Integration of Cognitive Skills as a Cross-Cutting Theme Into the Undergraduate Medical Curriculum at Tehran University of Medical Sciences

Akbar Soltani[1], Maryam Allaa[2], Hamideh Moosapour[2], Azadeh Aletaha[2], Farzaneh Shahrtash[2], Alireza Monajemi[3], Tohid Arastoo[2], Maryam Ahmadinejad[2], Azim Mirzazadeh[4,5], and Mahboobeh Khabaz Mafinejad[6]

[1] Department of Endocrinology, Endocrinology and Metabolism Research Institute, Tehran University of Medical Sciences, Tehran, Iran

[2] Endocrinology and Metabolism Research Institute, Shariati Hospital, Tehran University of Medical Sciences, Tehran, Iran

[3] Department of Philosophy of Sciences, Institute for Humanities and Cultural Studies, Tehran, Iran

[4] Department of Internal Medicine, School of Medicine, Tehran University of Medical Sciences, Tehran, Iran

[5] Department of Medical Education, School of Medicine, Tehran University of Medical Sciences, Tehran, Iran

[6] Education Development Center (EDC), Tehran University of Medical Sciences, Tehran, Iran

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Abstract- Nowadays, improvement of thinking skills of students is one of the universally supported aims in the majority of medical schools. This study aims to design longitudinal theme of reasoning, problem-solving and decision-making into the undergraduate medical curriculum at Tehran University of Medical Sciences (TUMS). A participatory approach was applied to design the curriculum during 2009-2011. The project was conducted by the contribution of representatives of both basic and clinical faculty members, students and graduates at Tehran University of Medical Sciences. The first step toward integrating cognitive skills into the curriculum was to assemble a taskforce of different faculty and students, including a wide variety of fields with multidisciplinary expertise using nonprobability sampling and the snowball method. Several meetings with the contribution of experts and some medical students were held to generate the draft of expected outcomes. Subsequently, the taskforce also determined what content would fit best into each phase of the program and what teaching and assessment methods would be more appropriate for each outcome. After a pilot curriculum with a small group of second-year medical students, we implemented this program for all first-year students since 2011 at TUMS. Based on findings, the teaching of four areas, including scientific and critical thinking skills (Basic sciences), problem-solving and reasoning (Pathophysiology), evidence-based medicine (Clerkship), and clinical decision-making (Internship) were considered in the form of a longitudinal theme. The results of this study could be utilized as a useful pattern for integration of psycho-social subjects into the medical curriculum.

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Introduction

The main concern frequently expressed by medical students at the time of graduation is a lack of preparation for beginning practice at the workplace (1). This issue is so complex that many graduates after entrance into the workplace in the first-year, acknowledge that they do not have the enough readiness to practice as a physician in the healthcare team and the training programs have failed to prepare them appropriately (2). In this regard, Dennet and Harden (2013) believed that a doctor is a whole collection of varied competencies, but many medical schools may train doctors with uncertain capabilities (3).

To address this challenge, many efforts have been made to reform the medical curriculum (4), and many medical schools around the world have tried to use new educational strategies in order to provide context for training efficient, thoughtful and creative graduates with the ability to judge and make the right decision regarding the care of patients in the framework of competency-based education (5). In the meantime importance of strengthening the cognitive abilities and improving intellectual skills of medical students to deliver effective care to patients has led to consideration of education of these skills as a part of the expected

Corresponding Author: M. Khabaz Mafinejad
Education Development Center (EDC), Tehran University of Medical Sciences, Tehran, Iran
Tel: +98 21 64053365, Fax: +98 21 64053365, E-mail address: mahboobe.mafinezhad@gmail.com

competencies of the curriculum (6). Tommy and colleagues have pointed out in this regard that the complexity and variety of clinical environments, reveals the necessity of paying attention to improving these skills such as critical thinking, problem-solving, reasoning and decision making as one of the expected competencies of the medical education (7).

Considering the importance of this issue and the fact that improvement of critical thinking skills, problem-solving and reasoning of learners is being regarded as one of the supported global objectives of most medical universities; accreditation agencies around the world have considered the acquisition of these skills as a requirement to assess the ability of the health care team members (8,9). Therefore, the training of doctors to meet the needs of society in the 21st century has been an important factor in the reform of undergraduate medical curriculum at TUMS. With considering the fact that the formulation of outcomes is affected by local, political, social and cultural conditions, and translation of the available versions will not be applicable (10); Tehran University of Medical Sciences in parallel with the reform of the undergraduate medical curriculum, codified the expected competencies of medical graduates in eight areas including: "Clinical skills", "Communication skills", "Patient management", "Personal development", "Professionalism, ethics and medical law", "Decision-making, reasoning and problem-solving", "Prevention and health promotion" and "Health system and the corresponding role of physician" (11).

It is obvious that many aspects of medical graduates' competencies require practice and persistence of educational activities and cannot be achieved by providing certain modules in a limited time frame. Thus the subject of cross-cutting themes was predicted in the medical curriculum. And due to the need for medical students to enhance their thinking and cognitive skills and the lack of addressing these subjects in the medical curriculum, this study was conducted and aimed to develop the longitudinal theme of reasoning, problem-solving and decision-making curriculum for the general medical curriculum at TUMS.

Materials and Methods

Study context

This study was done at Tehran University of Medical Sciences (TUMS), School of Medicine. The undergraduate medical curriculum at TUMS is divided into four phases; including Basic sciences, pathophysiology, clerkship, and internship. Since 2006, TUMS started to develop and implement a renewal curriculum for delivering undergraduate medical education. The principal feature of the revised curriculum is to take more attention to integration psychosocial subjects as cross-cutting themes for training physicians who are competent in different areas.

Design

A participatory approach was applied to conduct the project during 2009-2011. The project was done by the contribution of representatives of both basic and clinical faculty members, students and graduates at TUMS. The details of the project are summarized in following phases (Table 1).

Table 1. Project phases of developing longitudinal integrated theme of reasoning, problem-solving and decision-making

Phase 1) Developing a taskforce:
- Experts with a wide variety of fields
- Representatives of medical students
Phase 2) Need assessment:
- Searching on databases of PubMed, Elsevier, Google Scholar, Ovid, and Eric
- Reviewing related program developed by other universities including Washington, Sheffield, and McMaster University
- Informal interviewing with some experts, medical students, and graduates
Phase 3) Development of program:
- Meetings with contribution of experts and some medical students in order to develop a draft of expected outcomes
- Determining content, teaching and assessment methods would be more appropriate for each outcome
- Planning the implementation considerations and program evaluation
Phase 4) Approval and dissemination:
- Holding a one-day workshop with participation of deans, basic sciences, and clinical faculty, a number of medical students and graduates
- Revision of the initial draft according to feedbacks from workshop
- Finalizing the program in the taskforce
- Sending the program to Curriculum Reform Committee (CRP) for approval
- Sending the approved curriculum to other committees (Basic Science, Fundamental Clinical Medicine, Clerkship, and Internship)
Phase 5) Implementation
- a pilot curriculum with a small group of second-year medical students
- Full implementation for whole medical students admitted since 2011

Phase 1) Formation of the taskforce

The first step toward infusing cognitive skills into the curriculum was to assemble a taskforce of different faculty and students in Evidence-based medicine (EBM) group as a center of the planning program. The taskforce was included a wide variety of fields with multidisciplinary expertise; cognitive psychologists, specialists, graduated doctors, medical educationists and some medical students who were selected using nonprobability sampling and the snowball method.

Phase 2) Need assessment

Prior to the development of the program, a comprehensive Internet search was conducted on the related literature on databases of PubMed, Elsevier, Google Scholar, Ovid, and Eric using the following keywords; including thinking, cognitive skills, and reasoning as well as medical education to find similar programs. The group, then, reviewed related program developed by other universities including Washington, Sheffield, and McMaster University. A series of informal interviews were conducted with some experts, medical students and graduates for curriculum process improvement.

Phase 3) Development of program

Based on reviews of the literature, the group has generated an initial list of outcomes which students should possess in relation to this area upon graduation from medical school. Several meetings with the contribution of experts and some medical students were held to generate the draft of expected outcomes. Subsequently, the taskforce also determined what content would fit best into each phase of the program and what teaching and assessment methods would be more appropriate for each outcome. Also, all related materials were discussed in weekly meetings by a group based on their educational content and methods and finally, taking their implementation feasibility into consideration. Afterward, a comparative analysis was done by the group in order to compare the draft with previously developed programs.

Phase 4) Approval and dissemination

The program has been reviewed in a one-day workshop by the deans, clinical and basic science faculty, and a number of medical students and graduates who provided strong support for implementation our program or approved funding. Participants discussed various aspects of the program, and the taskforce was charged with revising the draft of the program, based on discussions held during the workshop. The finalized the document was sent to Curriculum Reform Committee for final modifications and approval. Furthermore, to ensure that all related committees knew about the program, the final version of the program was sent to Basic Science, Pathophysiology (Fundamental Clinical Medicine), Clerkship and Internship committees and other related units.

Phase 5) Implementation of program

A pilot phase of the program was held in two-hour sessions with the participation of second-year medical students. Educational requirements including pre-reading texts, individual and group worksheets, program's evaluation forms were implemented during the pilot phase, and the necessary modifications were conducted according to feedbacks. The final program was implemented for all medical students since 2011 (under published).

Results

The longitudinal theme of decision-making, reasoning, and the problem-solving curriculum was conducted by taskforce, including the definition of outcomes, selecting and organizing content, choosing of teaching and assessment methods.

Outcomes of the program

In general, the aim of the program is promoting the students' ability to use skillful and reasonable thinking in a wide range of problems which were faced in the workplace. The goals of the program are as follows:

The development of the students' scientific and critical thinking skills to enable them to analysis, appraise, evaluate, and inference in a different situation which is faced.

The development of the students' problem-solving and reasoning skills to enable them to practically resolve the problems of patients, clients, and their families.

The development of the students' evidence-based skills to enable them to search and use of high-quality evidence in their practice.

The development of the students' decision-making skills to enable them to choose the best possible option.

The period of the program

The vertically integrated program was arranged as a spiral, with students studying the thinking skills in each

of the four phases of the undergraduate medical curriculum. Based on the literature review and opinion of experts, education of four areas including scientific and critical thinking skills (basic sciences), problem-solving and scientific reasoning (physiopathology), evidence-based medicine (clerkship) and clinical decision-making (internship) was considered in the form of a longitudinal integrated theme.

Participant's entrance to the program

All of the first-year medical students, who admitted at TUMS from 2011 onward, participated in the longitudinal integrated program.

Teaching and evaluation methods

The program is presented throughout the medical curriculum and is held as different forms (face to face classes; workshops and blended learning and etc.). We designed to use a variety of teaching methods, involving: interactive lecture; small group discussion; case study and etc. we also applied different assessment methods for evaluating students' knowledge and skills (for example, worksheets, written exams, Global rating form, OSCE, and etc.). Students' performances were recorded during and at the end of each term. The general topics, teaching and evaluation methods are summarized in Table 2.

Table 2. Details of longitudinal integrated theme of reasoning, problem-solving and decision-making in the four phases of medical curriculum

	Basic sciences	Pathophysiology	Clerkship	Internship
Content	Scientific and critical thinking	Problem-solving and reasoning	Evidence-based medicine	Clinical decision-making
Educational methods	Interactive lecture Discussion in the small group (providing the scenario, small group formation, and group discussion, reporting) Flipped classroom	Interactive lecture Discussion in The small group (providing the scenario, small group formation, and group discussion, reporting) Case based discussion	Virtual learning Evidence-based medicine journal club meetings	Evidence-based medicine journal club meetings
Assessment methods	Evaluation of newly arrived students class worksheets final exam project	Assignment final exam	Activity in the journal club Global rating form OSCE station	Checklist OSCE station Clinical reasoning tests

Discussion

The results of the studies indicate the fact that nearly one-third of patients' problems are not well managed due to physicians' diagnostic errors (12). From the viewpoint of Harsym *et al*., a part of the solution adopted in such conditions is to reinforce diagnostic and problem-solving skills as well as critical thinking abilities of doctors (12). Considering the main purpose of medical education is to enhance and train reasoning and thinking skills of medical students (13), this study was conducted and aimed to develop the longitudinal theme of reasoning, problem-solving and decision-making in the undergraduate medical curriculum at TUMS.

The evidence shows that thinking and cognitive skills program is implemented in different universities in the world. It appears that the focus of different universities in promoting intellectual skills are not the identical. For example, in Dundee Medical School, an educational module entitled "Research methods and critical thinking" is being provided in the whole five-year-period of general medicine course and in all 3-phases of education (14), In University of New Mexico, 12 training modules have spread over the four-year period of medical education course, which "evidence-based medicine" is one of the modules offered in the promotion of thinking skills (15), and At UCLA School of Medicine "clinical decision-making" module is one of the integrated training topics that students will be in some way related to at the end of their course (16). A possible explanation for this might be that selecting and implementing such course in different universities depend on how much students know about these subjects before entrance into the medical curriculum and the necessity of improvement these during their training.

In our study, based on the literature review and opinion of experts participating in the working group, education of four areas including scientific and critical thinking skills (basic science phase), problem-solving and scientific reasoning (physiopathology phase), evidence-based medicine (clerkship phase) and clinical decision-making (internship phase) were considered in the form of longitudinal integrated theme. The results of

the similar experiences of other medical schools around the world also indicate a certain consideration given to the issue of promotion of cognitive and intellectual skills such as critical thinking skills, problem-solving and clinical reasoning in medical students, which is consistent with the results of our study (17,18). However, a review of literature indicates that conflicting evidence exists in different studies regarding the effect of education of critical thinking skills on the improvement of problem-solving and clinical reasoning skills (19,20). Nevertheless, in many studies, there is still an assumption that promoting critical thinking skills in medical students improves their problem-solving and clinical decision-making skills because many decisions are not easy in the clinical settings (21). Therefore, in the design of the longitudinal theme curriculum of reasoning, problem-solving and decision-making, education of critical thinking was considered as a basis for other cognitive skills.

Based on the results of our study, education of clinical decision-making based on the subjects taught in the previous phases takes place in the internship. The survey of evidence shows that in spite of the consideration taken regarding the education of these skills in the curriculum of students, different approaches exist toward their educational process. Efforts have been made in some educational programs to directly teach these skills to students by providing integrated educational modules over the course of general medicine (22), while some others try to provide grounds for enhancement of the students' capabilities through the use of proper educational strategies (23). For example, Wilkes *et al*., at the UCLA School of Medicine implemented a program entitled "doctoring" which used the problem-based learning as an educational strategy (16). In our study, considering the necessity of conveying the basic concepts and providing opportunities for practicing the trained topics, education of this longitudinal theme was considered to be direct and integrated with other subjects in the curriculum of general medicine course. For instance, in addition to holding meetings and workshops in the related fields, it was tried that in the team-based learning sessions where students in addition to learning a specific subject, practice critical thinking as well as problem-solving. This finding is in agreement with Mcinerney and Fink's (2003) findings which showed that using team-based learning improves comprehension and critical thinking of students in an undergraduate microbial metabolism-physiology course (24). Performing further research to determine the effect of this program on the students' future professional performance is suggested.

This article presented the experience of Tehran University of Medical Sciences regarding designing the longitudinal theme of reasoning, problem-solving and decision-making. The results of this study could be used as a useful pattern for integration of psycho-social subjects such as critical thinking, reasoning and problem-solving into the medical curriculum.

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