



ORIGINAL ARTICLE

Towards Basic Sciences Curriculum Reform in General Medicine at Mashhad University of Medical Sciences

مراجعة منهج العلوم الأساسية لبرنامج الدكتوراه في الطب العام في جامعة مشهد للعلوم الطبية

Seyed Isaac Hashemy¹,
Haniye Mastour^{2,*}

¹Department of Clinical Biochemistry, School of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran
²Department of Medical Education, School of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran

*Mashhad University of Medical Sciences, Azadi Square, Mashhad, 9177948564 Iran

Tel: +98 5138002435
Fax: +98 5138828560
Email:
Mastourh@mums.ac.ir

Background: Integration is accepted as an important strategy in medical education and its final results depend on organizing different topics. In this method, the subjects (based on content) which are often included separately in a curriculum, are integrated in order to link and combine the content of the curriculum to create a cohesive learning experience. Development of this method is among the objectives of the medical education reform.

Methods: The present applied cross-sectional study was performed on a statistical population (n=602) consisting of general medicine students of Mashhad University of Medical Sciences at the level of basic sciences. The participants were selected using the census sampling method and included 150 and 130 students who were admitted in February 2017 (the reformed curriculum) and in February 2016 (the conventional curriculum), respectively. The curriculums were compared in terms of learning outcomes and the number of vulnerable students. Moreover, the research hypotheses were tested using the independent t-test and chi-square test in SPSS software (version 22).

Results: Based on the findings, with 95% confidence, the learning outcomes of the students who followed the reformed curriculum were better than those of the students who followed the conventional curriculum. According to the analysis of the collected data, the mean learning outcomes for the conventional and the reformed curriculum groups were 14.30 ± 3.28 and 16.76 ± 2.80 for the subject of anatomy, 14.10 ± 2.62 and 15.13 ± 2.93 for the subject of physiology, and 14.35 ± 3.13 and 15.44 ± 2.85 for the subject of biochemistry. However, no significant difference was observed in the number of vulnerable students in two groups.

Conclusion: Based on the findings, basic sciences curriculum reform in medical education can improve the academic achievement of the general medicine students.

Keywords: Curriculum, Medical Education, Medical Student, Reform

الخلفية و الهدف: التكامل مقبول كاستراتيجية مهمة في التعليم الطبي. تعتمد النتيجة النهائية لهذه العملية على كيفية تنظيم الموضوعات المختلفة معاً. تكامل المناهج (مجالات المحتوى) - التي يتم تضمينها غالباً بشكل منفصل في المناهج الدراسية بهدف ربط و دمج محتوى المنهج لدمج خبرات تعلم المتعلمين- يعتبر من بعثات و اهداف المراجعة في التعليم الطبي.

المنهج: هذا البحث عبارة عن دراسات تطبيقية و مقطعية. يضم مجتمعها الإحصائي 602 من طلاب العلوم الطبية بجامعة مشهد في مرحلة العلوم الأساسية غير السريرية. أخذ العينات بطريقة التعداد من بين الطلاب الوافدين للفصل الدراسي الثاني من العام الدراسي 1396 هجرياً شمسياً حينما شارك 150 شخصاً في البرنامج التعليمي المعدل على شكل دورة، و 130 شخصاً في البرنامج التعليمي المعمول من طلاب الفصل الثاني للعام الدراسي 1395 هجرياً شمسياً. تمت مقارنة هاتان المجموعتان من المشاركين من حيث نتائج التعلم و عدد الطلاب الضعفاء. تم اختبار فرضيات البحث باستخدام اختبار t المستقل و اختبار chi-square باستخدام SPSS.

النتائج: أظهرت النتائج مع ثقة 95% أن تعليم الطلاب الذين شاركوا في البرنامج التعليمي المعدل في شكل دورات كان أكثر من الذين شاركوا في البرنامج التعليمي العادي على أساس فصل دراسي. متوسط نتائج التعلم للمنهج التعليمي العادي و المنهج المعدل في شكل دورات على التوالي هو 14.30 ± 3.28 و 16.76 ± 2.80 لموضوع التشريح، 14.10 ± 2.62 و 15.13 ± 2.93 لموضوع علم وظائف الأعضاء و 14.35 ± 3.13 و 15.44 ± 2.85 لموضوع الكيمياء الحيوية التي تم الحصول عليها أثناء تحليل البيانات المجمعة. مع ذلك؛ لم يلاحظ أي اختلاف كبير في عدد الطلاب الضعفاء في المجموعتين.

الخلاصة: أظهرت النتائج ان مراجعة و اصلاح مرحلة العلوم الأساسية لبرنامج الدكتوراه في الطب العام في كلية الطب و استخدام البرنامج التدريبي في شكل دورات تعليمية يمكن أن يحسن التحصيل الأكاديمي للطلاب.

الكلمات المفتاحية: المنهج، التعليم الطبي، طالب الطب، الإصلاح

بازنگری برنامه آموزشی دوره علوم پایه مقطع دکترای حرفه‌ای پزشکی عمومی در دانشکده پزشکی دانشگاه علوم پزشکی مشهد

طب عمومی کے ڈاکٹریٹ مرحلے میں بنیادی سائنسی علوم کے تعلیمی نصاب کی اصلاح. مشهد یونیورسٹی آف میڈیکل سائنسس میں انجام دی گئی ایک تحقیق

زمینه و هدف: ادغام به عنوان یک استراتژی مهم در آموزش پزشکی پذیرفته شده است. پیامدهای این فرآیند منوط به نحوه سازماندهی موضوعات مختلف در کنار یکدیگر می‌باشد. تلفیق موضوعات درسی (حوزه‌های محتوایی) که اغلب به صورت مجزا از یکدیگر در برنامه‌های آموزشی گنجانده می‌شود با هدف ارتباط دادن و در هم آمیختن محتوای برنامه درسی به منظور انسجام تجارب یادگیری فراگیران از جمله رسالتهای بازنگری آموزش پزشکی محسوب می‌گردد.

روش: این پژوهش کاربردی و از نوع مطالعات مقطعی (Cross-Sectional) است. جامعه آماری آن شامل 602 دانشجوی مرحله علوم پایه دانشکده پزشکی دانشگاه علوم پزشکی مشهد می‌باشد. با عنایت به نمونه‌گیری به روش سرشماری، دانشجویان ورودی نیمسال دوم سال تحصیلی 1396 شامل 150 نفر که در برنامه آموزشی ریفرم شده در قالب کورس شرکت داشته‌اند و دانشجویان ورودی نیمسال دوم سال تحصیلی 1395 شامل 130 نفر که در برنامه آموزشی متداول و به شیوه ترمی حضور داشته‌اند از نظر پیامدهای یادگیری و تعداد دانشجویان آسیب‌پذیر مورد مقایسه قرار گرفتند. فرضیه‌های پژوهش با استفاده از آزمون‌های t مستقل و کای دو با استفاده از SPSS بررسی شد.

یافته‌ها: یافته‌ها حاکی از آن بود که با 95 درصد اطمینان یادگیری دانشجویانی که در برنامه آموزشی ریفرم شده در قالب کورس شرکت داشتند بیشتر از دانشجویانی است که در برنامه آموزشی متداول به صورت ترمی حضور داشته‌اند. میانگین پیامدهای یادگیری به ترتیب برای گروه برنامه آموزشی متداول و به شیوه ترمی و برنامه آموزشی ریفرم شده در قالب کورس عبارت است از 14.30 ± 3.28 و 16.76 ± 2.80 برای موضوع علوم تشريح، 14.10 ± 2.62 و 15.13 ± 2.93 برای موضوع فیزیولوژی و 14.35 ± 3.13 و 15.44 ± 2.85 برای موضوع بیوشیمی که طی تجزیه و تحلیل داده‌های جمع‌آوری شده به دست آمده است.؛ با این حال، تفاوت معناداری در تعداد دانشجویان آسیب‌پذیر در دو گروه مورد مطالعه مشاهده نشد.

نتیجه‌گیری: بازنگری مرحله علوم پایه برنامه آموزشی مقطع دکترای حرفه‌ای پزشکی عمومی در دانشکده پزشکی و استفاده از برنامه آموزشی در قالب کورس در آموزش پزشکی می‌تواند موجب ارتقای پیشرفت تحصیلی دانشجویان گردد.

واژه‌های کلیدی: برنامه آموزشی، آموزش پزشکی، دانشجوی پزشکی، بازنگری

یک گروند: علم طب کی تعلیم میں موضوعات کو ایک دوسرے میں ضم کرنے کی روش ایک مسلمہ روش تسلیم کی جاتی ہے۔ موضوعات کو ضم کرنے کا حتمی نتیجہ اس وقت ملتا ہے جب موضوعات کو بہترین اور مفید طریقے سے ایک دوسرے کے ساتھ رکھا گیا ہو۔ نصابی موضوعات کو ایک دوسرے کے ساتھ پیش کرنے کا ہدف ان میں ربط برقرار کرنا اور دوسروں کے تعلیمی تجربوں سے فائدہ اٹھانا ہے۔ طبی تعلیمی مراکز کی یہ یکا ہم ذمہ داری ہے۔

روش: یہ تحقیق مشہد یونیورسٹی آف میڈیکل سائنسس میں انجام دی گئی تھی اور اس میں چھپے سو دو طلبا نے شرکت کی جن کا تعلق میڈیکل تعلیم کے پہلے دو برسوں سے تھا دوہزار سترہ میں طبی تعلیم کے دوسرے سال کے نصف اول کے ایک سو پچاس طلبا اصلاح شدہ نصاب پڑھایا گیا اور دوسرے گروہ کے ایک سو تیس طلبا کو جو گذشتہ سال کے نصف دوم سے تعلق رکھتے تھے رائج طریقے سے تعلیم دی گئی۔ اس کے بعد دیکھا گیا کہ کونسے طلبا تعلیم میں آگے بڑھتے ہیں اور کونسے پیچھے رہ جاتے ہیں۔

ڈیٹا کا تجزیہ ٹی ٹسٹ اور چی اسکوائر ٹسٹ سے کیا گیا۔

نتیجے: واضح سی بات ہے جن طلبا کو اصلاح شدہ نصاب کی تعلیم دی گئی تھی ان کی تعلیم کی کیفیت ان طلبا سے بہتر تھی جنہیں اصلاح شدہ نصاب پڑھایا گیا تھا۔
سفارش: اس نتیجے سے یہ معلوم ہوتا ہے کہ طبی نصاب کو مسلسل اپڈیٹ کرنے کی ضرورت ہے کیونکہ یہ طلبا کی بہتر تعلیم کا ضامن ہے۔

کلیدی الفاظ: تعلیمی نصاب، طبی تعلیم، میڈیکل طلبا، اصلاح شدہ

INTRODUCTION

Universities of medical sciences have the important responsibility to train skilled and specialized human resources needed for the society. This will be done if medical education is constantly reviewed and improved through the elimination of its deficiencies (1). The general medicine students undergo various theoretical and clinical trainings at different levels during their program (2). Educational planning in medical sciences is based on skills (3); accordingly, educators in this field must effectively get their students prepared so that they can play significant roles in the field of healthcare services. However, it must be noted that gaining the necessary competence for the performance of basic and clinical skills requires the educational provision in a suitable context (4).

Educational planning can be improved by designing educational courses based on appropriate models and usage of planned variables in clinical domains (5). It is attempted to improve the effectiveness of medical education through reform and modification of the educational designing methods. New approaches to education strive to properly manage the factors that affect the process of clinical education and learning, and take advantage of all the available opportunities to move towards the goals of clinical education (6). Several factors affect educational planning and one of them is the arrangement of courses with regard to each other and the curriculum for each semester (7). Worldwide advancement of science that is inevitably followed by the medical sciences has created the need to review and modify the curriculum of General Medicine, especially the basic sciences, both in terms of content and design in a cohesive manner (8). The General Medicine program in Iran includes courses on basic sciences, introduction to clinical medicine, traineeship, and internship. It is worth noting that basic sciences comprise the first stage of medical education (9). The current structure of curriculums in medical schools of developed countries indicates their great emphasis on the review and integration of basic sciences and clinical education (10).

The medical education system of Finland has undergone major reforms that primarily focused on the modification of the curriculum (11). Generally, various issues can lead to desired and effective modifications, such as transparency of educational goals, learning-oriented education, alteration of university hospitals into educational institutions, self-awareness of the educators, exchanges with other universities and community resources, modification of the postgraduate education, as well as fundamental reforms in the national medical exams (12). Whitehead argued that many of the current efforts for medical education reform do not consider the depth of changes and are merely about the addition of new courses; however, it is important to consider which new approaches are consistent with the current paradigms, which ones require fundamental changes, and what the consequences of such changes might be (13). Regarding the paradigm shift in education, Nancy Andrews stated that ideally, students who prepare for various careers in medical-related professions should be trained through

educational experiences to enhance their comprehension and inference (14). According to Vassallo et al., ensuring the competence of trainees is one of the issues that should be considered in medical education. In their view, reform in medical education is necessary to adapt the education to the competency-based evaluation scales (15).

Kapoor et al. in their recent study conducted in 2020 on proposed reforms in medical education in India pointed out that reform can be divided into categories of knowledge, skills training, and research. From their point of view, the main problems regarding "knowledge" were the inefficient use of the time of educators and students as well as inappropriate evaluations. Moreover, they declared that regarding the "skills training", the issue was insufficient skills training while "research" suffered from the students' lack of familiarity with and interest in research. They suggested some solutions for these problems, such as supporting the new methods of education and evaluation (e.g., flipped classroom) and clinical education approaches. Therefore, they would experience earlier exposure to skills training and be able to develop clinical skills and receive competency-based education. Moreover, it would be possible to increase their interest in research as the core of research conventions (16).

Wang et al. emphasized the reform of general medical education as one of the main components of medical education reform (17). Moreover, the article of Lancet Commission on the education of specialists in the 21st century (18, 19) indicated that the conventional curriculum and teaching methods differ from the skills of healthcare professionals and public needs and this has been confirmed by other educational reports (20-22).

In Iran, the previous basic science curriculum faced various challenges, including lack of relevant content of the offered courses in one semester, non-observance of the proper sequence in the presentation of some courses, and doubts about the applicability of the content in future semesters (9). Therefore, integrated educational planning provides the required context to make learning meaningful for the students (23). In addition, the integrated approach can be a facilitator and the only possible effort in educational planning to realize the integrated interests (24).

According to the raised issues and the official notifications of the relevant ministry, the General Medicine curriculum of Mashhad University of Medical Sciences underwent reforms in 2017. Among the measures taken in this regard was the provision of the basic sciences in the form of courses as well as the integration of anatomy, physiology, and biochemistry. In this reform, the subject related to each organ of the body is presented in one semester and simultaneous with other courses. Based on this reform, in the first semester of General Medicine, introductory basic science subjects are offered, including molecule and cell physiology, introductory anatomy, and molecule and cell biochemistry. These courses are the prerequisites for the next semesters.

In the second semester, cardiovascular system subjects (i.e., cardiovascular anatomy, cardiac physiology, circulatory physiology, and blood physiology), respiratory system (i.e., respiratory anatomy and physiology), and biochemistry are

presented simultaneously. Furthermore, the gastrointestinal tract (i.e., gastrointestinal anatomy and physiology), endocrine system (i.e., endocrine anatomy, endocrine and reproductive physiology, and hormones biochemistry), and genitourinary system (i.e., genitourinary anatomy and kidney physiology and biochemistry) are presented in the third semester. Additionally, in the fourth semester, courses on the nervous system (i.e., the anatomy of the nerves and special senses and physiology of the nerves and special senses) are taught.

Currently, after the implementation of the reforms in the basic science subjects, it was considered necessary to conduct a study to compare the reformed curriculum with the conventional form of semesters in the medical school of Mashhad University of Medical Sciences. It should be noted that the conventional method included courses of trunk anatomy, limb anatomy, head and neck anatomy, neuroanatomy, physiology 1, 2, 3, and 4, and biochemistry 1 and 2. It is aimed to use the results of this study for future modifications.

This study aimed to compare the reformed curriculum with the conventional form of semesters in the Medical School of Mashhad University of Medical Sciences and also evaluate the educational status of vulnerable students.

METHODS

The present applied cross-sectional study was performed on a statistical population ($n=602$) consisting of general medicine students at the level of basic sciences at Mashhad University of Medical Sciences. The participants were selected using the census sampling method and the inclusion criteria were admission in February 2017 (the reformed curriculum) and in February 2016 (the conventional curriculum). Finally, 150 and 130 students from those who followed the reformed and conventional curriculums were included in the study, respectively.

The required data were collected through a demographic characteristic including the student number, gender, marital status, native status, grade point average, and grades of the basic science courses of the participants. This information was extracted from the educational records of the participants in the system of Mashhad University of Medical Sciences.

In this study, the main outcome was the academic achievement of students in two groups of conventional and reformed curriculums. In order to evaluate the learning outcomes, the grades of the participants in the basic sciences, including anatomy, physiology, and biochemistry were

collected and the means of the two groups were compared. Moreover, the number of normal and vulnerable students in two groups of reformed and conventional curriculums was another outcome that was also compared.

In addition, the number and duration of courses were changed in the reformed curriculum and it was attempted that the total number of courses in the reformed curriculum (e.g., physiology of circulation, respiration, and heart worth 2.3 units) be compared with that of the corresponding courses in the conventional curriculum (physiology 2 worth 2.5 units). Besides, the lecturers and teaching methods of anatomy, physiology, and biochemistry courses were the same in both groups during the study period.

This study was approved by the Research Council (code: 971842) and the Ethics Committee (ethics code: IR.MUMS.REC.1398.147) of Mashhad University of Medical Sciences.

Descriptive statistics were presented, including the number, frequency of subgroups, mean, and standard error of measurement. Furthermore, the distribution of learning outcome and its normality was examined using the Kolmogorov-Smirnov test. Regarding the normal distribution and establishment of the desired assumptions, the learning outcome was studied in SPSS software (version 22) using the independent t-test to compare the mean scores of students in the conventional and reformed curriculums.

Furthermore, in order to study the relationship between the curriculum and the educational status of students according to the existing assumptions, the number of normal and vulnerable students in two groups of conventional and reformed curriculums was compared using the chi-squared test. It should be noted that the results were reported with 95% confidence at a significance level of 0.05.

RESULTS

Table 1 tabulates the demographic characteristics of the participants in two groups of conventional and reformed curriculums.

Table 2 summarizes the descriptive statistics indices and the independent t-test results in order to compare the learning outcomes of the two groups of conventional and reformed curriculums. Based on the findings, with 95% confidence, the students who followed the reformed curriculum made more academic progress, compared to those who followed the conventional curriculum ($P<0.05$).

Table 3 shows the results of comparison between the number of normal and vulnerable students between two groups of the conventional and reformed curriculums using

Table 1. Demographic characteristics of the subjects

| Curriculum | Number of students | Gender | Marital status | Native status | | | |
|--------------|--------------------|--------|----------------|---------------|-----|------------|----|
| Conventional | 130 | Female | 62 | Single | 126 | Native | 64 |
| | | Male | 68 | Married | 4 | Non-native | 66 |
| Reformed | 150 | Female | 83 | Single | 145 | Native | 77 |
| | | Male | 67 | Married | 5 | Non-native | 73 |

| Academic Achievement statistics | Group | Number | Mean (Std. Deviation) | Std. Error Mean | P |
|---------------------------------|--------------|--------|-----------------------|-----------------|--------|
| Anatomy | Conventional | 123 | 14.30 (3.28) | 0.29 | 0.0001 |
| | Reformed | 150 | 16.76 (2.80) | 0.22 | |
| Physiology | Conventional | 130 | 14.10 (2.62) | 0.22 | 0.002 |
| | Reformed | 144 | 15.13 (2.93) | 0.24 | |
| Biochemistry | Conventional | 120 | 14.35 (3.13) | 0.28 | 0.004 |
| | Reformed | 140 | 15.44 (2.85) | 0.24 | |

| Curriculum | Educational status | | Chi-squared statistic | Degree of freedom | P |
|--------------|---------------------------|-------------------------------|-----------------------|-------------------|-------|
| | Number of normal students | Number of vulnerable students | | | |
| Conventional | 101 | 29 | 0.223 | 1 | 0.637 |
| Reformed | 120 | 30 | | | |

the chi-squared test. The results indicated that there is no significant difference between the two groups in terms of the number of vulnerable students.

Figure 1 shows the comparison between the number of normal and vulnerable students in two groups of conventional and reformed curriculums.

DISCUSSION

The present study aimed to compare the reformed curriculum of the General Medicine students with the conventional form of semesters in the Medical School of Mashhad University of Medical Sciences in terms of the

learning outcomes and the number of vulnerable students. As mentioned above, students who followed the reformed curriculum achieved better academic achievement and educational results, compared to those who followed the conventional curriculum. It must be noted that integration is accepted as a significant strategy in medical education.

As Harden declared, the final results of this process depend on how different subjects are organized. A combination or integration of the subjects (based on content) that are often separate from each other in the curriculum is one of the most challenging and difficult issues in educational planning (25). Curriculum integration means linking and integrating the

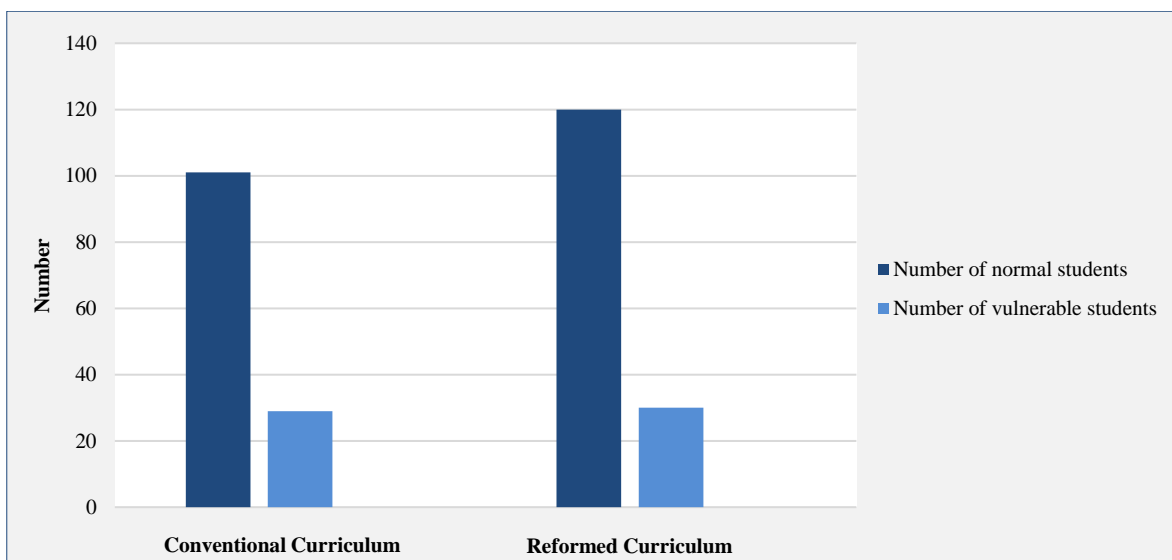


Figure 1. Comparison of the number of normal and vulnerable students in the conventional and reformed curriculums

content of a curriculum in order to provide cohesive learning experiences for the students. Curriculum integration has been emphasized mainly due to its advantages as well as the disadvantages and unpleasant consequences of the conventional curriculum. Based on the available resources about curriculum integration, there is a need to organize the curriculums in this manner at all levels of education, including higher education (26). One of the first experts in this field was Dewey who advocated the centralization of professions in the organization of educational experiences in learners in order to create a cohesive curriculum. As previously explained, new educational achievements and inefficiencies of traditional teaching methods in basic sciences in medicine have led to changes in the General Medicine curriculum, especially regarding basic sciences. This has created a need for modifications in the content and their sequence in an integrated form. Horizontal and vertical integration of basic and clinical courses is one of the solutions offered to resolve this issue which has received special attention from the Ministry of Health and Medical Education in recent years (27).

Purpose of integration as an alternative to conventional methods is to provide a comprehensive rather than discrete perspective of concepts; accordingly, separate subjects are combined with each other in a meaningful manner and ultimately led to greater understanding and increased efficiency of the educational content (28). The most common method of medical education over the past century has been two to three years of theoretical education followed by clinical education. However, this method has undergone some changes recently and many medical schools around the world are implementing vertical integration programs and familiarizing medical students with the clinical environment in the first year (29, 30). In this regard, reform and integration are considered as strategies to achieve better educational results (31).

Medical education reform in China was accompanied by the provision of better quality education and was accredited by the Chinese Medical Association. For Chinese doctors, this reform provided professional growth and an opportunity to improve their responsibilities (12). Based on previous studies, some physicians are not sufficiently trained to function in complex organizational and social systems. Successful healthcare reform in the United States requires doctors who are trained in the social sciences as well as biomedicine. In addition, effective educational reform should address the process of medical admission, scientific and intellectual preparation, professionalism, and clinical education.

Comprehending the underlying structures of practice should become a major part of education which means that in addition to being taught in the classroom, its scientific and practical values should also be considered in all levels of clinical education. Medical students and specialist assistants should have the opportunity to observe and learn from the knowledge and skills of their mentors regarding the improvement of patient health. Medicine in the United States is practiced in a complex organizational field, and effective medical practices require professional abilities as well as knowledge in this regard.

According to the findings of a research conducted by Sales and Schlaff, healthcare reform is recommended to be accompanied by reform in medical education with a focus on the social sciences. Moreover, they suggested that this extensive education should be used by academic physicians who train students and specialist assistants (32, 33). Results of a study performed by Parrish et al. indicated that it is essential to support medical education to bridge the gap in education. They also stated that reforming medical education is crucial for the preparation of the students for real healthcare environments they will face in the future (14).

Kwan et al. studied the reform of the oncology curriculum in general medical education at the University of Toronto, Canada. They examined the strengths and weaknesses of teaching General Medicine oncology at that school and presented curriculum changes over the past 11 years. They argued that all educators should consider the potential benefits of oncology curriculum reform to meet the specific needs of the community and engage oncologists in multidisciplinary systems in medical education. In their study, the 2012 Cancer Curriculum was compared to pre-2001 curriculums and the results indicated a significant development regarding the coverage of epidemiology, prevention, screening, and molecular biology. From their point of view, reduction of the course content to a minimum, emphasis on the educational content based on the needs of the community, and provision of educational services with the support and skills of subject-matter experts were among the next steps that need to be considered. In particular, they emphasized that 20th-century pedagogy, which includes a science-based curriculum with didactic and problem-based education in small groups, was no longer sufficient; therefore, reform is and will always be required (34).

Based on the results of a research carried out by Vassallo et al., reform in medical education according to their desired challenge was led to improvement in training and performance of trainees (15). Moreover, the findings of a recent study performed by Kapoor et al. in 2020 indicated that there is an inevitable need for fundamental changes in the way educators and students infer the principles of learning. They declared that in order to reform medical education, it is necessary to highlight these points to policymakers and executors of the medical education system (16).

After a comprehensive evaluation of the status of its General Medicine program and a thorough study of the developments in medical education worldwide, Mashhad University of Medical Sciences has decided to reform its General Medicine program. The roadmap for this reform was developed after extensive consultation with faculty members, experts, and students within the framework of the "General Medicine Course Reform Vision". It was implemented after it was approved and the required permits were obtained in the second semester of the 2017 academic year. Given the findings of the present study, it is hoped that with the great efforts of all of those who contributed to this study, it will be possible to implement the General Medicine reform based on the required capabilities to educate qualified physicians and serve the Iranian society. One of the limitations of this study was its cross-sectional design which made it difficult to

draw conclusions about the causality of the results.

Based on the findings, reforming the basic science curriculum of General Medicine and using this reformed curriculum in medical education can improve the learning outcomes and academic achievement of the students. However, it should be noted that merely reforming the content of education is not enough to correct the basic epistemological aspects of medicine and professionalism, since the improvement of medical practice requires reforming the system in action not just reforming the education.

Ethical considerations

Ethical issues (Including plagiarism, informed consent,

misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

ACKNOWLEDGEMENT

We hereby express our gratitude to the Mashhad University of Medical Sciences for their support.

Financial Support: This research was funded by the Research Council (code: 971842) of Mashhad University of Medical Sciences.

Conflict of Interest: There is no conflict of interest.

REFERENCES

- Avizhgan M, Omid A, Dehghani M, Esmaeili A, Asilian A, Akhlaghi M R, et al. Determining Minimum Skill Achievements in Advanced Clinical Clerkship (Externship) in School of Medicine Using Logbooks. *Iranian Journal of Medical Education*. 2011;10(5):543-51. Persian.
- Sabzghabae A M, Izadi Mood N, Memarzadeh M, Shirani S, Yamani N. Designing and Implementing a Practical Course of "Pharmacotherapy in Special Populations" for Medical Interns. *Iranian Journal of Medical Education*. 2011;10(5):815-21. Persian.
- Hosseini S, Vartanoosian J, Hosseini F, Farzin Fard F. Validity and reliability of OSCE/OSPE in assessing biochemistry laboratory skills of freshman nursing students of Shahid Beheshti University of Medical Sciences. *Advances in Nursing & Midwifery*. 2013;23(80):34- 43.
- Dadvar L, Dadgari A, Mirzaee M, Rezaee M. Evaluation of Educational Goals Achievement in Fundamental Nursing Clinical Skills: Application OSCE among Senior Nursing Students in ICU. *Knowledge and Health*. 2015;9(4):24-31. Persian.
- Khalifehzadeh A, Tavasoli A A, Golshahi J, Sanei H, Mirdehghan A, Payehdar Z, et al. Synergy Model in Clinical Teaching of Critical Care MSc Nursing Students and Cardiovascular Diseases Patients. *Iranian Journal of Medical Education*. 2011;10(5):593-601. Persian.
- Haghani F, Alavi M. An introduction to some new approaches in clinical education. *Iranian Journal of Medical Education*. 2011;10(5):801-06. Persian.
- Bahramian H, Bahmani F, Aghababaei A A. Study of Curriculum Changes and Sequence of Anatomy Courses on Medical Students Score of Esfahan Medical Sciences University. *Anatomical Sciences Journal*. 2010;8(1):77-83. Persian.
- Yamani N, Shater Jalali M. Curriculum Integration, With Emphasis on Integration in Medical Education. *Iranian Journal of Medical Education*. 2012;11(9):1202-13. Persian.
- Teimouri Jervekani Z, Ashoorion V, Mozafarpour S, Sirous S. Evaluation of Basic Sciences Curriculum Modifications in Isfahan University of Medical Sciences: The Students' Viewpoint. *Iranian Journal of Medical Education*. 2015;15:79-88. Persian.
- Prince KJ, Van Mameren H, Hylkema N, Drukker J, Scherpbier AJ, Van Der Vleuten CP. Does problem-based learning lead to deficiencies in basic science knowledge? An empirical case on anatomy. *Medical Education*. 2003;37(1):15-21.
- Vuori H and Jonas S. Finnish Reform of Medical Education: Implications for the United States. *Health Policy and Education*. 1980;1(4): 367-82.
- Lueddeke GR. *Transforming Medical Education for the 21st Century*. 2012. Published by CRC Press.
- Whitehead C. Recipes for medical education reform: Will different ingredients create better doctors? A commentary on Sales and Schlaflfq. *Social Science & Medicine*. 2010;70(11):1672-76. doi:10.1016/j.socscimed.2010.02.017.
- Parrish RK, Mladenovic J, Gedde SJ. Health care reform and graduate medical education in ophthalmology. *Am J Ophthalmol*. 2011;151(4):572-74. doi:10.1016/j.ajo.2010.10.017. PMID: 21420521.
- Vassallo P, Jeremiah J, Forman L, Dubois L, Simmons DL, Chretien K, et al. Parental Leave in Graduate Medical Education: Recommendations for Reform. *The American Journal of Medicine*. 2019;132(3):385-89. <https://doi.org/10.1016/j.amjmed.2018.11.006>
- Kapoor D, Tiwari K, Faruqi A, Garg A, Gupta S, Nain S, et al. Proposed Reforms in Medical Education in India: Perspective of Undergraduate Students. *Clinical Epidemiology and Global Health*. 2020;8(1):305-07. <https://doi.org/10.1016/j.cegh.2019.03.012>
- Wang S, Fu X, Liu Z, Wang B, Tang Y, Feng H, et al. General Practitioner Education Reform in China: Most Undergraduate Medical Students do not Choose General Practitioner as a Career under the 5+3 Model. *Health Professions Educations*. 2018;4(2):127-32. <http://dx.doi.org/10.1016/j.hpe.2017.05.001>
- Medical education reform in China. *The Lancet*. 2017; 390(10092):334.
- Frenk J, Chen L, Bhutta ZA, Cohen J, Crisp N, Evans T, et al. Health professionals for a new century: Transforming education to strengthen health systems in an interdependent world. *The Lancet* 2010; 376: 1923-58.
- The Association of Faculties of Medicine of Canada. *The Future of Medical Education in Canada (FMED): A Collective Vision for MD Education*. Ottawa: The Association of Faculties of Medicine of Canada; 2010.
- Cooke M, Irby DM, O'Brien BC. Educating Physicians: A Call for Reform of Medical School and Residency. *The Journal of Chiropractic Education*. 2011;25(2):193-95.
- World Health Organization. *The World Health Report: Working Together for Health*. Geneva: World Health Organization; 2006.
- Ivanitskaya L, Deborah C, George M, Ronald P. *Interdisciplinary Learning: Process and Outcomes*. Innovative Higher Education. 2002;27(2):95-111.
- Jelsing EJ, Lachman N, O'Neil AE, Pawlina W. Can a Flexible Medical Curriculum Promote Student Learning and Satisfaction? *Annals of the Academy of Medicine*. 2007; 36 (9): 713-18.
- Harden RM. The integration ladder: a tool for curriculum planning and evaluation. *Med Educ*. 2000;34(7):551-57.
- Ahmadi P. Analysis of the Numerosity and Variety of Integration Concept in the Curriculum. *IRPHE*. 2003;9(3):87-124. Persian.
- Khazaei M. Medical Students' Viewpoints toward Clinical Physiology Presentation in Isfahan University of Medical Sciences. *Iranian Journal of Medical Education*. 2011;10 (5):602-08. Persian.

28. Yazdani Sh HF, Homayoni Zand R. Reform of the General medicine training program (Basic Science phase): Theoretical and review experience. Tehran: Development Center for Medical Education, Shahid Beheshti University of Medical Sciences; 2008. Persian.
29. Dornan T, Littlewood S, Margolis SA, Scherpbier A, Spencer J, Ypinazar V. How can experience in clinical and community settings contribute to early medical education? A BEME systematic review. *Medical teacher*. 2006;28(1):3-18.
30. Dahle L, Brynhildsen J, Fallsberg MB, Rundquist I, Hammar M. Pros and cons of vertical integration between clinical medicine and basic science within a problem-based undergraduate medical curriculum: examples and experiences from Linköping, Sweden. *Medical teacher*. 2002;24(3):280-5.
31. Abdolmaleki A SM, Farshad A, Joneidi Jafari A, Mohtadi N. Study of occupational health research and educational challenges from the perspective of students. The 1th National Conference on the Evaluation of the University Systems. Sanati Sharif University; 2014 May 7-8; Tehran, Iran. Persian.
32. Sales CS, Schlaff AL. Reforming medical education: A review and synthesis of five critiques of medical practice. *Social Science & Medicine*. 2010;70(11): 1665-8. doi:10.1016/j.socscimed.2010.02.018.
33. Sales CS, Schlaff AL. Reforming medical education: A response to Weller and Woodward, and Whitehead, and Schwabq. *Social Science & Medicine*. 2010.70(11):1680-81. doi:10.1016/j.socscimed.2010.02.015.
34. Kwan J.Y.Y, Nyhof-Young J, Catton P, Meredith E, Giuliani. Mapping the Future: Towards Oncology Curriculum Reform in Undergraduate Medical Education at a Canadian Medical School. *Int J Radiat Oncol Biol Phys*. 2015;91(3):669-77. <http://dx.doi.org/10.1016/j.ijrobp.2014.11.017>.