 students at UMP to assess the clarity and comprehension before actually using them in the study.

Earlier, we had developed an online questionnaire to collect anonymous quantitative feedback from students on the traditional curriculum. Twelve of 56 questions in the questionnaire used in the traditional curriculum shared the same content as 12/30 questions in the questionnaire used in the new curriculum, including three questions on preparation lessons before class (**Question 1, 4, 5**), five questions on interaction between faculty and students inside and outside class (**Question 11, 12, 13, 15, 18**), and 4 questions on integration of teaching and student assessment (**Question 21, 22, 23, 24)**. Actually, we used the online questionnaire of the traditional curriculum to develop the online questionnaire for the new curriculum so that we could compare the data of the similar questions between the two curricula.

We asked the school registrar's office to email the open letter from our study group to all of the faculty and students, informing the purpose and implication of our study and emphasizing that they were free to participate in our study or not and that their feedback would be used uniquely for the curriculum improvement. If the faculty and students agreed to participate, they would click on the included link to the online surveys to faculty and students to invite them to answer online survey. After a week, the school registrar's office emailed reminders to non-responders to encourage them to participate. After another week, the school registrar's office called remaining non-responders to remind them to participate for the final time. The participants' identification details were then permanently deleted and no one could know who answered what and who did not answer.

MCQ items:

We evaluated the content validity and internal reliability of all MCQ items. We evaluated content validity by assessing how closely they came to assessment according to the three components predetermined in the new curriculum: cognitive levels, learning objectives, and integrated content.

We requested the school testing office to provide us with all MCQ items of summative exams of the first academic year in both new and traditional curricula. We recorded the learning objectives and cognitive levels that faculty members had assigned to each of their MCQ items.

- Collection of data on learning objectives of MCQ items:

We invited discipline heads to assign learning objectives to each of their disciplines' MCQ items. In cases where the assignments of learning objectives of faculty members and their discipline heads were different, we used the discipline head's assignments in the consideration of their highest expertise in the discipline.

- Collection of data on integrated content of MCQ items:

We embedded four questions in the online survey questionnaires to ask for feedback from faculty and students on the integrated content of MCQ items.

- Collection of data on cognitive levels of MCQ items:

We developed an MCQ cognitive level assignment tool (**Appendix 3**). We adapted the original 6–level Bloom's taxonomy (remember | understand | apply | analyze | evaluate | create) [16] into a simplified 3–level Bloom's taxonomy (remember | understand | apply and above) by combining all four higher cognitive levels into a level "apply and above".

We recruited two independent experts on test assessment to separately assign cognitive levels to each MCQ item, using our simplified 3-level Bloom's taxonomy. In cases where the two independent assessors gave different assignments to a same MCQ item, they discussed the discrepancies with each other and attempted to modify their assignments by consensus. We estimated the reliability of the measurement tool for the assessment of cognitive levels to MCQ items, using Kappa coefficients of the agreement between the assignments of cognitive levels to MCQ items of two independent assessors in both the new and traditional curricula.

In the case of unresolved disputes between two assessors, the principal investigator determined the final cognitive level of these "disputed" MCQ items. Similarly, in cases where the cognitive level assignments given by the faculty and the study team (assessors and principal investigator) were different, we used the study team' assignments as final results.

We collected data on cognitive levels of MCQ items in the traditional curriculum. We narrowed the data collection from only four disciplines of the traditional curriculum: physics, chemistry, biology and anatomy because they were also taught in the new curriculum. To reduce task burden, from the four disciplines we randomly selected 130 out of the 400 items in the traditional curriculum. They included 20 items in physics, 40 in chemistry, 40 in biology, and 30 in anatomy. The number of items selected from each discipline in the traditional curriculum was equal to that in the similar discipline in the new curriculum.

Test scores:

We asked the school testing office to give us test scores of summative exams of the first academic year in the new and traditional curriculum. We requested both total test scores for all items and component test scores for each item of every student. The school testing office removed student identification details before sending us the final results.

We translated individual test scores into achievement percentages, which is a product of test scores divided by maximum scores. For instance, physics has 20 MCQ items including 8 high cognitive items. A student who answered 14 items correctly including 4 high cognitive items would get 70% (14/20) achievement in total scores in physics and 50% (4/8) achievement in high cognitive items in physics. We then calculated mean scores and mean achievement percentage for all students in each discipline and in all disciplines as a whole.

To reduce task burden, we randomly selected 2 (physics and biology) out of the 4 disciplines (physics, chemistry, biology, and anatomy) in the traditional curriculum to explore the differences in test scores between the two curricula. Given that the MCQ items in the two curricula are different; we did not compare their test scores directly. We just explored the differences in students' answering to high cognitive versus all items in the two curricula.

Focus group discussions:

We developed focus group interview guides to collect qualitative feedback from the students (**Appendix 4**) and from faculty (**Appendix 5**) on the teaching, learning, and assessment activities of the new curriculum. Both interview guides included questions on the relevant constructs covered in online survey questionnaires. We also sent the interview guides to collect inputs from internal and external experts. We then revised the interview guides accordingly.

The collection of qualitative data using focus group discussion happened after the collection of quantitative data using online surveys had been completed. We asked the school registrar's office to email faculty and students to invite them to volunteer for focus group discussions. We sent confirmation letters with specific meeting logistics to the first 20 faculty and first 20 student registrants. They participated in two focus group discussions for faculty and two for students. Each focus group discussion had 8 to 10 participants and lasted approximately 2 hours.

We discussed the purpose, expectations, and interview guides for focus group discussion with an independent expert on focus group facilitation. She took responsibility to facilitate the discussion, and was free to adapt the discussion questions to group dynamics.

We audio-recorded the content of the discussions but did not video-record or take any photos. The facilitator explained the discussion's purposes and expectations to participants. She encouraged participants to freely share ideas and to honor the code of confidentiality.

We asked two research assistants to separately transcribe the audiotapes and translate them into English. The principal investigator took responsibility for identifying discrepancies in their two independent transcripts. He listened to the original audiotapes, focusing on the differences. He made necessary corrections for the final transcripts before qualitative analysis.

3 Data analysis

We managed and analyzed quantitative data including online feedback of students and faculty, MCQ items and relevant test scores, using STATA software, version 14.2.

Online survey questionnaires:

In terms of descriptive statistics, we reported the following data:

- Rate of response to online survey questionnaires.

- Distribution of answers (strongly disagree | disagree | agree | strongly agree) to each item.

In terms of inferential statistics, we reported the testing results of the two hypotheses:

- Primary hypothesis: the combined positive feedback (agree | strongly agree) of students were more positive in the new curriculum than the traditional curriculum.
- Secondary hypothesis: the combined positive feedback (agree | strongly agree) on the new curriculum of students were different from that of faculty.

MCQ items:

In terms of descriptive statistics, we calculated:

- Kappa coefficients for inter-rater agreement of the assignments of cognitive levels to MCQ items of the two assessors to confirm the reliability of measurement tool.
- Kappa coefficients and agreement percentages of the assignments of cognitive levels to MCQ items of faculty and of study team to see how well faculty had assigned cognitive levels to MCQ items.
- Cronbach's alpha coefficients for internal reliability of MCQ items in each discipline of the new curriculum.

In terms of inferential statistics, we showed the testing results of the hypotheses:

- First hypothesis: the actual learning objectives covered in MCQ items were different from the predetermined learning objectives in the new curriculum.
- Second hypothesis: the actual cognitive levels of MCQ items were different from the predetermined cognitive levels in the new curriculum.
- Third hypothesis: the new curriculum gave more MCQ items of higher cognitive levels than the traditional curriculum in their four similar disciplines.

Test scores:

In terms of descriptive statistics, we reported:

- Total mean test scores and relevant achievement percentages of each and all disciplines in the new curriculum.
- High cognitive mean test scores and relevant achievement percentages of each and all disciplines in the new curriculum.
- Total mean test scores and relevant achievement percentages of physics, biology and all disciplines in the traditional curriculum.
- High cognitive mean test scores and relevant achievement percentages of each and all disciplines in the traditional curriculum.

Focus group discussion:

We entered qualitative data (focus group discussion of students and faculty) into the qualitative management software DEDOOSE, version 7.5.6.

We conducted a content analysis of the transcriptions of the focus group discussion with the goal of using the qualitative data to explain our quantitative results and understanding the underlying mechanisms to gain insight into the strengths and weaknesses of the new curriculum.

We described qualitative and quantitative data simultaneously step by step in quantitative–qualitative sequence to assure their coherence.

4 Ethical issues:

We received an IRB study exemption determination for our study from Harvard Medical School, USA (**Appendix 6**) and from University of Medicine and Pharmacy at HoChiMinh city, Vietnam (**Appendix 7**).

The online surveys were anonymous. Students' participation in focus groups was completely voluntary, and all of the identification details of the participants were removed. The summative test scores were de-identified.

Chapter 3: Results

In this chapter, before presenting the results concerning our two study questions, we describe the response rates to online survey questionnaire and focus group discussion to have a general idea about potential bias due to low response rates. We mention the inter-rater agreement between two independent assessors of MCQ cognitive levels to have a notion of the reliability of our study MCQ cognitive level assignment tool.

We had very high response rates to online survey questionnaires. 98% (383/392) of the students in the new curriculum, 98% (386/393) of the students in the traditional curriculum participated in the student online surveys. 81% (39/48) of the faculty members in the new curriculum answered the faculty online survey. 85% (17/20) of the faculty and 100% (20/20) of the students in the new curriculum participated in the focus group discussions.

The Kappa coefficients between the two independent assessors of MCQ items in our study were 0.91 both in the new and the traditional curricula.

We present the study results in two sections: the first section is about the teaching activities of the faculty; and the second section is about the learning activities of the students in the new curriculum.

In each section, we demonstrate quantitative data from online surveys, MCQ items, and test scores followed by qualitative data from focus group discussions as further explanations for quantitative data. Exclusively to online survey data, we illustrate faculty and student perspective closely to each other to identify the discrepancy between their perspectives.

Though the comparison between the new and traditional curricula was only our secondary study objective, we introduced comparative quantitative data between the new and traditional curricula, where possible, to provide a view of the differences between the two curricula.

1 Did the new curriculum successfully affect the faculty development, teaching content, instructional methods, assessment instrument of the first year medical education at UMP and if so, how?

Faculty development

We present quantitative data on faculty satisfaction with faculty development program in the new curriculum in **Table 1.1.**

Table 1.1 Faculty's satisfaction with faculty development program – faculty ratings (n = 39)

Faculty have been adequately trained on	Strongly disagree	Disagree	Agree	Strongly agree
Preparing integrated lessons	0%	5%	56%	39%
Using interactive methods in teaching	0%	0%	56%	44%
Giving and receiving feedback in the interaction with students	0%	10%	59%	31%
Giving and receiving feedback in the interaction with other faculty	0%	26%	56%	18%
Developing MCQ items	0%	0%	63%	37%

More than 95% of faculty members were satisfied with the trainings on preparation of integrated lessons, use of interactive instructional methods, and development of MCQ items. Although quite high, comparatively only 90% and 74% of faculty members were satisfied with the trainings on exchanging feedback with students and faculty peers respectively.

The faculty thought that the faculty development program helped to improve their knowledge and interaction with students and peers:

> "*Since the beginning of curriculum reform, faculty members have met with each other. It has created positive impacts on improving faculty's knowledge, interaction with students, and interaction with faculty. Faculty members help each other much better.*"

"I see faculty development program really useful. It teaches us how to compose well-structured lectures including slides on "objectives" and "take home messages"; how to write standardized MCQ items; and how to run "flipped" classes."

We show quantitative data on faculty confidence to apply new competences after faculty development program in the new curriculum in **Table 1.2.**

Table 1.2 Faculty's confidence to apply new competencies – faculty ratings **(n = 39)**

Faculty feel confident to	Strongly disagree	Disagree	Agree	Strongly agree
Prepare integrated lessons	0%	5%	69%	26%
Use interactive methods in teaching	0%	8%	56%	36%
Give and receive feedback in the interaction with students	0%	5%	74%	21%
Give and receive feedback in the interaction with other faculty	0%	11%	76%	13%
Develop MCQ items	0%	11%	56%	33%

The faculty's confidence to apply new competencies was also high, around 90% in all five competencies.

The faculty thought that the faculty development program gradually built up their confidence in teaching the new curriculum:

"*As beginners, we could not avoid mistakes. Faculty development program gradually builds up our confidence to address new requirements. I judge the training sessions extremely useful*."

Besides giving positive feedback on the faculty development program, the faculty also indicated several weak points of this program including short training time, inappropriate assignment of faculty to discussion group, and inadequate time for competence maturation:

"*The time faculty spent to meet with each other in training sessions is insufficient, sometimes, too short, for such a big curriculum*."

"*It seems to me that we are randomly assigned into group discussion, which inhibits the practice of creating integrated lessons. For example, I was not assigned to a group of faculty members from disciplines related to mine in last training session.*"

"*Faculty competence is improving but has not met expectations yet. It is really hard. Faculty works more and harder but has still not addressed many requirements previously mentioned. Of course, our competence develops when we learn. However, it develops slowly, not as fast as we wish. The development in competence depends on our own gifts, background, and exercise in regardless of our willingness. Some faculty members could master while the others could not. It needs more time for competence maturation*."

Further qualitative data analysis suggested room for improvements in the following areas: introduction of smaller class sizes, dedication more time to practice, and repetition of the faculty development program in future time.

"*If possible, we should organize more classes of smaller sizes, and gather faculty members of near-related disciplines to facilitate content integration. Admittedly, to make content integration possible is so hard and requires more investment. I feel so confused*."

"*We need to practice frequently (to compose integrated lessons); we might have some obstacles during practice and try to overcome by using trained techniques. Without proper practice, simple training on technique theory might be useless*".

"*A repetition of faculty development program is necessary to make sure that all faculty members have chance to participate. Faculty members from some disciplines have been trained many times, while faculty members from the other disciplines have never been trained. They are so reluctant to try new ways.*"

Teaching content

We describe the evaluation of teaching content by faculty **Table 1.3** and students **Table 1.4**.

Table 1.3 Teaching content in the new curriculum – faculty ratings (n = 39)

Faculty frequently provided students with	Strongly disagree	Disagree	Agree	Strongly agree
Lecture contents integrated among disciplines in basic sciences	0%	10%	69%	21%
Lecture contents integrated to clinical applications	0%	11%	50%	39%
Laboratory contents illustrating relevant lectures	0%	3%	62%	35%
Laboratory contents relating to clinical applications	0%	8%	50%	42%
Pre-reading materials before class	0%	3%	46%	51%
Quiz to prepare before class	0%	26%	64%	10%
Assignments to accomplish after class	3%	41%	41%	15%

Table 1.4 Teaching content in the new curriculum – student ratings (n = 384)

Faculty frequently provided students with	Strongly disagree	Disagree	Agree	Strongly agree
Lecture contents integrated among disciplines in basic sciences	3%	8%	77%	12%
Lecture contents integrated to clinical applications	3%	8%	77%	12%
Laboratory contents illustrating relevant lectures	3%	15%	75%	7%
Laboratory contents relating to clinical applications	2%	35%	56%	7%
Pre-reading materials before class	3%	13%	72%	12%
Quiz to prepare before class	9%	45%	44%	2%
Assignments to accomplish after class	4%	49%	45%	2%

In general, almost 90% of the faculty members rated that their lecture contents were integrated across basic sciences and integrated to clinical applications; their laboratory content illustrated well the lectures and related to clinical applications; and they frequently provided students with pre-reading materials before class. Only 74% and 56% of the faculty members indicated that they frequently provided students with quizzes, and assignments respectively.

The student ratings of lecture content were positive, but not as high as the faculty ratings. Actually, faculty was more likely to rate teaching content in the new curriculum statistically greater than students in the four domains of teaching content: laboratory' illustrating relevant lectures, laboratory' relating to clinical applications, faculty's providing pre-reading materials, and faculty' s providing quiz before class ($p < 0.05$). The differences were not statistically significant in the three remaining domains of teaching content ($p > 0.05$).

We demonstrate comparative students' ratings on teaching content of the new and traditional curricula in **Figure 1.1** to **Figure 1.5**

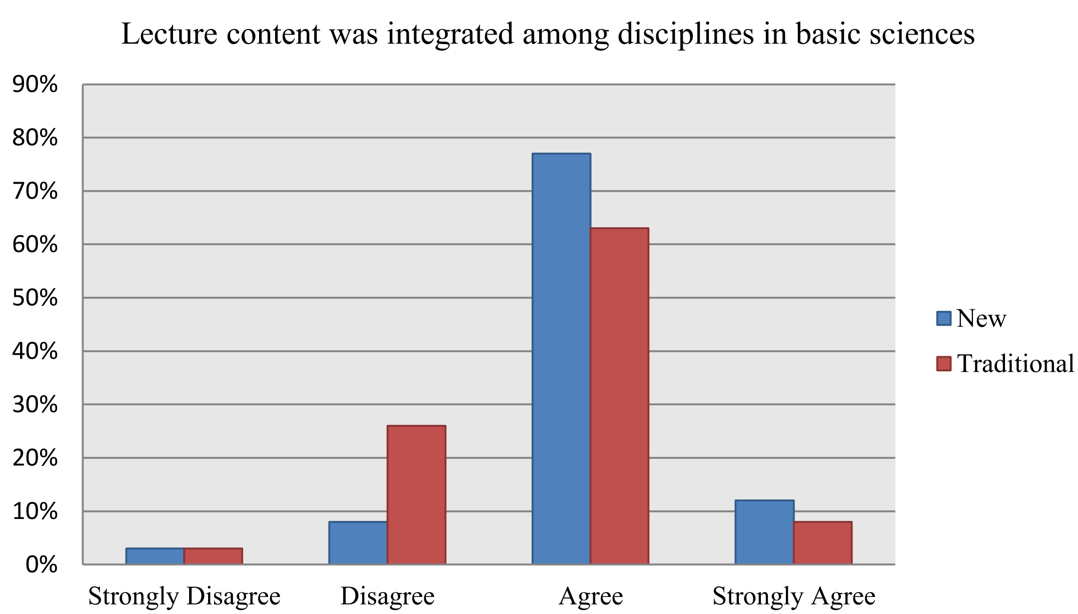

Figure 1.1 Integrated content among disciplines in basic sciences of lectures in new versus traditional curriculum – student ratings

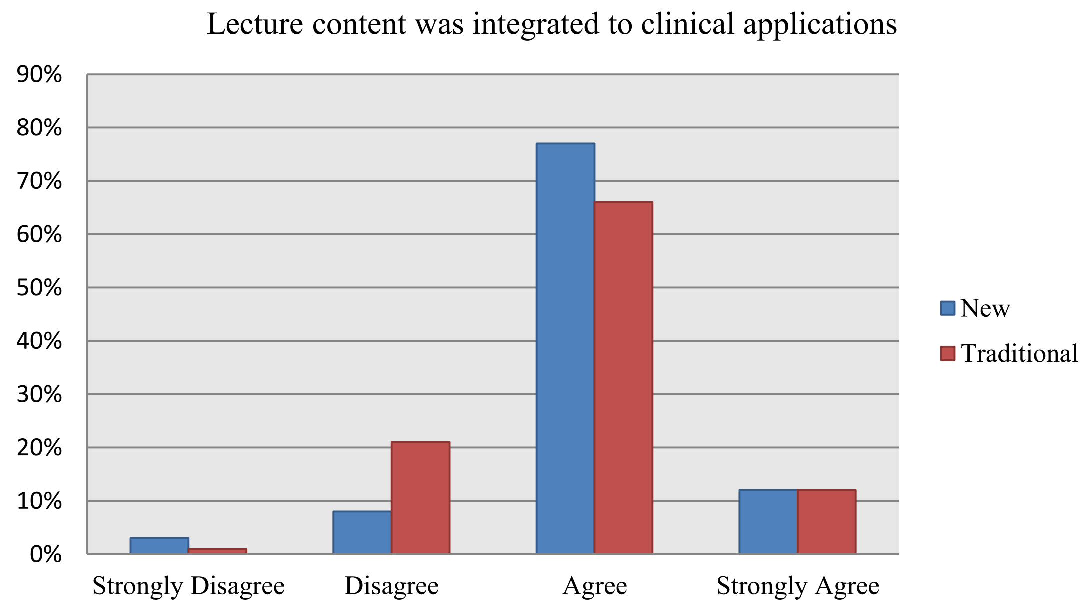

Figure 1.2 Integrated content between basic sciences and clinical application of lectures in the new versus traditional curriculum – student ratings

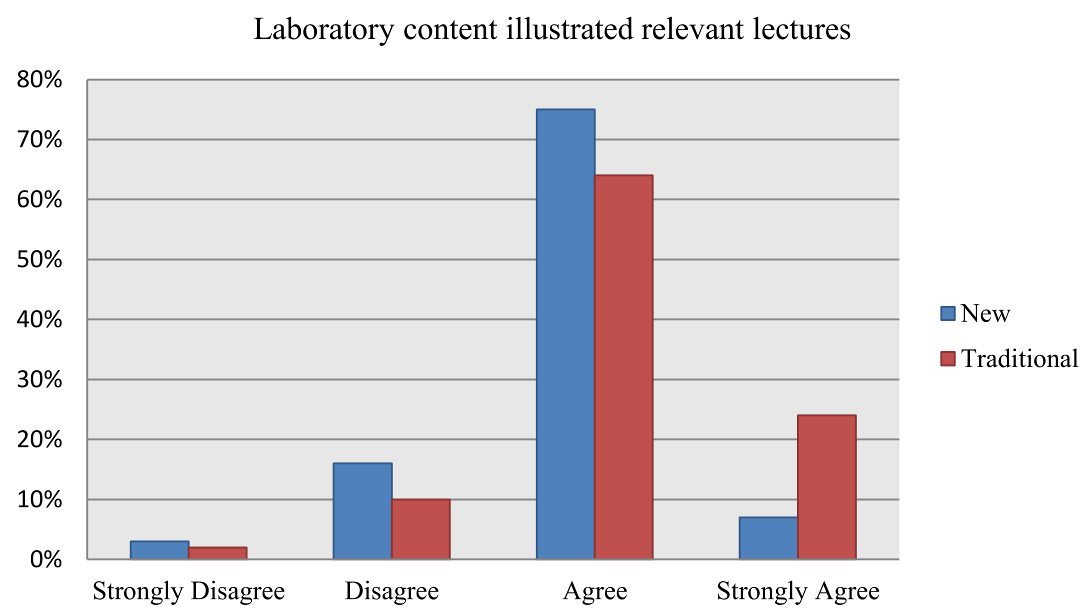

Figure 1.3 Illustration of lectures of laboratory contents in the new versus traditional curriculum – student ratings

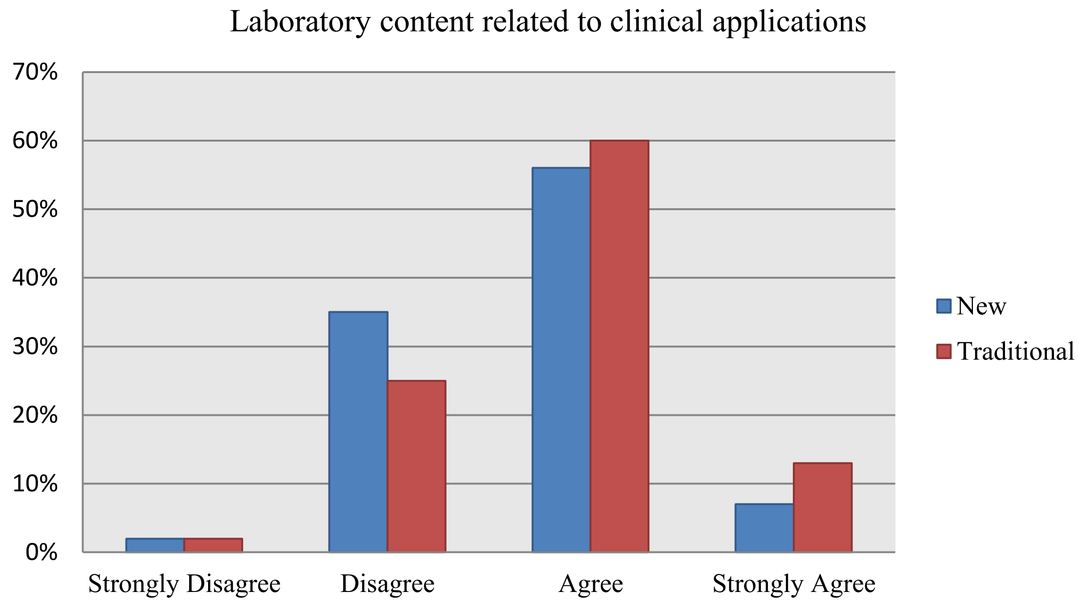

Figure 1.4 Relation between laboratory contents and clinical applications in the new versus traditional curriculum – student ratings

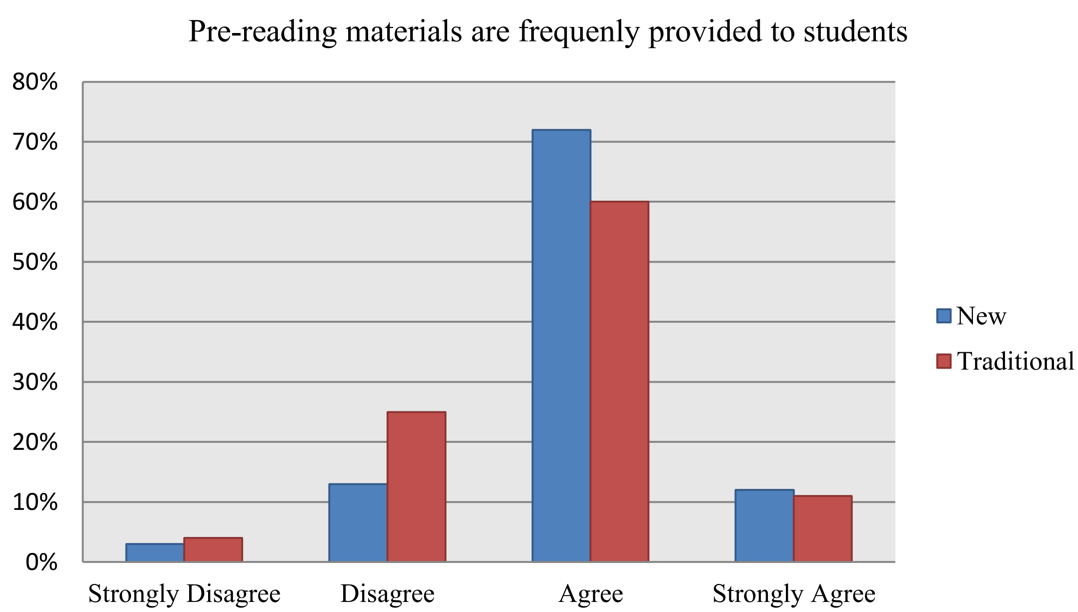

Figure 1.5 Availability of pre-reading materials in the new versus traditional curriculum – student ratings

We hypothesized that the students' positive ratings on teaching content would be greater in the new than traditional curriculum. We presented the results of these tests in **Table 1.5**

Table 1.5 Combined positive ratings * on teaching content between the new versus traditional curriculum – student ratings

Faculty frequently provided students with:	New	Traditional	p
Lecture content integrated among disciplines in basic sciences	84%	72%	**0.000**
Lecture content integrated to clinical applications	89%	78%	**0.000**
Laboratory contents illustrating relevant lectures	82%	89%	**0.006**
Laboratory contents relating to clinical applications	63%	72%	**0.007**
Pre-reading materials to prepare before class	84%	72%	**0.000**

(*) *Sum of "agree" and "strongly agree" responses*

In contrast to our hypothesis, the students' combined positive ratings on laboratory contents were statistically higher in the traditional than the new curriculum ($p < 0.01$).

In the four remaining domains of teaching content, students' combined positive ratings were statistically higher in the new curriculum than the traditional curriculum ($p<0.001$), including the integration of lecture content among disciplines in basic sciences, the integration between lecture content with clinical applications and the availability of pre-reading materials.

Our qualitative data analysis showed that integration among basic disciplines was weak, though it did help to avoid redundancies between disciplines. Lack of interaction among faculty members from different disciplines might be a plausible reason.

> *"There is almost no integration between physics and chemistry, chemistry and microbiology in module 1. Integration is weak among anatomy, anapathology, and histomembryology in module 2. Anatopathology and biology are mildly integrated. I only feel their minor connections only at reviewing lessons for exams."* (Student quote)

*"We could do well the first part of faculty collaboration: overlap avoidance. I know which discipline covers which content and I avoid teaching the content already taught by other faculty. We could avoid the overlap in content, and save time for faculty and students. However, the second part: content integration is not widely applied. It requires close collaboration among faculty from different disciplines to integrate our contents to resolve a common problem. For example, the topic "cell membrane" is common in chemistry, biology and physics, I have read, applied but not much. Faculty from different disciplines in basic sciences should meet and talk more with each other." (*Faculty quote*)*

"I feel that faculty teaches his lessons without having double checked with what other faculty in other disciplines have already taught." (Student quote)

On the contrary, basic sciences and clinical applications were closely integrated. The readiness to help of faculty from clinical sciences might be a good explanation.

"The most interesting feature in module 1 is the integration between basic sciences and clinical applications: physics has clinical cases on bone movement; biochemical tests are introduced in biochemistry." (Student quote)

"Faculty from clinical sciences helps us in building clinical cases, writing questions. They are almost accessible via email, phone and ready to address our uncertainty. They also support us in teaching sessions; they teach with us. If there are four sessions, they are available in all four. When students have questions on clinical sides, they are willing to answer. I see the integration between basic sciences and clinical applications is very effective. We need to meet with each other to write more clinical cases." (Faculty quote)

"Integration among different disciplines in basic sciences in module 1, for example, is inappropriate. While integration between basic sciences and clinical applications in a

same discipline in basic sciences is well done, integration between different disciplines is not clear." (Student quote)

Pre-reading materials were available and included PowerPoint presentations, clinical cases, and textbooks recommended by disciplines; further reading materials were not included.

> *"In my discipline, we have posted our PowerPoint presentations on school website before class. They include learning objectives, teaching content, and name of references. We do this for every lecture."* (Faculty quote)
>
> *"Actually, we only share with students PowerPoint slides and clinical cases to teach in class, discipline recommended textbooks, and that is all. We have not provided them with further reading materials."* (Faculty quote)

PowerPoint presentations uploaded to the school's website might differ from the ones taught in class. One reason was that faculty had reviewed and modified them shortly before class.

> *"I see the slides are uploaded on school website, but they are not similar to what the teachers used in class. The slide contents were updated very late".* (Student quote)
>
> *"My lecture is pretty long and I am afraid that I might be lost in teaching it. In the night before my teaching session, I stay up very late to review and modify every slide, even though they have been uploaded on school website long ago."* (Faculty quote)

Reference materials which had been uploaded on school website, if any, were too long and mainly written in English. As illustrated in the following quotes, faculty found it hard to write concise reference materials due to the huge amount and disperse locations of information.

> *"The reference materials that faculty gave us to read in preparation for clinical cases are mainly written in English. It takes us much time to read and translate them. Each clinical case goes with many reference materials written in English. Some faculty*

members say that they are short. Short though, but at least ten pages, sometimes as many as twenty, fifty pages" (Student quote)

"My lesson is on pathogenic mechanisms of bacteria, which are huge. Initially, I have prepared reference materials of over 100 pages in English for a 4-hour lesson. I see it is too much. Sharing with other faculty, some say the new curriculum requires us to provide 2-page reference material for a 4-hour lesson. However, I find very hard to write such concise reference materials to address this requirement." (Faculty quote)

"References on biophysics in general and on my narrow specialty in particular are not widely available. The references written in Vietnamese are so limited while the ones written in English are so disperse and come from different sources. We need to search extensively, read and synthesize into a 2-page reference material. It is hard and time-consuming" (Faculty quote)

Instructional methods

We show evaluation of instructional methods by faculty (**Table 1.6)** and students (**Table 1.7)**.

100% of the faculty indicated that they believed that they had encouraged students to think independently, guided students to identify and solve problems; encouraged students to contribute their ideas in class and to discuss and work in team; addressed students' questions appropriately. The student ratings of these five domains of the instructional methods were also positive, but statistically lower than the faculty's ($p< 0.05$).

90% and 85% of the faculty indicated giving the students feedback on learning content and method, and created chances to meet with students in person after class respectively. The student ratings on these two remaining domains of instructional methods were also positive and not statistically different from the faculty's ($p > 0.05$). Similar to teaching content, faculty was more likely to rate instructional methods better than students.

Table 1.6 Instructional methods in the new curriculum – faculty ratings (n = 39)

Faculty frequently	Strongly disagree	Disagree	Agree	Strongly agree
Encouraged students to think independently	0%	0%	51%	49%
Guided students to identify and solve problems	0%	0%	66%	34%
Encouraged students to contribute their ideas in class	0%	0%	49%	51%
Encouraged students to discuss and work in team	0%	0%	62%	38%
Addressed students' questions appropriately	0%	0%	66%	34%
Gave students feedback on learning content and method	0%	10%	62%	38%
Created chances to meet with students in person after class	0%	15%	72%	13%

Table 1.7 Instructional methods in the new curriculum – student ratings (n = 384)

Faculty frequently	Strongly disagree	Disagree	Agree	Strongly agree
Encouraged students to think independently	3%	8%	81%	8%
Guided students to identify and solve problems	1%	17%	75%	7%
Encouraged students to contribute their ideas in class	1%	9%	82%	8%
Encouraged students to discuss and work in team	2%	18%	73%	7%
Addressed students' questions appropriately	1%	16%	77%	6%
Gave students feedback on learning content and method	6%	17%	71%	6%
Created chances to meet with students in person after class	1%	21%	71%	7%

We report comparative students' ratings on instructional methods of the new and traditional curriculum in **Figure 1.6** to **Figure 1.11.**

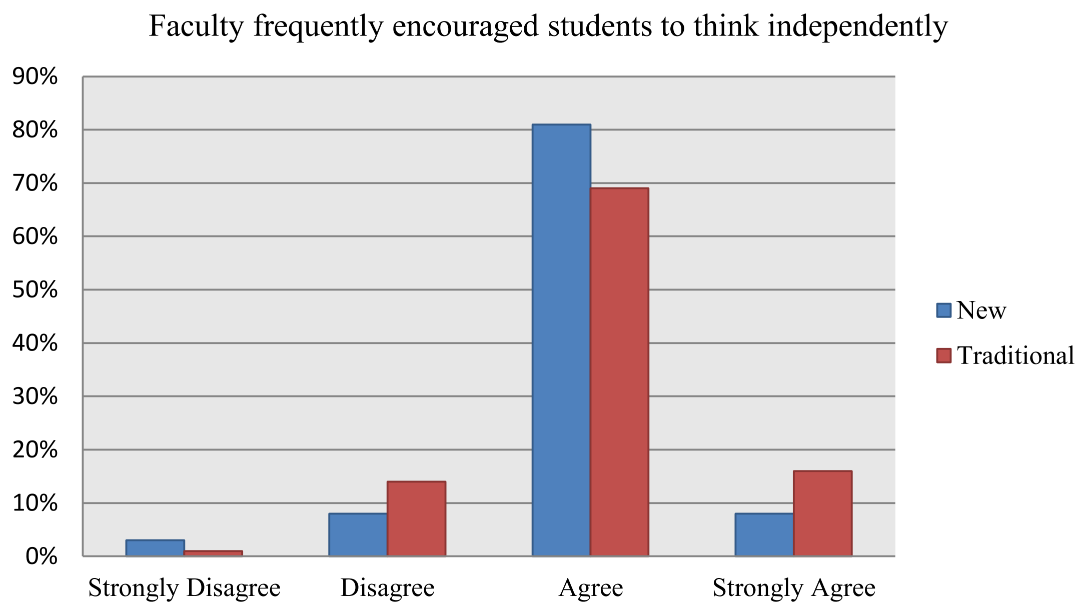

Figure 1.6 Faculty's encouraging students to think independently in the new versus traditional curriculum – student ratings

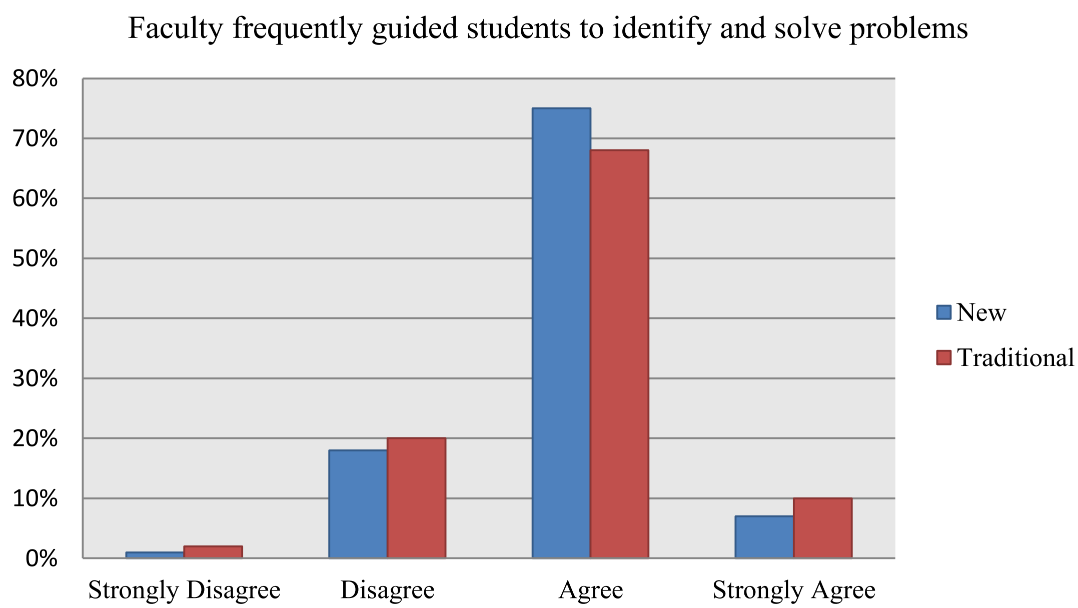

Figure 1.7 Faculty's guiding students to identify and solve problems in the new versus traditional curriculum – student ratings

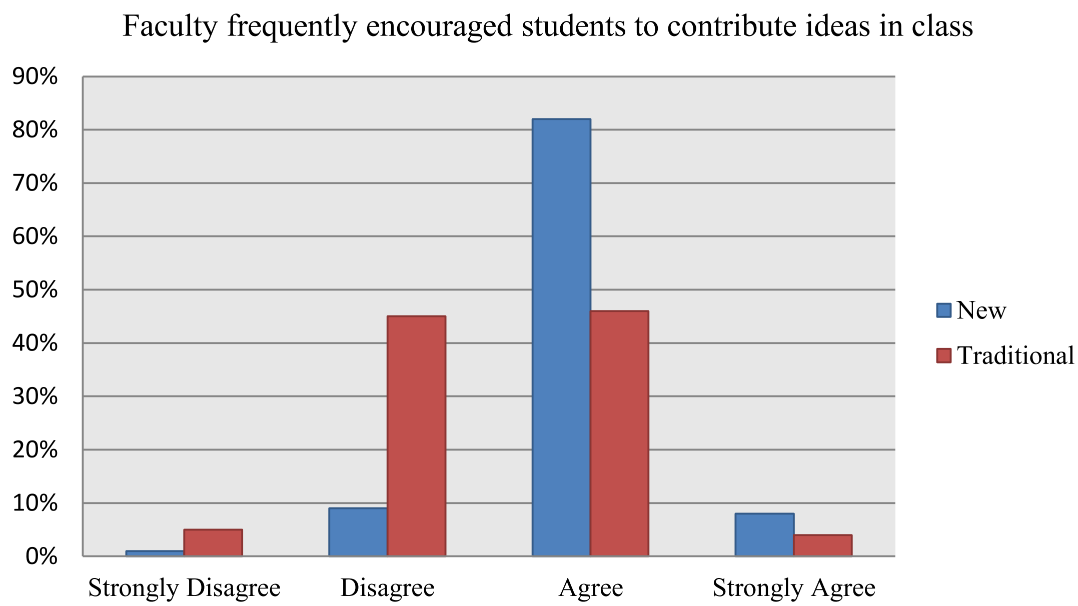

Figure 1.8 Faculty's encouraging students to contribute ideas in class in the new versus traditional curriculum – student ratings

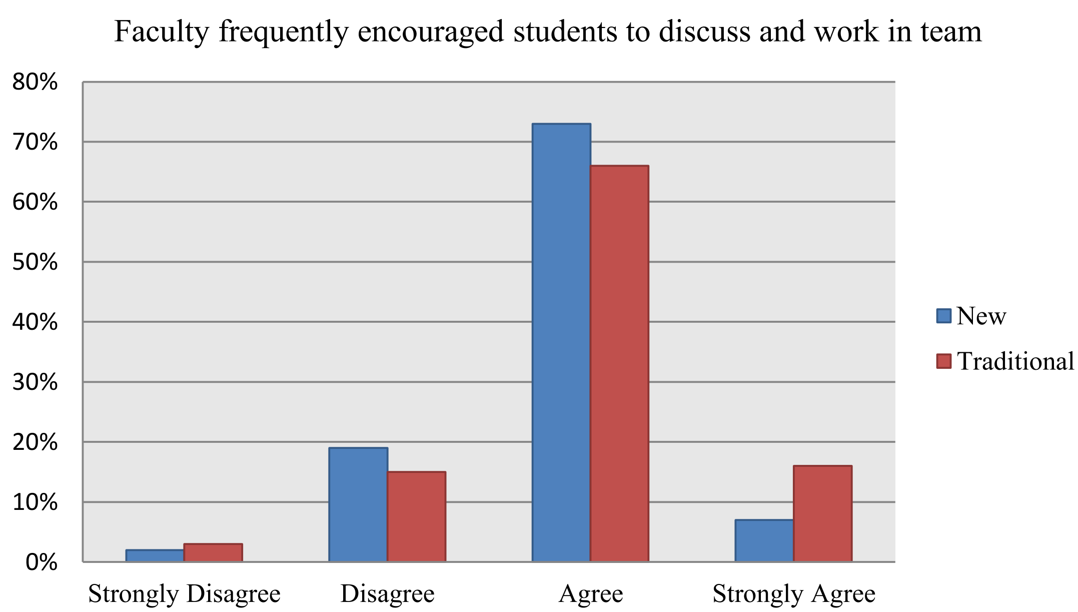

Figure 1.9 Faculty's encouraging students to discuss and work in team in the new versus traditional curriculum – student ratings

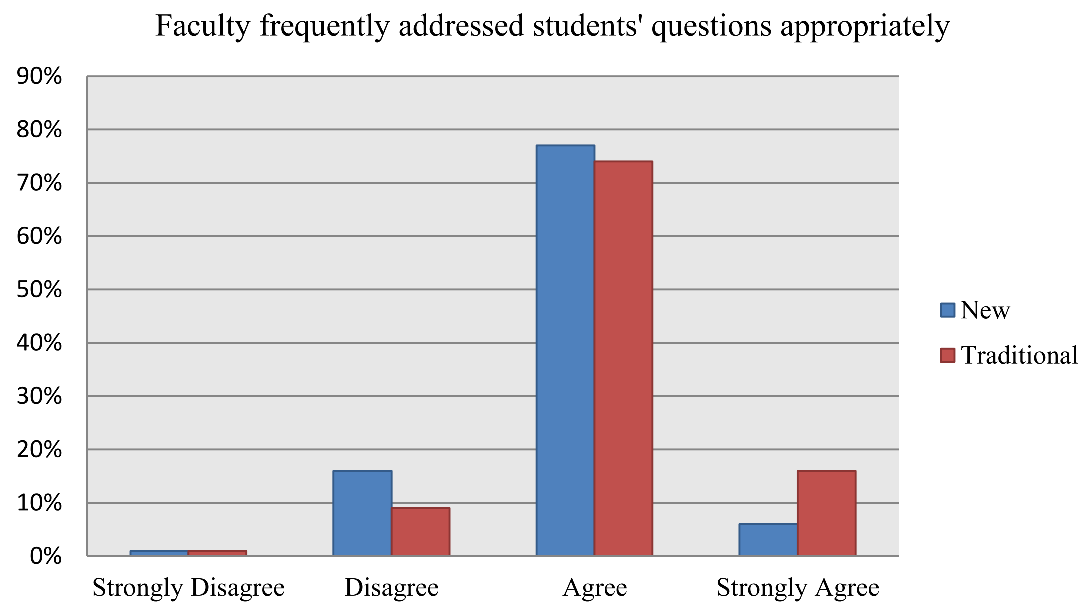

Figure 1.10 Faculty's addressing students' questions appropriately in the new versus traditional curriculum – student ratings

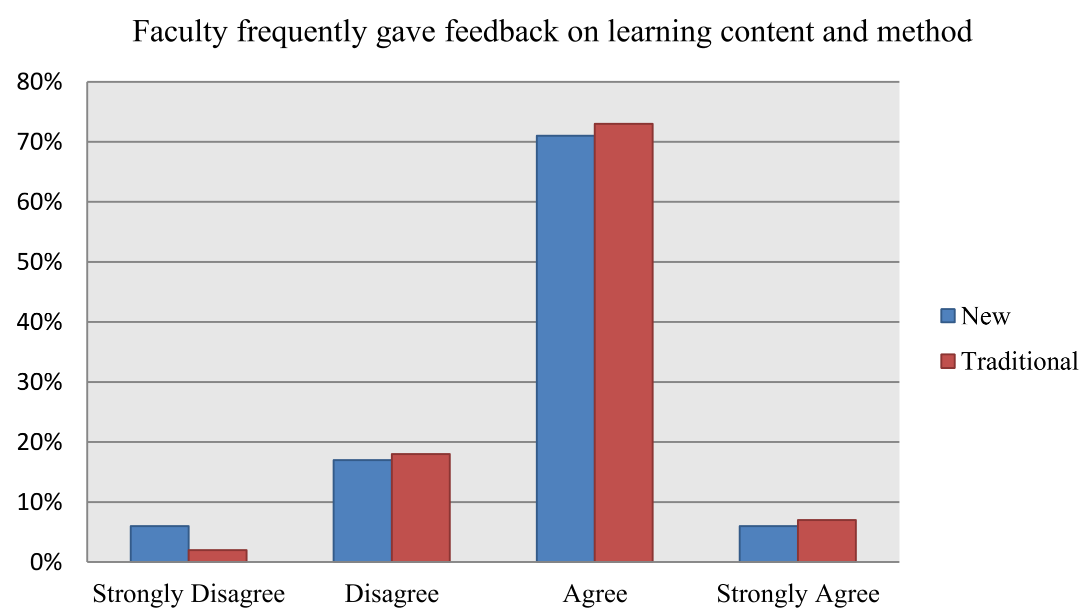

Figure 1.11 Faculty's giving students feedback on learning content and method in the new versus traditional curriculum – student ratings

We hypothesized that the students' combined positive ratings on instructional methods would be better in the new curriculum than traditional curriculum. We illustrated the results of these tests in **Table 1.8**.

Table 1.8 Combined positive ratings * on instructional methods between the new versus traditional curriculum – student ratings

Faculty frequently:	New	Traditional	p
Encouraged students to think independently	89%	85%	0.066
Guided students to identify and solve problems	82%	78%	0.275
Encouraged students to contribute their ideas in class	90%	50%	**0.000**
Encouraged students to discuss and work in team	80%	78%	0.648
Addressed students' questions appropriately	83%	90%	**0.005**
Gave students feedback on learning content and method	77%	83%	0.063

(*) *Sum of "agree" and "strongly agree" responses*

In contrast to our hypothesis, the student ratings on faculty's appropriately addressing the students' questions were statistically better in the traditional than the new curriculum ($p = 0.005$).

The student ratings on faculty's encouraging students to contribute ideas in class were statistically higher in the new than the traditional curriculum ($p < 0.001$).

The student ratings on the four remaining domains of the instructional methods in the new curriculum were not statistically different between the new and traditional curriculum ($p > 0.05$).

Qualitative data analysis confirmed the usefulness of new instructional methods in enhancing faculty interaction with students.

> *"In traditional curriculum, we paid less attention to interaction with students and did not know whether they had prepared lessons at home. In new curriculum, we use clicker questions to interact with them and verify their lesson preparation. If students have prepared, we will know for sure"* (Faculty quote)

"Faculty in microbiology integrates clinical applications and use clicker questions to interact with students. She goes around classroom and tries to encourage us to speak. For example, she comes and gives microphone to reserved students to encourage them to answer her questions. Most of faculty members in anatomy also come to interact with students during lecture sessions." (Student quote)

In addition, qualitative data analysis revealed barriers for faculty interaction with students: limited time, large class size, low faculty-student ratio, and insufficient material resources.

"Limited time might be a problem in interactive teaching. Active teaching requires inclusion of problems, topics in lectures; organization of seminars. Those requires much of time for preparation and implementation. We need to meet with students before class for task distribution. Students take turn to show up and talk during seminar sessions. In traditional curriculum, I had 4 hours to teach one lesson and I could easily organize a seminar. In new curriculum, I have only 2 hours to teach the same lesson, I could not organize seminar anymore." (Faculty quote)

"Large class size is a huge barrier for faculty interaction with students in active teaching. It is impossible for a faculty to control a class of 200 students" (Faculty quote)

"A faculty to interact with hundreds of students is impossible, they could not manage. The student number is too high while the faculty number is too low" (Student quote)

"It is impossible to interact without microphone. At the beginning, we have support for light and sound, we have a group of technical assistants. After a while, everything has gone: no screen, no sound. Actually, two microphones do not work properly: the first is completely broken and the second is half dead. We do not have technical assistant anymore: the man responsible for classroom management does not know how to fix light and sound problems." (Faculty quote)

Assessment instrument

We present the data of validity of MCQ items on three domains: cognitive levels, learning objectives, and integrated content.

We analyze inter-rater agreement between the assignments of cognitive levels to MCQ items of faculty and study team in **Table 1.9.**

Table 1.9 Faculty-study team inter rater agreement on cognitive level assignment (n = 270 items)

		Faculty			
	Cognitive level	Remember	Understand	Apply or above	Total
Study team	Remember	95	53	6	154
	Understand	20	35	20	75
	Apply or above	0	7	34	41
	Total	115	95	60	270
	Agreement (%)	96.7%		56.7%	
	κ coefficient	**0.37** (p = 0.000)			

The inter-rater coefficient between faculty and study team was low (0.37). While they highly agreed with each other on their assignments of low cognitive levels to MCQ items with an agreement percentage as high as 96.7%, they did not agree much with each other on the assignments of high cognitive levels to MCQ items with an agreement percentage of only 56.6%.

Faculty members tended to assign higher cognitive levels to MCQ items in comparison to the assessors, implying that they tended to over-estimate cognitive levels of their MCQ items.

We offer data of the cognitive levels versus the predetermined (planned) cognitive levels of MCQ items in the new curriculum in **Table 1.10.**

Table 1.10 Cognitive levels of MCQ items in the new curriculum: actual versus planned levels (n = 270 items)

Cognitive level	**Remember**		**Understand**		**Apply and above**		**p**
Discipline	Actual	Planned	Actual	Planned	Actual	Planned	
Biochemistry	20	18	13	12	7	10	0.714
Biology	20	19	13	17	7	4	0.502
Physics	9	8	4	8	7	4	0.331
Anapathology	15	10	5	8	0	2	0.158
Histoembryology	42	33	13	21	5	6	0.217
Anatomy	24	18	4	9	2	3	0.225
Microbiology	19	10	0	8	1	2	**0.004**
Chemistry	5	22	23	16	12	2	**0.000**

The actual cognitive levels covered by the MCQ items were not statistically different from the predetermined cognitive levels in most disciplines in the new curriculum ($p > 0.05$), which supported the content validity of MCQ items in terms of assessment of cognitive levels in these disciplines of the new curriculum.

The faculty from microbiology gave more low cognitive items ($p = 0.004$), while the faculty from chemistry gave more high cognitive items ($p < 0.001$).

We illustrate comparative evaluation data of the cognitive levels of test questions of the four similar disciplines between the new and the traditional curriculum in **Table 1.11.**

As shown on **Table 1.11**, the percentage of the overall high cognitive MCQ items is statistically higher in the new than the traditional curriculum: 21.5% versus 12.3%, $\chi^2(1) = 3.94$, $p = 0.047$.

Table 1.11 Cognitive levels of MCQ items in the new versus the traditional curriculum (n = 130 items)

Cognitive level	**Remember**		**Understand**		**Apply or above**	
Discipline	**New**	**Traditional**	**New**	**Traditional**	**New**	**Traditional**
Physics	9	11	4	6	7	3
Chemistry	5	3	23	29	12	8
Biology	20	24	13	12	7	4
Anatomy	24	26	4	3	2	1
Total	**58**	**64**	**44**	**50**	**28**	**16**

We provide survey data concerning integrated content in test questions of the new curriculum from the faculty (**Table 1.12**) and students (**Table 1.13**).

Table 1.12 Integrated content in test questions of the new curriculum – faculty ratings (n = 39)

Faculty frequently gave	Strongly disagree	Disagree	Agree	Strongly agree
Question content integrated among disciplines in basic sciences	0%	32%	47%	21%
Question content integrated between basic sciences and clinical applications	0%	16%	60%	24%

Table 1.13 Integrated content in test questions of the new curriculum – student ratings (n = 384)

Faculty frequently gave	Strongly disagree	Disagree	Agree	Strongly agree
Questions with integrated content among disciplines in basic sciences	4%	15%	75%	6%
Questions with integrated content between basic sciences and clinical applications	1%	15%	78%	6%

68% and 84% of the faculty rated that question content was integrated across basic sciences and between basic sciences and clinical applications. These two ratings were different but not statistically significant ($p > 0.05$). The student ratings of question content were also positive and did not statistically differ from the faculty's ($p > 0.05$).

We illustrate evaluation data of the learning objectives actually covered by MCQ items in the new curriculum in comparison to the predetermined (planned) learning objectives in **Table 1.14.**

Table 1.14 Learning objectives actually covered by MCQ items in the new curriculum in comparison to the planned learning objectives (n=270 items)

Objective	**1**		**2**		**3**		**4**		**p**
Discipline	Actual	Planned	Actual	Planned	Actual	Planned	Actual	Planned	
Anatomy	4	3	5	4	21	23			0.842
Anapathology	6	6	6	6	8	8			1.000
Histoembryology	4	8	5	10	19	10	32	32	0.122
Microbiology	1	6	3	4	12	6	4	4	0.126
Physics	8	6	3	5	4	4	5	5	0.853
Biochemistry	2	2	9	8	27	28	2	2	0.994
Biology	7	8	10	8	8	8	7	6	0.988
Chemistry	2	2	4	4	5	4	6		0.947
Objective	**5**		**6**		**7**		**8**		**p**
Biology	5	4	3	4					0.988
Chemistry	10	8	6	4	4	8	3	3	0.947

The actual learning objectives covered by the MCQ items were not statistically different from the predetermined learning objectives in the new curriculum ($p > 0.05$), which supported the content validity of MCQ items in terms of assessment of learning objectives.

We show evaluation data of the internal reliability of MCQ items in **Table 1.15.**

Table 1.15 Internal reliability of MCQ items in new curriculum by disciplines

Discipline	Item (n)	Response (n)	Cronbach's alpha
Anapathology	20	392	0.52
Microbiology	20	391	0.53
Physics	20	391	0.59
Biology	40	391	0.67
Biochemistry	40	391	0.68
Anatomy	30	392	0.68
Chemistry	40	391	0.76
Histoembryology	60	392	0.77

The internal reliability coefficients were relatively low in anapathology, microbiology, and physics (less than 0.6); whereas the internal reliability coefficients were quite good for the five remaining disciplines (more or less 0.7).

Our qualitative data analysis showed that writing MCQ items capable to assess integration and high cognitive levels was hard and time-consuming due to the necessity to read each other's teaching content while the school's compensation for their efforts was inappropriate.

> "*To write high cognitive MCQ items is very hard and time-consuming. We need to read the other disciplines' teaching content to know what have been taught in the other disciplines. It takes me a half day just to write one or two items. We do not have enough time and patience to sit down and write them.*" (Faculty quote)
>
> "*We wrote MCQ items easily in traditional curriculum; we can write 30 or 40 items per hour. MCQ items in new curriculum must address more stringent requirements. We could hardly complete a MCQ item after 30 or 40 minutes. However, we do not receive an appropriate compensation for our intense efforts. Of course, we work for our common*

educational cause. However, it is still advisable to provide faculty with reasonable compensation as incentive." (Faculty quote)

2 Did the new curriculum successfully affect learning attitude, learning behavior, and knowledge achievement of the first year medical students at UMP and if so, how?

Learning attitude:

We present data of students' commitment to self-learning in **Table 2.1** and **Table 2.2.**

Table 2.1 Students' commitment to self-learning in the new curriculum – student ratings (n = 384)

Student frequently	Strongly disagree	Disagree	Agree	Strongly agree
Prepared pre-reading materials before class	3%	20%	71%	6%
Completed quiz before class	5%	37%	56%	2%
Completed assignments after class	3%	28%	65%	4%
Raised questions related to lessons to their own	1%	26%	66%	7%
Searched literature to identify and solve problems	6%	17%	68%	8%

Table 2.2 Students' commitment to self-learning in the new curriculum – faculty ratings (n = 39)

Student frequently	Strongly disagree	Disagree	Agree	Strongly agree
Prepared pre-reading materials before class	3%	38%	49%	10%
Completed quiz before class	3%	34%	50%	13%
Completed assignments after class	5%	33%	54%	8%
Raised questions related to lessons to their own	3%	38%	48%	11%
Searched literature to identify and solve problems	3%	47%	37%	13%

77% of the students rated that they prepared pre-reading materials, 76% of the students rated that they searched literature to identify and solve problems. The student ratings of these two domains of learning attitude were statistically higher than the faculty ratings ($p < 0.005$), though faculty ratings were also positive on these two domains. Around 60% of students rated that they completed quiz before class, completed assignments after class, and raised questions related to lessons on their own. The student ratings were not statistically different from the faculty ratings ($p > 0.05$), though faculty tended to give worse ratings on the three domains than students.

Overall, the student ratings of their commitment to self-learning were likely better than the faculty ratings of students' commitment to self-learning.

We describe data of students' satisfaction with integrated content in **Table 2.3** and **Table 2.4**.

Table 2.3 Students' satisfaction with integrated content in the new curriculum – student ratings (n = 384)

Student frequently felt	Strongly disagree	Disagree	Agree	Strongly agree
Comfortable to learn integrated issues across basic sciences	3%	20%	70%	8%
Comfortable to learn integrated issues between basic sciences and clinical applications	5%	13%	73%	9%

Table 2.4 Students' satisfaction with integrated content in the new curriculum – faculty ratings (n = 39)

Student frequently felt	Strongly disagree	Disagree	Agree	Strongly agree
Comfortable to learn integrated issues across basic sciences	3%	44%	42%	11%
Comfortable to learn integrated issues between basic sciences and clinical applications	5%	19%	54%	22%

78% of the students indicated that they felt comfortable learning integrated issues across basic sciences, in comparison to the faculty ratings of only 53%. The difference was statistically significant ($p <0.001$). 82% of students rated that they felt comfortable learning integrated issues between basic sciences and clinical applications, compared to the faculty ratings of 76%. The difference was not statistically significant (p = 0.433).

Similar to the students' commitment to self-learning, the student ratings on students' satisfaction with the integrated content in the new curriculum were somewhat better than the faculty's ratings.

Qualitative data analysis confirmed that the integrated teaching content and interactive instructional methods in new curriculum improved student learning attitude.

> *"In module 2 and 3, I find integration among different disciplines. Having knowledge in one discipline allows better knowledge acquisition in other disciplines because they are related. It is very helpful for me to maximize time usage. I can use the time reserved for reviewing old lessons to prepare new lessons for next classes"* (Student quote).

> *"Integration between physics and clinical applications excites students very much. Students have chance to interact with real surgeon. In that session, students put more questions on clinical applications of physics than physics per se. They are so excited to raise such questions on integrated clinical cases."* (Faculty quote)

> "*I feel stressful coming to class unprepared. I could not get 100% and miss about 30– 40%. I cannot catch up with lectures with clicker questions. Therefore, I think I should prepare lessons at home, which is tiring but makes me feel more comfortable in class."* (Student quote)

> "*Clinical cases are presented with guiding questions. We have questions to discuss. I try answering those questions. It was like I know what direction to follow. I put aside the questions that I can answer for future discussion; I do literature research or ask senior students to address questions that I cannot answer. So I can answer questions at home before actual class."* (Student quote)

Students raised plausible barriers to their commitment to self-learning and satisfaction with integration in the new curriculum: the understandability of pre-reading materials, the pressure to learn many disciplines in a short time, and the time coincidence for lectures and exams.

> *"In module 2, I do not prepare lessons on histology at home. I could not understand anything when reading them; I have to imagine too much what are written. As a result, I give up preparing and wait for explanation from faculty in class."* (Student quote)
>
> *"In module 1, we do not adequately prepare lessons because module 1 includes five disciplines while the relevant preparation time is insufficient"* (Student quote)
>
> *"While learning a discipline, I take exams for another. For example, I have to take exams for module 2 in weekend while I still have to attend classes for module 3 during weekdays. I spend time reviewing old lessons to pass exams for module 2 and barely have any time to prepare new lessons for module 3."* (Student quote)

Learning behavior:

This set of questions related to learning-related behaviors of students through their interaction with peers and faculty in and out of class (**Table 2.5** and **Table 2.6**).

As indicated on **Table 2.5** and **Table 2.6**, 41% of students contributed ideas in class, and 21% met faculty in person after class; while the faculty ratings of the two domains of student interaction were 61% and 41% respectively. The absolute differences of 20% were statistically significant ($p < 0.05$). 47% of students raised questions in class, and 52% gave faculty feedback on teaching content and methods. The faculty ratings of the similar questions were 56% and 46% respectively but not statistically different from the the student ratings ($p > 0.05$).

Interestingly, while admitting that students were quite passive in contributing in class and interacting with faculty, faculty members acknowledged good peer interaction among students. The only domain of student interaction that both students and faculty rated positively was the students' discussing and working in team with peers: 85% for the student ratings and 77% for the faculty ratings. The two ratings were not statistically different ($p > 0.05$).

Table 2.5 Students' interaction in the new curriculum – student ratings (n = 384)

Student frequently	Strongly disagree	Disagree	Agree	Strongly agree
Contributed their ideas in class	7%	52%	39%	2%
Raised their questions in class	4%	49%	45%	2%
Discussed and worked in team with peers	3%	12%	72%	13%
Met with faculty in person after class to understand lessons further	6%	73%	17%	4%
Gave faculty feedback on teaching content and methods	4%	44%	49%	3%

Table 2.6 Students' interaction in the new curriculum – faculty ratings (n = 39)

Student frequently	Strongly disagree	Disagree	Agree	Strongly agree
Contributed their ideas in class	3%	36%	41%	20%
Raised their questions in class	3%	41%	46%	10%
Discussed and worked in team with peers	0%	23%	62%	15%
Met with faculty in person after class to understand lessons further	5%	54%	41%	0%
Gave faculty feedback on teaching content and methods	3%	51%	38%	8%

We detail comparative students' ratings on the students' giving faculty feedback on teaching content and instructional methods of the new versus the traditional curriculum in **Figure 2.1.**

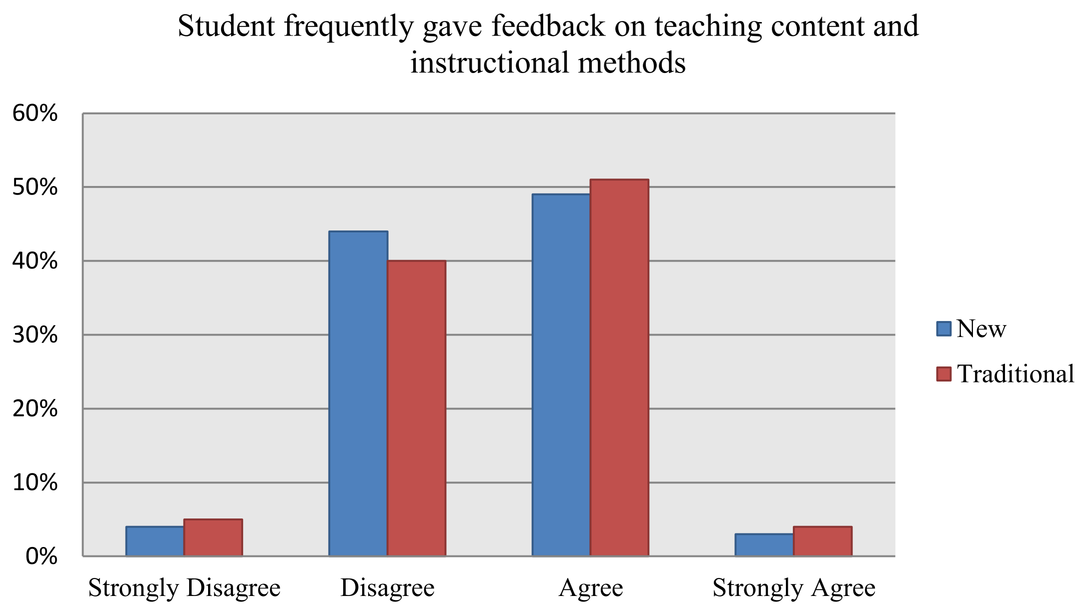

Figure 2.1 Students' giving faculty feedback on teaching content and instructional methods in the new versus traditional curriculum – student ratings

The student ratings of students' giving faculty feedback on teaching content and instructional methods were not statistically different between the new and the traditional curriculum, 52% versus 55% ($p = 0.418$).

Our qualitative data analysis confirmed the effect of integrated teaching content and interactive instructional methods on improvement of student interaction.

> *"I like the way faculty integrates basic sciences with clinical applications. It excites me a lot and makes me more interactive. For instance, a lesson which integrates with issues in real life incites my curiosity. I find it so amazing."* (Student quote)

> *"Interaction in class results from clicker questions which promote discussion. Faculty shows clicker question, students try to answer by themselves, then discuss with each other, and finally revise the answer. It is peer interaction."* (Student quote)

> *"Teaching clinical cases using team based learning format is excellent. Interaction is very much between faculty and students and among students. In lectures, students are*

passive but in clinical case discussion, they exchange ideas and work in team actively. They keep on working and feel excited with clinical case discussions." (Faculty quote)

"I see abundant interaction during discussions of clinical cases. Actually, interaction among peers is very strong in many clinical case discussions. We are divided in small groups. Each group comes up with one answer. If our answers are different, we will discuss with each other or with teachers." (Student quote)

Paradoxically, integration might reduce interaction between faculty and students.

"Questions on integrated content are not appropriately answered by all teachers. Once, I have asked such kind of question, my faculty kept saying: "Oh, yes, this issue is available, yes, available online" and encouraged me to look it up online. Her hesitation in addressing my question makes me wonder if she really knew the answer. She gave me the answer as if she did not give any answer at all." (Student quote)

"I find interesting to see that students extend their questions on different disciplines, for example, they point out the differences in common knowledge between different disciplines and ask me for explanations. They also compare the differences in content between books written in Vietnamese and in English. They do not satisfy with knowledge in basic sciences but also explore knowledge in related clinical sciences. I have to read a lot to be able to address their questions, and I learn a lot from them." (Faculty quote)

Similarly to faculty interaction, large class size also prevented interaction between peers.

"Students from four classes attend a same lecture session. Students can sit at any place in classroom. Because I sit next to different students on different days, I do not know who the students sitting next to me are. As a result, interaction between peers in the class is prevented by "strangers" effect", I hesitate to share ideas with them and decide to learn by myself." (Student quote)

Oriental hierarchical and collective culture was huge barriers to students' interaction.

> *"When I find something different from my perspective during lecture; I dare not raise my hand to speak up. I feel so reserved that I usually approach them after class to ask. It is not good to interrupt teachers' lecturing. It looks like a bad behavior*." (Student quote)
>
> *"Passive interaction might result from our cultural feature. In a collective culture which does not appreciates individualism. Everyone hesitate to speak up in public. We are afraid of being laughed at and being labeled "ignorant" if we give incorrect answer. Students do not have habit and dare not to speak in public."* (Faculty quote)
>
> *"I prefer holding back to interrupting teaching flow. I mean, I want to wait until faculty finishes his talk and ask him after class. I get very upset to be interrupted while I am listening to lecture and my peers feel the same. Listening to same things after having fully understood them is quite irritating to many. As a result, I feel uneasy to interrupt faculty that way."* (Student quote)

In terms of interaction between faculty and students out of class, our qualitative data analysis illustrated that faculty members were not easily accessible after class, even though they provided students with their email addresses and phone numbers.

> *"Interaction between faculty and students in class is more advantageous. After class, faculty is so busy and interaction out of class is much harder. Interaction through email might be the best option for all. Most faculty work in many places, and meeting in person with students is really hard. We prefer interacting through email or phone. Only when faculty cannot satisfy students' questions, they might meet in person."* (Faculty quote)
>
> "*Interaction with faculty out of class is infrequent. We often identify hard issues only after returning home and revising lessons. It is hard to ask faculty at that moment. I have*

sent emails to faculty and received no reply. I dare not telephone them either because I am not sure if they are available." (Student quote)

In addition, interaction tools after class were not effective and reliable.

> *"Well, faculty provides email address though, I hesitate to use because it take too much time to interact through email: he has to write to answer my questions. Personally, I feel uncomfortable because interactions could not be smooth. After he answers my questions, I have more questions to ask. It takes too much time. Having their phone numbers, I dare not calling due to my financial limitation*" (Student quote)

> *"Each discipline has one forum on school website and so that students can use to interact with faculty, but they are almost inactive. Once, I have entered forum to ask question, I discover that forum must have been activated by faculty before students can type in questions. It means faculty must switch on forum's discussion function to start the interaction, otherwise, students cannot raise questions."* (Student quote)

> *"It is quite hard to meet faculty in person after class because we do not know where they are. They do not provide office hour either."* (Student quote)

In terms of interaction content, faculty members commented that students were interested in assessment content more than knowledge in that discipline per se. They assumed that students under-estimated the importance of basic sciences in medicine. They also blamed bad learning habits acquired from high school as a reason for students' ineffective interaction.

> "*Some students called me at 10 PM, mostly in the night before exam. They asked me to help them to select correct answers to test questions. Because their exams came soon, they were so nervous and asked for help. However, they did not ask to further understand a lesson or deeply explore an issue. We could see that students' content of interaction badly meets faculty expectation.*" (Faculty quote)

"Students attend medical school to become physicians. They think they only need to learn internal medicine, surgery, obstetric gynecology, and pediatrics. They do not make enough efforts to learn disciplines in basic sciences and basic medical sciences without knowing that these disciplines provide them with solid foundation in medicine. They just learn to pass exams not to obtain profound knowledge." (Faculty quote)

"*Students are accustomed to learning ways acquired from high school, which is passive and imposed from teachers. For example, my kid is now high school student. He is stuck to passive and directive teaching formats. He is expected to think and behave in only one way; otherwise, he will be punished. After a quick transition to medical school from high school, first year students find hard to adapt to new active learning ways in medical school."* (Faculty quote)

Knowledge achievement:

We describe the students' confidence to answer integrated questions in the new curriculum in **Table 2.7** and **Table 2.8.**

As shown on **Table 2.7** and **Table 2.8**, 55% of the students and 63% of the faculty members indicated that students felt confident in answering to questions integrated across basic sciences in the new curriculum. The positive rating of students was statistically lower than that of faculty ($p = 0.008$). 51% of students and 82% of faculty rated that students felt confident in answering questions integrated between basic sciences and clinical applications in the new curriculum. The positive rating of the students was statistically lower than those of the faculty ($p < 0.001$).

We present students' summative test scores in the traditional curriculum in **Table 2.9,** and the new curriculum in **Table 2.10.**

As shown in **Table 2.9**, the students in the traditional curriculum dealt with MCQ items at high cognitive levels comparably to MCQ items at all cognitive levels: 67.2% versus 62% (p

>0.05). In **Table 2.10**, similarly to the traditional curriculum, the students in the new curriculum also dealt with MCQ items at high cognitive levels comparably to MCQ items at all cognitive levels: 65.5% versus 66% ($p > 0.05$).

Table 2.7 Students' confidence to answer integrated questions in the new curriculum – student ratings (n = 384)

Student felt confident in answering to	Strongly disagree	Disagree	Agree	Strongly agree
Questions integrated across basic sciences	4%	41%	52%	3%
Questions integrated between basic sciences and clinical applications	4%	45%	46%	5%

Table 2.8 Students' confidence to answer integrated questions in the new curriculum – faculty ratings (n = 39)

Student felt confident in answering to	Strongly disagree	Disagree	Agree	Strongly agree
Questions integrated across basic sciences	3%	19%	50%	13%
Questions integrated between basic sciences and clinical applications	5%	13%	68%	14%

Table 2.9 Students' summative test scores in the traditional curriculum (n = 393)

	All items			High cognitive items		
	Item(n)	Mean	Achievement	Item(n)	Mean	Achievement
Biology_general	20	10.9 ± 2.93	55%			
Biology_genetics	20	11.5 ± 2.69	58%	4	2.4 ± 1.02	60%
Physics	20	14.7 ± 2.96	74%	3	2.4 ± 0.75	80%
Overall	**60**		**62%**	**7**		**67.2%**

Table 2.10 Students' summative test scores in the new curriculum (n= 392)

	All items			High cognitive items		
	Item(n)	Mean	Achievement	Item(n)	Mean	Achievement
Biology	40	20.0 ± 4.65	50%	7	2.5 ± 1.06	36%
Physics	20	11.5 ± 2.57	58%	7	4.3 ± 1.27	61%
Biochemistry	40	23.7 ± 4.44	62%	7	3.7 ± 1.35	53%
Microbiology	20	11.2 ± 2.67	62%	1	0.7 ± 0.47	68%
Anapathology	20	13.6 ± 2.42	68%			
Histoembryology	60	42.9 ± 5.70	72%	5	3.7 ± 1.03	74%
Chemistry	40	29.2 ± 4.31	73%	12	9.5 ± 1.64	79%
Anatomy	30	22.8 ± 3.46	76%	2	1.8 ± 0.45	90%
Overall	**270**		**66%**	**41**		**65.5%**

Qualitative data analysis shows that integrated teaching content enhanced memorization.

"Integrated content is helpful in reducing academic workload; we only have to learn the overlapping among disciplines once. The connections helped to link knowledge and memorize better." (Student quote)

"In traditional curriculum, we do not know why we need to learn a discipline. In new curriculum, we understand the reason why we need to learn physics, for example. Physics and biophysics provided us with basic knowledge to explain human body; we know to what part biochemistry is related. We understand and learn better." (Student quote)

However, their achievement might decrease due to concept mismatches among disciplines.

"Within a module, there are some concept mismatches among different disciplines, for example, terminologies are not used similarly in anatomy and histology. Alike for the example in thermodynamics, the static electric voltage of cell membrane is different among disciplines. As a result, there might be different answers to a similar MCQ item on static electric voltage depending on different disciplines." (Student quote)

Chapter 4. Discussion

1 Summary of main findings

With some exceptions that are valuable as feedback for further curricular improvement, our findings indicate that most of the objectives of the new curriculum were successfully met. In terms of teaching activities, almost 90% of the faculty members were satisfied with the new curriculum's faculty development program and most of them felt confident to apply in the first year of curriculum implementation their newly acquired compentencies in teaching. 89% of the faculty and students indicated that the teaching content was integrated across basic disciplines and with clinical applications. 100% of the faculty and 80% of students rated that the instructional methods were interactive. 84% of the faculty and students responded that the test questions integrated basic sciences and clinical applications. 100% questions reflected the learning objectives. The integrated teaching content and interactive instructional methods promoted the students' learning activities. 77% of the students and 59% of faculty answered that the students prepared before lectures with clicker questions and team based learning. 85% of the students and 75% of faculty assessed that students interacted with their peers.

In comparison to the traditional curriculum, the new curriculum's lecture content was rated as more integrated both across basic sciences (84% versus 72%) and between basic sciences and clinical applications (89% versus 78%). The faculty provided students with pre-reading materials more frequently (84% versus 72%), encouraged students to contribute their ideas in class more often (90% versus 50%), and gave more MCQ items at high cognitive levels in the summative exams (21.5% versus 12.3%).

Among the less positive results, we found that the new curriclum's laboratory content was rated as less illustrative of lecture content (82% versus 89%) and less related to clinical applications (63% versus 72%) than the traditional curriculum. Only 41% of the students and 61% of faculty rated that the students contributed in class. 21% of the students and 41% of faculty rated that the students met with faculty in person after class to understand the lessons better. The faculty members addressed students' questions less appropriately (83% versus 90%). And although high cognitive level testing was higher in the new curriculum, the absolute level was still low, only 9.2%.

Zooming in, our study has pointed out three interesting mismatches.

First, the lecture content was rated as better in the new curriclum whereas the laboratory content was better in the traditional curriculum. It was a mismatch in improvement of teaching content. Actually, we had decided to keep our laboratory content unchanged from the traditional curriculum. The asynchronous reform in content of lectures and laboratory created the mismatch. The result implies a necessity to reform the laboratory content in our next step. In addition, the integration across disciplines in basic sciences was not as strong as that between basic sciences and clinical applications. The qualitative results indicated that the ineffective interaction between faculty of different disciplines in basic sciences versus the effective interaction between faculty of disciplines in basic sciences and clinical disciplines might be a reason. The result implies that more faculty-faculty interaction across disciplines in basic sciences should be created.

Second, almost 100% of the faculty members confirmed that they actively interacted with students wheras more than 50% of the students indicated that they passively interacted with faculty. It was a mismatch in reaction to instructional methods. Besides some inherent limitations in human and material resources of a developing country such as low faculty-student ratio and poor classroom facility, the oriental hierachical and collective culture might explain the relatively passive interaction between the faculty and students. Obviously, we might employ technical measures to optimize faculty-student ratio, to ameliorate classroom conditions in our next step. However, what action options to modify the students' mindset might are less clear.

Third, the ratings of teaching activities were more positive from the faculty than the students; whereas the ratings of learning activities were more positive from the student than the faculty. It was a mismatch in rating between the faculty and students. Actually, faculty and students were all involved in the new curriculum as key stakeholders, and had a difficult time playing roles as independent assessors in evaluating the curriculum. They might find it impossible to avoid their own bias. The tendency that people overestimate their own performance and underestimate the others' might be an explanation for this third mismatch. This result implies a search for other unbiased resources for curriculum evaluation, and for possibly bringing faculty and students together to discuss and better understand the others' perspectives.

2 Strengths and weaknesses of this study

Strengths

This study took a scholarly approach to the curriculum evaluation, collecting comprehensive and comparative data in a systematic way. This is a characteristic of far too few studies involving curricular evaluation. Moreover, the combination of qualitative data that complemented quantitative data allowed us not only to identify and describe areas of success, but also to achieve an active understanding of the change process and its underlying mechanisms. The data collected are likely to have strong practical implications for further curricular improvement.

The careful and comprehensive nature of this study guarantees that multiple topics and perspectives were incorporated, and that the assessments and instruments used demonstrated the appropriate statistical qualities such as reliability and validity. We collected data on teaching activities (faculty development, teaching content, instructional methods, and assessment instrument) and learning activities (students' attitude and behaviors during learning, students' knowledge achievement). We carefully developed our study measurement tools (online survey questionnaires, MCQ cognitive level assignment tool, and focus group interview guides), using expert input to establish the validity of measurement tools. We collected feedback from both faculty and students (to counterbalance their inherently contradictory bias), and we used educational experts as our independent facilitators of focus group discussions, and independent assessors of MCQ items (to assure the objectivity of assessement).

The response rates were more than 80% for the faculty, and more than 90% for the students. We believed that the online survey data were representative of our study population, and we thereby avoided selection bias due to low response rates. The high response rates are another strong point in our study. This is important, especially for a study in the social sciences using an online survey questionnaire as a principal method of data collection, in which low response rates may present a threat to validity.

Weaknesses

Study weaknesses include the short-term perspective taken, and the fact that this was a single center study using a historical control as the comparison group, as well as potential bias from self-evaluation. Faculty members and students are key stakeholders because they each understand their educational activities the most. As a result, we felt it necessary to collect both of their perspectives for evaluation data, which allowed us to recognize and identify the presence of bias due to self-evaluation. Acknowledging the possibility of any given stakeholder's biases, we plan to add more independent sources of evaluation in our follow-up studies by training independent classroom assessors and arranged video-recordings for class sessions. The independent assessors will attend classes as if they were students and use the Classroom Observation Protocol for Undergraduate STEM (COPUS) tools to evaluate educational activities [17]. The video content will be analyzed more objectively by independent assessors using a standardized check list. We hope that these new approaches and tools might provide objective evaluation data on our new curriculum.

Our one-year study provides no data to evaluate the new curriculum's long-term impacts. We believe that improvements in the teaching and learning activities derived from the new curriculum are likely to be translated into positive long-term impacts on students or its eventual impact on patients and patient care. We plan to collect data to confirm our expectations of the effect of new curriculum on these impacts when students start their clinical rotations and after they graduate from medical school. Our single-center study provides data only applicable for UMP because our study population might not be representative of the population in the other medical schools which do not share UMP's characteristics. However, four other medical schools in Vietnam are about to change their curricula; it is possible to apply our study design to collect relevant data from these four schools and compare with the UMP data.

3 Implications

Our study potentially has significant implications at the school, country and world levels.

At UMP, our study provides evidence on early effectiveness of the new curriculum, which reinforces our school's motivation to pursue curriculum reform. In addition to demonstrating its successes, it also indicates room for improvement. For example, we might create official spaces and time for peer teaching among faculty members to strengthen integration; we might offer more training on faculty skills in giving and receiving feedback to enhance faculty-faculty and faculty-student interactions; we might organize office hours to promote faculty-student interaction out of class; we might offer courses on writing high cognitive MCQ items; we might try to protect students' learning time by reasonably arranging different times for learning and taking examinations; and we might repair and upgrade classroom facilities to ensure an even more supportive learning environment.

At the country level, UMP is a pioneer in medical curriculum reform in Vietnam. Four other schools have planned to change similarly. Our study results might provide good comparisons and guidance for them. They can learn from our experience and overcome similar challenges in a shorter time. For example, although it took UMP 6 years to prepare its new curriculum, the other schools might spend only two or three years to undergo similar preparation thanks to the UMP experience and the data derived from this study. They might also apply our study measurement tools to evaluate their curriculum reform.

At the world level, our study is one of the first to comprehensively and systematically evaluate a medical curriculum toward an integrated and interactive curriculum in a developing country. Our study's findings may derive, in part, from the hierarchical and collective culture that characterizes some oriental countries, which might be a barrier to a medical curriculum which promotes effective faculty-student interaction; however the study also demonstrates that there are ways of sucessfully overcoming this barrier. To maximize benefits of interactive instructional methods in medical education, faculty and students in medical schools in oriental countries might need to adopt a new mindset on the one hand; and we also need to adapt western approaches in medical education to better fit in oriental cultural characteristics on the other hand.

4 Conclusions

The new curriculum at UMP has achieved almost all of its stated objectives. The data provide evidence of integrated teaching content, interactive instructional methods, valid and reliable assessment instruments. We also found that the new curriculum promoted students' commitment to self-learning, effective interaction with faculty and peers, and better achievement of integrated knowledge as assessed at high cognitive levels. Further study is planned beyond the first curriculum year to evaluate the new curriculum's long-term impacts on students' clinical competencies and patient care.

Bibliography

1. Flexner, Abraham. 1910. *Medical Education in the United States and Canada: A Report to the Carnegie Foundation for the Advancement of Teaching*
2. Papa, F. J., and P. H. Harasym. 1999. "Medical Curriculum Reform in North America, 1765 to the Present." *Academic Medicine: Journal of the Association of American Medical Colleges* 74 (2): 154–64.
3. Moore, G. T., S. D. Block, C. B. Style, and R. Mitchell. 1994. "The Influence of the New Pathway Curriculum on Harvard Medical Students." *Academic Medicine: Journal of the Association of American Medical Colleges* 69 (12): 983–89.
4. Peters, A. S., R. Greenberger-Rosovsky, C. Crowder, S. D. Block, and G. T. Moore. 2000. "Long-Term Outcomes of the New Pathway Program at Harvard Medical School: A Randomized Controlled Trial." *Academic Medicine: Journal of the Association of American Medical Colleges* 75 (5): 470–79.
5. Dienstag, Jules L. 2011. "Evolution of the New Pathway Curriculum at Harvard Medical School: The New Integrated Curriculum." *Perspectives in Biology and Medicine* 54 (1): 36–54.
6. http://www.thecrimson.com/article/2015/9/2/hms-curriculum-major-revamp/
7. Ten Cate, Olle. 2007. "Medical Education in the Netherlands." *Medical Teacher* 29 (8): 752–57.
8. Vu NV, Bader CR, Vassalli JD. The redesigned undergraduate medical curriculum at the University of Geneva. In: Scherpbier AJJA, van der Vleuten CPM, Rethans JJ, eds. Advances in Medical Education. Dordrecht: Kluwer Academic Publishers; 1997. p. 532-5.
9. Nikendei, Christoph, Peter Weyrich, Jana Jünger, and Markus Schrauth. 2009. "Medical Education in Germany." *Medical Teacher* 31 (7): 591–600.
10. Teo, Alan. 2007. "The Current State of Medical Education in Japan: A System under Reform." *Medical Education* 41 (3): 302–8.
11. Sherer, Renslow, Hongmei Dong, Zhou Yunfeng, Scott Stern, Yang Jiong, Karl Matlin, Yu Baoping, et al. 2013. "Medical Education Reform in Wuhan University, China: A Preliminary Report of an International Collaboration." *Teaching and Learning in Medicine* 25 (2): 148–54.

12. Amin, Zubair, Khoo Hoon Eng, Matthew Gwee, Koh Dow Rhoon, and Tan Chay Hoon. 2005. "Medical Education in Southeast Asia: Emerging Issues, Challenges and Opportunities." *Medical Education* 39 (8): 829–32.
13. Chastonay, Philippe, Nu Viet Vu, Jean-Paul Humair, Emmanuel Kabengele Mpinga, and Laurent Bernheim. 2012. "Design, Implementation and Evaluation of a Community Health Training Program in an Integrated Problem-Based Medical Curriculum: A Fifteen-Year Experience at the University of Geneva Faculty of Medicine." *Medical Education Online* 17 (1): 16741.
14. Spiel, Christiane, Barbara Schober, and Ralph Reimann. 2006. "Evaluation of Curricula in Higher Education: Challenges for Evaluators." *Evaluation Review* 30 (4): 430–50.
15. Frenk, Julio, Lincoln Chen, Zulfiqar A. Bhutta, Jordan Cohen, Nigel Crisp, Timothy Evans, Harvey Fineberg, et al. 2010. "Health Professionals for a New Century: Transforming Education to Strengthen Health Systems in an Interdependent World." *The Lancet* 376 (9756): 1923–58.
16. Anderson, Lorin W., David R. Krathwohl, and Benjamin Samuel Bloom. 2001. *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives*. Allyn & Bacon.
17. Smith, Michelle K., Francis H. M. Jones, Sarah L. Gilbert, and Carl E. Wieman. 2013. "The Classroom Observation Protocol for Undergraduate STEM (COPUS): A New Instrument to Characterize University STEM Classroom Practices." *CBE Life Sciences Education* 12 (4): 618–27.

Appendices

Appendix 1: Student online questionnaire

Dear Students,

The first academic year of the new curriculum at UMP has recently completed. You have spent a whole academic year under the new curriculum as students. You must have generous experiences and viewpoints to share: how the new curriculum affects your learning methods, your interaction with peers and faculty. The effectiveness of the new curriculum should be adequately assessed. As key stakeholders in the new curriculum, your feedback provides solid evidence on the curriculum effectiveness as well as the essential material for the improvement of curriculum in the following years.

We invite all medical students who attended the 1st academic year 2016 – 2017 to participate in the study "Evaluation of the new Integrated and Interactive Curriculum of the 1st year Medical Education at University of Medicine and Pharmacy (UMP), Vietnam" by answering this online survey of 30 questions on your own experience about your activities in: 1) preparation of teaching contents; 2) interaction with students inside and outside the classes; and 3) integration in teaching and assessing students.

It will take you from 5 to 10 minutes to complete the online survey. Your feedback is completely confidential. No personal data is recorded. Only overall data will be analyzed and presented. No personal identification data is disclosed. Your feedback is essential to the school to improve teaching quality, though you could opt not to join the survey if you are not interested.

In case you have any question or concern in relation to this survey, please contact the study team through email: email bao_le@hms.harvard.edu or lekhacbao@ump.edu.vn

Thank for your time to answer the questions

Student Online Survey Questionnaire (*)

No	Question	Strongly disagree	Disagree	Agree	Strongly agree
Construct 1: Preparation of lessons before class					
1	Faculty frequently gave pre-readings before class	(•)	(•)	(•)	(•)
2	Faculty frequently gave quiz before class.	(•)	(•)	(•)	(•)
3	Faculty frequently gave assignments after class.	(•)	(•)	(•)	(•)
4	Faculty frequently encourage students to think independently	(•)	(•)	(•)	(•)
5	Faculty frequently guided students to identify and solve problems	(•)	(•)	(•)	(•)
6	I frequently read pre-readings before class.	(•)	(•)	(•)	(•)
7	I frequently completed quiz before class.	(•)	(•)	(•)	(•)
8	I frequently submitted assignments on time	(•)	(•)	(•)	(•)
9	I frequently raised questions related to lessons to my own	(•)	(•)	(•)	(•)
10	I frequently searched literature to identify and solve problems	(•)	(•)	(•)	(•)
Construct 2: Interaction between faculty and students inside and outside class					
11	Faculty frequently encourage students to participate in class	(•)	(•)	(•)	(•)
12	Faculty frequently answered students' questions appropriately	(•)	(•)	(•)	(•)
13	Faculty frequently give students feedback on learning contents and methods	(•)	(•)	(•)	(•)
14	Faculty frequently create opportunities to meet students in person after class	(•)	(•)	(•)	(•)
15	Faculty frequently encouraged students to learn in team with peers	(•)	(•)	(•)	(•)
16	I frequently contributed my ideas in class	(•)	(•)	(•)	(•)

17	I frequently raised my questions in class	(•)	(•)	(•)	(•)
18	I frequently gave faculty feedback on teaching contents and methods	(•)	(•)	(•)	(•)
19	I frequently met with faculty in person after class	(•)	(•)	(•)	(•)
20	I frequently discussed and worked in team with peers	(•)	(•)	(•)	(•)
Construct 3: Integration in teaching and student assessment					
21	Faculty frequently related their teaching contents to other basic disciplines	(•)	(•)	(•)	(•)
22	Faculty frequently mentioned clinical applications in their teaching contents	(•)	(•)	(•)	(•)
23	Faculty frequently illustrated the relevant lectures in their laboratory contents	(•)	(•)	(•)	(•)
24	Faculty frequently related their laboratory contents to clinical applications	(•)	(•)	(•)	(•)
25	Faculty frequently integrated their test questions to other basic disciplines	(•)	(•)	(•)	(•)
26	Faculty frequently integrated their test questions to clinical applications	(•)	(•)	(•)	(•)
27	I frequently felt comfortable to learn integrated issues across basic sciences	(•)	(•)	(•)	(•)
28	I frequently felt comfortable to learn integrated issues between basic sciences and clinical applications	(•)	(•)	(•)	(•)
29	I frequently felt confident in answering to questions integrated across basic sciences	(•)	(•)	(•)	(•)
30	I frequently felt confident in answering to questions integrated between basic sciences and clinical applications	(•)	(•)	(•)	(•)

Note

- "*Frequently*" means that the statement is correct in more than 50% of times.
- "Strongly" means that the statement is correct or incorrect in more than 50% of times.

(*) Twelve questions: **1, 4, 5, 11, 12, 13, 15, 18, 21, 22, 23,** and **24** were exactly copied from the online survey questionnaire for the traditional curriculum.

Appendix 2: Faculty online questionnaire

Dear Professors,

The first academic year of the new curriculum at UMP has recently completed. You have participated in the process of preparation and delivery of the new teaching contents, you must have generous experiences and viewpoints to share: whether the new curriculum is useful in training qualified physicians, what are the strengths and weaknesses of the new curriculum in compared to the traditional curriculum, how to further improve the teaching quality. The effectiveness of the new curriculum should be adequately assessed. As key stakeholders, your feedback provides solid evidence on the curriculum effectiveness as well as essential material for the improvement of curriculum in the following years.

We invite all faculty members who directly taught the 1st academic year 2016 – 2017 to participate in the study "Evaluation of the new Integrated and Interactive Curriculum of the 1st year Medical Education at University of Medicine and Pharmacy (UMP), Vietnam" by answering this online survey of 40 questions on your own experience about your activities in: 1) preparation of teaching contents; 2) interaction with students inside and outside the classes; 3) integration in teaching and student assessment; and 4) faculty development activities

It will take you from 5 to 10 minutes to complete the online survey. Your feedback is completely confidential. No personal data is recorded. Only overall data will be analyzed and presented. No personal identification data is disclosed. Your feedback is essential to the school to improve teaching quality, though you could opt not to join the survey if you are not interested.

In case you have any question or concern in relation to this survey, please contact the representative of study team, Dr. **Bao Le** through email: email bao_le@hms.harvard.edu or lekhacbao@ump.edu.vn

Thanks for your time to answer the questions

Faculty Online Survey Questionnaire

No	Question	Strongly disagree	Disagree	Agree	Strongly agree
Construct 1: Preparation of lessons before class					
1	I frequently gave pre-readings before class	(•)	(•)	(•)	(•)
2	I frequently gave quiz before class.	(•)	(•)	(•)	(•)
3	I frequently assignments after class.	(•)	(•)	(•)	(•)
4	I frequently encourage students to think independently	(•)	(•)	(•)	(•)
5	I frequently guided students to identify and solve problems	(•)	(•)	(•)	(•)
6	Students frequently read pre-readings before class	(•)	(•)	(•)	(•)
7	Students frequently completed quiz before class	(•)	(•)	(•)	(•)
8	Students frequently completed assignments after class	(•)	(•)	(•)	(•)
9	Students frequently raised questions relating to lessons to their own	(•)	(•)	(•)	(•)
10	Students search literature to identify and solve problems	(•)	(•)	(•)	(•)
Construct 2: Interaction between faculty and students inside and outside class					
11	I frequently encourage students to participate in class	(•)	(•)	(•)	(•)
12	I frequently answered students' questions appropriately	(•)	(•)	(•)	(•)
13	I frequently give students feedback on learning contents and methods	(•)	(•)	(•)	(•)
14	I frequently create opportunities to meet students in person after class	(•)	(•)	(•)	(•)
15	I frequently encouraged students to learn in team with peers	(•)	(•)	(•)	(•)
16	Students frequently contributed their ideas in class	(•)	(•)	(•)	(•)

17	Students frequently raised their questions in class	(•)	(•)	(•)	(•)
18	Students frequently gave me feedback on teaching contents and methods	(•)	(•)	(•)	(•)
19	Students frequently met me in person after class	(•)	(•)	(•)	(•)
20	Students frequently discussed and worked in team with peers	(•)	(•)	(•)	(•)
Construct 3: Integration in teaching and student assessment					
21	I frequently related my teaching contents to other basic disciplines	(•)	(•)	(•)	(•)
22	I frequently mentioned clinical applications in my teaching contents	(•)	(•)	(•)	(•)
23	I frequently illustrated the relevant lectures in my laboratory contents	(•)	(•)	(•)	(•)
24	I frequently related my laboratory contents to clinical applications	(•)	(•)	(•)	(•)
25	I frequently integrated my test questions to other basic disciplines	(•)	(•)	(•)	(•)
26	I frequently integrated my test questions to clinical applications	(•)	(•)	(•)	(•)
27	Students frequently felt comfortable to learn integrated issues across basic sciences	(•)	(•)	(•)	(•)
28	Students frequently felt comfortable to learn integrated issues between basic sciences and clinical applications	(•)	(•)	(•)	(•)
29	Students frequently felt confident in answering to questions integrated across basic sciences	(•)	(•)	(•)	(•)
30	Students frequently felt confident in answering to questions integrated between basic sciences and clinical applications	(•)	(•)	(•)	(•)
Construct 4: Faculty development activities					
31	I was adequately trained on preparing integrated lessons in the new curriculum.	(•)	(•)	(•)	(•)
32	I was adequately trained on teaching actively with highly interactive methods of teaching in the new	(•)	(•)	(•)	(•)

	curriculum.				
33	I was adequately trained on giving and receiving feedback in my interactions with students in the new curriculum.	(•)	(•)	(•)	(•)
34	I was adequately trained on giving and receiving feedback in my interactions with other lecturers in the new curriculum.	(•)	(•)	(•)	(•)
35	I was adequately trained on developing the assessment questions in the new curriculum.	(•)	(•)	(•)	(•)
36	I frequently felt confident to prepare integrated lessons in the new curriculum.	(•)	(•)	(•)	(•)
37	I frequently felt confident to teach actively with highly interactive methods of teaching in the new curriculum.	(•)	(•)	(•)	(•)
38	I frequently felt confident to give and receiving feedback in my interactions with students in the new curriculum.	(•)	(•)	(•)	(•)
39	I frequently felt confident to give and receive feedback in my interactions with other lecturers in the new curriculum.	(•)	(•)	(•)	(•)
40	I frequently felt confident to develop assessment questions in the new curriculum.	(•)	(•)	(•)	(•)

Note:

- **“***Frequently*” means that the statement is correct in more than 50% of times.
- “Strongly” means that the statement is correct or incorrect in more than 50% of times.

Appendix 3: MCQ cognitive level assignment tool (Adapted from Anderson et al [16])

MCQ Cognitive Level Assignment Tool

Cognitive level		Implication	Examples of action verbs
Low levels	**Remember**	Exhibit simple and basic memory of facts, terms, equations, definitions, rules, principles, concepts	choose, define, find, label, list, match, name, recall, relate, select, show, tell, what, when, where, which, who, why, etc.
	Understand	Demonstrate understanding of facts, concepts by structuring, comparing, translating, interpreting, describing, and stating main ideas	classify, compare, contrast, demonstrate, explain, extend, illustrate, infer, interpret, outline, relate, rephrase, show, summarize, translate, etc.
High levels	**Apply**	Solve problems to new situation by applying acquired knowledge, concepts, principles in new context	apply, build, choose, construct, develop, experiment with, identify, interview, make use of, model, organize, plan, select, solve, utilize, etc.
	Analyze	Break whole information into components by identifying their dynamic relationship, making inferences or generalization	analyze, assume, categorize, classify, compare, conclusion, contrast, discover, dissect, distinguish, divide, examine, function, inference, inspect, list, motive, simplify, survey, etc.
	Evaluate	Assess the validity of information or judge the quality of work based on a set of different criteria	appraise, assess, choose, compare, conclude, criticize, decide, deduct, defend, determine, disprove, estimate, evaluate, importance, influence, interpret, judge, justify, mark, measure, prioritize, prove, rate, recommend, support, value, etc.
	Create	Build new knowledge or propose alternative solutions to known problems by combining learned components in different patterns, different ways	adapt, build, change, choose, combine, compile, compose, construct, create, delete, design, develop, discuss, elaborate, estimate, formulate, happen, imagine, improve, invent, make up, maximize, minimize, modify, original, originate, plan, predict, propose, solution, solve, suppose, test, theory, etc.

Appendix 4: Student focus group interview guide

Student Focus Group Interview Guide

Dear Students,

The first academic year of the new curriculum at UMP has recently completed. You have spent a whole academic year under the new curriculum as students. You must have generous experiences and viewpoints to share: how the new curriculum affects your learning methods, your interaction with peers and faculty. The effectiveness of the new curriculum should be adequately assessed. As key stakeholders in the new curriculum, your feedback provides solid evidence on the curriculum effectiveness and the essential material for the improvement of curriculum in the following years.

We invite 20 first-year medical students in the academic year 2016 – 2017 to participate in two discussions. The discussions aim at revealing the advantages and inconveniences of the activities and their reasons if possible: 1) preparation of lessons before class; 2) interaction between faculty and students inside and outside the classes; 3) integration in teaching and student assessment.

It will take you 120 minutes to join the discussion. The discussion will be audio recorded. Your feedback is completely confidential. No personal data is recorded. Only overall data will be analyzed and presented. No personal identification data is disclosed. Though your feedback is essential, you could opt not to join the discussion if you are not interested.

In case you have any question or concern in relation to this discussion, please contact the study team through email: email bao_le@hms.harvard.edu or lekhacbao@ump.edu.vn

Thanks for your time to join the discussion.

Student Focus Group Interview Guide

Construct 1: **How did the new curriculum impact the preparation of lessons before class?**

1. Please share your preparation of lessons before class.

Probe: How long did it take for lesson preparation before class? What materials did you use and with whom did you prepare lessons before class?

2. How did the new curriculum affect your preparation of lessons before class?

Probe: Please share your lesson preparation in different teaching methods: lecture with clicker questions, team based learning with clinical cases.

3. Please share your feeling about the preparation of lessons before class.

Probe: Did you feel comfortable preparing lessons before class? How useful was the lesson preparation for your learning in class?

Construct 2: How did the new curriculum impact the interaction inside and outside classes?

4. Please share the interactions between faculty and students inside class.

Probe: What kind of questions did you ask in class? What kind of comments did you give in class? What strategies did faculty use to interact with students and encourage students to interact with peers?

5. Please share the interactions between students and peers inside class.

Probe: How did you react to your peers' comments and how did they react to your comments in class?

6. Please share the interactions between faculty and students outside class.

Probe: What communication tools did you use to interact with faculty outside class?

7. Please share your feeling about the interactions in learning activities.

Probe: Did you feel comfortable interacting with faculty and peers in class? How useful was the interaction for your learning in class?

Construct 3: How did the new curriculum impact the integration in teaching and student assessment?

8. Please share the integration activities that faculty used in teaching.

Probe: How did faculty integrate their teaching content in class? Was the integration appropriate? Why?

9. Please share the integration activities that students used in learning.

Probe: How did you manage to deal with the requirement of integration in teaching an assessment?

10. Please share your feeling about the integration in teaching and learning activities.

Probe: What advantages and inconvenience did the integration bring to you?

Conclusion:

Thank for your participation in the discussion. Before we stop, have you got anything else to share with your group? Have you got any questions to ask us?

Appendix 5: Faculty focus group interview guide

Faculty Focus Group Interview Guide

Dear Professors,

The first academic year of the new curriculum at UMP has recently completed. You have participated in the process of preparation and delivery of the new teaching contents, you must have generous experiences and viewpoints to share: whether the new curriculum is useful in training qualified physicians, what are the strengths and weaknesses of the new curriculum in compared to the traditional curriculum, how to further improve the teaching quality. The effectiveness of the new curriculum should be adequately assessed. As key stakeholders, your feedback provides solid evidence on the new curriculum effectiveness and essential material for the improvement of curriculum in the following years.

We invite 20 faculty members from 8 disciplines directly teaching the 1st year medical students during 2016 – 2017 to participate in two discussions. The discussions aim at revealing the advantages and inconveniences of the activities and their reasons if possible: 1) preparation of teaching contents to encourage the students' preparation of lessons before class; 2) interaction between faculty and students inside and outside class; 3) integration in teaching and student assessment; and 4) faculty development.

It will take you 120 minutes to join the discussion. The discussion will be audio recorded. Your feedback is completely confidential. No personal data is recorded. Only overall data will be analyzed and presented. No personal identification data is disclosed. Though your feedback is essential, you could opt not to join the discussion if you are not interested.

In case you have any question or concern in relation to this discussion, please contact the study team through email: email bao_le@hms.harvard.edu or lekhacbao@ump.edu.vn

Thanks for your time to join the discussion.

Faculty Focus Group Interview Guide

Construct 1: **How did the new curriculum impact the preparation of lectures in order to improve students' preparation of lessons before class?**

1. How did you prepare the pre-reading materials to encourage students' preparation at home? What advantages and inconveniences did you encounter? Why that?

Probe: What are the uses to have the pre-reading for the students? How did you choose the pre-reading materials? How did you refer to the pre-readings during your lectures in class?

2. How different were your lectures in the new curriculum from the traditional one?

Probe: Please describe the contents and structures of your lectures in different teaching formats: lectures with clicker questions, case based teaching, lab practice.

3. In compared to the traditional curriculum, how differently did your students change their lesson preparation at home for the new curriculum?

Probe: What did the students read in the pre-reading materials? How did they benefit from the pre-reading materials in their studying in class?

Construct 2: How did the new curriculum impact the interaction inside and outside classes?

4. Please share your interactions with students inside class.

Probe: What measures did you use in class to interact with your students and encourage them to contribute to the lessons and interact with their peers? How did their fear of disturbing the teachers and friends influence their reluctance to ask questions?

5. Please share your interactions with students outside class.

Probe: How did you enable your students to contact you outside the class? What facilities did you use: email, social network, or meeting in person?

6. What advantages and inconveniences did you encounter during your interactions with students and with your faculty peers? Why? How different they were in compared to the traditional curriculum?

Probe: How did you perceive about the interactions with students in/outside and with your faculty peers in conferences or CME courses?

Construct 3: How did the new curriculum impact the integration in teaching and student assessment?

7. What working techniques and strategies did you use to integrate the contents in theory and clinical application within your own discipline in your lectures? Did they work? Why?
8. What working techniques and strategies did you use to integrate the contents in your own disciplines and those in other disciplines in your lectures? Did they work? Why?
9. What working techniques and strategies did you use to integrate the contents in theory and clinical application within your own discipline in your test questions? Did they work? Why?
10. What working techniques and strategies did you use to integrate the contents in your own disciplines and those in other disciplines in your test questions? Did they work? Why?

Construct 4: How could the past experience predict the future improvement?

11. How useful or useless were the trainings to prepare integrated lectures you received in the past preparation for new curriculum? What other trainings would you wish to have?
12. How useful or useless were the trainings to teach interactively prepare you received in the past preparation for new curriculum? What other trainings would you wish to have?
13. How useful or useless were the trainings to develop assessment questions you received in the past preparation for new curriculum? What other trainings would you wish to have?
14. What strategies would you suggest to improve faculty's and students' English proficiency?
15. What other suggestions do you have to improve the curriculum in general?

Conclusion:

Thank for your participation in the discussion. Before we stop, have you got anything else to share with your group? Have you got any questions to ask us?

Appendix 6: HMS Study Exemption Determination

HARVARD
Human Research Protection Program

Harvard Faculty of Medicine
Office of Human Research Administration
90 Smith Street, 3rd Floor
Boston, MA 02120
Federalwide Assurance FWA00007071

Notification of Initial Study Exemption Determination

February 17, 2017

Bao Le
bao_le@hms.harvard.edu

Protocol Title:	Effectiveness of the new Integrated and Interactive Curriculum on the 1st year Medical Students at University of Medicine and Pharmacy (UMP), Vietnam
Principal Investigator:	Bao Le
Protocol #:	IRB17-0135
Funding Source:	None
IRB Review Date:	2/17/2017
IRB Effective Date:	2/17/2017
IRB Review Action:	Exempt

This Initial Study submission meets the criteria for exemption per the regulations found at 45 CFR 46.101(b)(1) (4) (2). As such, additional IRB review is not required. For international research, the Principal Investigator is required to comply with any applicable local laws, legislation, regulations, and/or policies. Additionally, if local IRB/ethics review is required, it must be obtained before any human subjects research activities are conducted in the field. If assistance with applicable local requirements is needed, please contact the Harvard Faculty of Medicine IRB office.

The determination that your research is exempt does not expire, and you will not file annual renewals. If changes to the research are proposed that would alter the IRB's original exemption determination, they should be submitted in ESTR by using the Modify Study button. If unsure, contact the Harvard Faculty of Medicine IRB office.

The IRB made the following determinations:

- Research Information Security Level: The research is classified, using Harvard's Data Security Policy, as Level 2 Data.

Please contact me at 6174325174 or kninsala@hsph.harvard.edu with any questions.

Sincerely,

Keren-Nicole Insalaco
Sr. IRB Review Specialist

University Area IRB http://cuhs.harvard.edu
Longwood Medical Area IRB http://www.hsph.harvard.edu/ohra/

Appendix 7: UMP Study Exemption Determination

MINISTRY OF HEALTH
UNIVERSITY OF MEDICINE AND PHARMACY AT HCMC

INSTITUTIONAL REVIEW BOARD
No: 197/DHYD-HD
On: Approval Ethical Issues in Human Research

SOCIALIST REPUBLIC OF VIETNAM
Independence – Freedom – Happiness

HCMC, May 30th , 2017

APPROVAL OF INSTITUTIONAL REVIEW BOARD IN HUMAN RESEARCH AT UNIVERSITY OF MEDICINE AND PHARMACY AT HOCHIMINH CITY

In accordance to Decision 1863/QD-BYT on May 25th 2009 by Ministry of Health on issuing regulations on organization and function of University of Medicine and Pharmacy at HoChiMinh city;

In accordance to Decision 5129/QD-BYT on December 19th 2002 by Ministry of Health on issuing regulations on organization and function of Institutional Review Board in Human Research;

In accordance to Decision 1238/QD-DHYD-TC on May 18th 2016 by President of University of Medicine and Pharmacy at HoChiMinh city on establishing Institutional Review Board in Human Research;

In consideration of review made by the permanent member of Institutional Review Board in Human Research on May 30th, 2017,

Institutional Review Board **approves** the ethical aspects in human research of the following study:

- Tittle: *Evaluation of the new integrated and interactive curriculum on the first year medical education at University Of Medicine and Pharmacy (UMP), Vietnam*
- Principal Investigator: Le Khac Bao, MD., PhD.,
- Organization: University of Medicine and Pharmacy at HCMC.
- Study site: University of Medicine and Pharmacy at HCMC.
- Study duration: June 2017 to June 2018.
- IRB review action: Exempt

Date of approval: May, 30th, 2017

Note: IRB might randomly control during the study time

On behalf of Institutional Review Board
On behalf of Institutional Review Board President
Permanent member

Pr. Do Van Dung MD,. PhD,.

BỘ Y TẾ
ĐẠI HỌC Y DƯỢC TP HỒ CHÍ MINH

HỘI ĐỒNG ĐẠO ĐỨC TRONG NCYSH

Số: 197 /ĐHYD-HĐ

V/v chấp thuận các vấn đề đạo đức NCYSH

CỘNG HÒA XÃ HỘI CHỦ NGHĨA VIỆT NAM
Độc lập – Tự do – Hạnh phúc

TP Hồ Chí Minh, ngày 30 tháng 5 năm 2017

CHẤP THUẬN (CHO PHÉP) CỦA HỘI ĐỒNG ĐẠO ĐỨC TRONG NGHIÊN CỨU Y SINH HỌC ĐẠI HỌC Y DƯỢC TP HỒ CHÍ MINH

Căn cứ quyết định số 1863/QĐ-BYT ngày 27 tháng 5 năm 2009 của Bộ Y tế về việc ban hành Quy chế Tổ chức và hoạt động của Đại học Y Dược thành phố Hồ Chí Minh;

Căn cứ quyết định số 5129/QĐ-BYT ngày 19 tháng 12 năm 2002 của Bộ trưởng Bộ Y tế về việc ban hành Quy chế về tổ chức và hoạt động của Hội đồng đạo đức trong nghiên cứu y sinh học;

Căn cứ Quyết định số 1238/QĐ-ĐHYD-TC ngày 18 tháng 5 năm 2016 của Hiệu trưởng Đại học Y Dược TP Hồ Chí Minh về việc thành lập Hội đồng đạo đức trong nghiên cứu y sinh học ;

Trên cơ sở xem xét của thường trực Hội đồng Đạo đức trong nghiên cứu y sinh học Đại học Y Dược ngày ngày 30 tháng 5 năm 2017,

Nay Hội đồng đạo đức **chấp thuận (cho phép)** về các khía cạnh đạo đức trong nghiên cứu đối với đề tài:

- Tên đề tài: *Đánh giá hiệu quả chương trình đổi mới "tích hợp và tương tác" trên sinh viên y khoa năm 1 tai Đại học Y Dược Tp. Hồ Chí Minh (UMP), Việt Nam.*
- Chủ nhiệm đề tài: *TS. Lê Khắc Bảo*
- Đơn vị chủ trì: Đại học Y Dược Tp. Hồ Chí Minh
- Địa điểm triển khai nghiên cứu: Đại học Y Dược Tp. Hồ Chí Minh.
- Thời gian tiến hành nghiên cứu: từ tháng 6/2017 đến tháng 6/2018
- Phương thức xét duyệt: Theo qui trình rút gọn.

Ngày chấp thuận (cho phép): *Ngày 30/5/2017.*
Lưu ý: **HĐĐĐ có thể kiểm tra ngẫu nhiên trong thời gian tiến hành nghiên cứu**

TM. HỘI ĐỒNG
KT. Chủ tịch Hội đồng
Thường trực Hội đồng
PHÓ HIỆU TRƯỞNG

PGS.TS. Đỗ Văn Dũng