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Brief Report

Vertical Integration in Visual System Education: A New Educational Experience

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Abstract

Background: The purpose of the medical curriculum is to train up-to-date physician who can safely and effectively diagnose diseases and increase the health of society.

Objectives: We designed a visual system anatomy educational course to investigate the effect of the "extending the teaching of the basic science throughout the curriculum" strategy, on the level of satisfaction and learning of medical student's anatomy knowledge.

Methods: This study was an interventional, in descriptive type, done in visual system anatomy educational course and designed in four training sessions consisted of: 1. A 15 multiple choice questions pre-course online test, distributing lesson plans and related educational videos, 2 and 3.training sessions in which education content by using cadaver and other teaching aids such as moulage and slides were presented; 4.Discussion, post-test holding and distribution of satisfaction questionnaire. The overall pre-intervention and post-intervention data were analyzed using Kolmogorov–Smirnov test and paired t-test in Statistical Package for the Social Sciences (SPSS) software. P-value less than 0.05 was considered as statistical significance.

Results: Based on the results of the final exam, correct answer percentage to each question (CAP) of post-intervention were higher than the CAP of the pre-intervention. The statistical analysis also indicated that there was significant difference in the mean of CAPs between the two tests ($p<0.01$).

Conclusion: It seems that proposing a new curriculum and including basic anatomy sessions in clinical training courses can help students to review basic science concepts and apply them in developing clinical skills and ultimately safe patient care.

Keywords: Curriculum; Integration, Training Programs, Questionnaire

Background

The basis of the medical school curriculum is to train competent physicians who are able to manage a variety of cases - from simple to complex - safely and effectively. However, this seemingly simple goal, sufficient coordination between theoretical and clinical courses (1) requires combining a wide range of information and skills into a complex balance, and collective agreement to achieve this has yet to be reached. There are several medical curriculum models that have been used over the years and in some form still form the basis of medical education today. These include the apprenticeship model (2), the discipline based model (3), outcome based model (4), e-portfolio model (5), and hybrid spiral model (6). In all the above educational models, what is important is the training of doctors who can benefit from the basic medical sciences in the face of patients and act efficiently in the diagnosis and treatment of diseases. The wide range of medical curricula in medical schools around the world reflects this lack of consensus (7).

The problems of separate pre-clinical and clinical curriculum have led scientists to open a new space called "integration in medical education" in the past decades (8). As the Brauer and Ferguson mentioned at the AMEE guide "horizontal integration is defined as integration across disciplines but within a finite period of time", whereas "vertical integration represents integration across time" (9). Different studies suggest teaching strategies like restructuring the curriculum into

cross-cutting themes (10), incorporating clinical experiences into the teaching of the basic sciences (11, 12), extending the teaching of the basic science throughout the curriculum (13, 14) and etc. to incorporate vertical integration into medical curriculum. According to the studies in this field ,the main goals of the integration program in medical education are significant improvement of learning and visualization of educational innovations in medicine, scientific orientation and study reform of students involved in medical fields (15). Structural goals include integrating theoretical and clinical teaching content and incorporating it as a core curriculum of broad studies as well as a higher degree of self-directed teaching and learning. Counseling services and actions performed by qualified and trained faculty, along with other quality assurance measures, form an important foundation for an integrated educational program (14, 16). Although the integration of basic science and clinical concepts into the curriculum of medical students helps them develop clinical reasoning skills (17), curriculum reform based on the vertical integration approach presents many challenges and cost to faculties and students. However, there are still no detailed studies to provide a framework or practical guidance on which of the teaching strategy is more efficient and how to plan and implement integration in a medical education curriculum (18). As it is important to continually return to basic science during clinical education and helps students connect the clinical information they learn from patient histories, physical examinations, and laboratory studies to biological principles and mechanisms and generally learn deeply (19), we designed a visual system anatomy educational course to investigate the effect of the "extending the teaching of the basic science throughout the curriculum" strategy which was mentioned above, on the level of satisfaction, learning and retention of anatomy of general medicine students at Alborz University of Medical Sciences in 2020.

Objectives

We designed a visual system anatomy educational course to investigate the effect of the "extending the teaching of the basic science throughout the curriculum" strategy, on the level of satisfaction and learning of medical student's anatomy knowledge.

Methods

This Interventional-descriptive study was conducted during the academic year 2020-2021 among available 145 fourth-year medical students on the first two days of their ophthalmology rotation at the Madani hospital, Karaj, Iran.

The study was approved by the Human Research Ethics Committee of the Alborz University of Medical Sciences (IR.ABZUMS.REC.1399.280). All participants provided online consent, and were assured of the voluntary nature of participation before providing consent.

The visual system anatomy educational course was designed in four training sessions which were held on online platforms due to restrictions of the Covid-19 pandemic.

The first session consisted of conducting a pre-course online test, distributing lesson plans and educational videos related to the vertical integration curriculum.

The online examination consisted of 15 multiple choice questions that assessed students' knowledge of visual system histology and embryology, orbit, eyelid, eyeball, extrinsic eye muscles, eye vessels and nerves anatomy. The book used as a source for designing the questions was Snell's Clinical Anatomy by Regions. After the exam, the instructor checked the exams and let the students get to know their weak points. The second and third sessions were the training sessions in which the faculty professor of anatomy taught education content by using cadaver and other teaching aids such as moulage and slides. In the fourth session one of the students was asked to teach the education content of the previous sessions using cadaver and moulage. The students had to take a second online exam, which had same questions as the first exam. Also, the questionnaire on students' satisfaction with the holding and the necessity of implementing the educational package with a vertical integration approach was provided for them to fill out. This questionnaire included descriptive questions about the current state of vision course students' awareness and 6 yes-or-no questions (6 points).

The overall pre-intervention and post-intervention data were analyzed using the Kolmogorov–Smirnov test to determine the normality of the data ($p=0.20$), and then a paired t-test was used to compare the mean scores of the groups in the Statistical Package for the Social Sciences (SPSS) software. A P-value less than 0.05 was considered statistically significant.

Results

Pre and posttest: Based on the results of the final exam, the correct answer percentage to each question (CAP) of the post-intervention test was higher than the

CAP of the pre-intervention test. Simultaneously, the mean of the CAPs was higher in the post-intervention test than in the pre-intervention test ($p<0.01$) (Table 1, Figures 1 and 2).

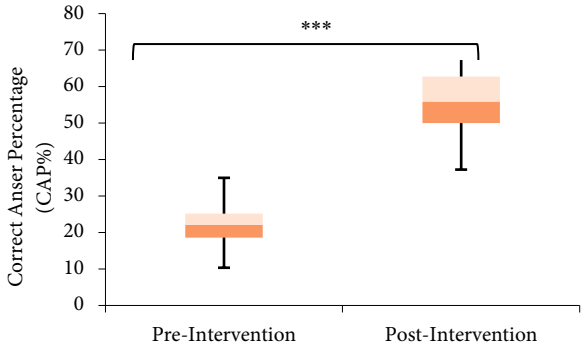

Figure 1. Pre- and post-intervention CAP (***P-value <0.01)

For all questions, the number of correct answers was higher after the course. The detail for each question is reported in Figure 2.

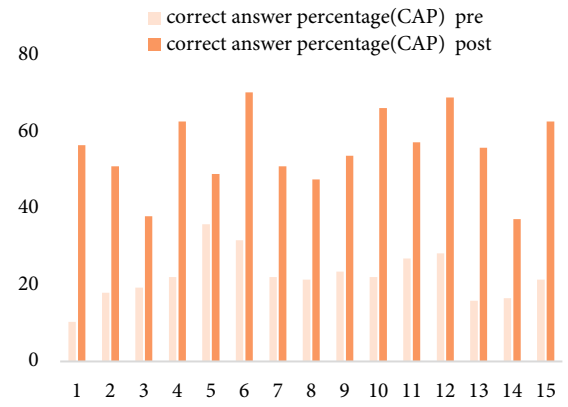

Figure 2. CAP before and after the courses for each question

Questionnaire: Approximately, 85% of the students declared that their anatomy knowledge from the basic science courses was not sufficient to use in the clinical course. They assessed limited faculty involvement, inadequate facilities like cadavers or moulage, absence of a person as a director of the laboratory as the main obstacles to incorporating basic science courses into the clinical curriculum. The other factors were insufficient space at hospitals and time restrictions.

80% of the students believed that anatomy should be integrated into internships' medical curriculum and most of them agreed that the impact of this vertical integration on their learning and retention would be greater through simulation or laboratory dissection like cadaver and moulage.

Discussion

In the present study, a one-month basic science training course was held at the beginning of the ophthalmology department for clinical course students, and the level of knowledge and awareness of the students was measured by taking pre- and post-course tests.

Also, using a standard questionnaire, the level of satisfaction and need of students to hold these courses during the clinical courses was measured. The comparison of the pre-test and post-test results showed that the students obtained better grades after the training course, which indicated the improvement of their awareness and understanding of the topics related to the anatomy of the visual system and the necessity of planning for such courses, basic sciences in clinical courses. In addition, based on the feedback of the majority of students, in response to the needs and satisfaction questionnaire, they responded positively to the approach of integrating basic anatomy while taking clinical courses and found this course useful and helpful for better performance as a doctor.

As we enter the new era of medicine, there is a continued emphasis on the need for integrated learning in health professions education and clinical education. Educational managers want to train thoughtful employees in the future. In other words, future doctors must be skilled and reliable in interacting, applying and transferring basic knowledge during clinical care of patients. Indeed, progress in lifestyle and personalized medicine in the 21st century depends on health care practitioners being able to bridge and combine basic and clinical science in a way that is personally meaningful and professionally useful (20). Despite imprecise and inconsistent definitions of terms related to integration in medical education, many studies involving vertical integration of basic medical sciences in a clinical setting have also received positive responses from students, with learners preferring vertical integration courses to basic science education or clinical hospital education, separately (21-23).

Overall, a substantial body of data and educational theoretical foundations support greater integration of the basic and clinical sciences in the medical curriculum, and feedback from students and instructors suggests that an integrated curriculum can be well suited to the effective practice of medicine and its positive results are at least not less successful than the traditional curriculums (7).

Table 1. The correct answer percentage of questions in pre- and post-intervention tests of the educational package of the visual system

Group	Correct answer percentage (CAP)			
	Mean	SE of mean	Maximum	Minimum
Pre-intervention	22.39%	1.66	35.86	10.34
Post-intervention	55.22%	2.60	70.34	37.24

The mean scores of students in post-test are higher than pre-test (p-value<0.01)

According to Garcia (24), "medical education is the process for training doctors, subordinate to the dominant economic and social structures in societies in which It takes place". Regarding to mentioned critical point, there are some categorized reasons for integration: 1. Standardizing learning outcomes and training doctors with high general competency indicators and providing options for customizing the learning process, providing opportunities to use experiences in research, policy making, education, etc., which reflects the broad role of doctors (24); 2. Medical schools should train graduates so that they can integrate all aspects of knowledge, skills, innovation, research and professionalism to provide medical services and improve the health of society, therefore, medical schools and teaching hospitals should support innovative educational systems (25); 3. The development and actions of professionalism should be the backbone of medical education (26).

The vertical integration of basic science knowledge and clinical education in parallel deepens the understanding of basic science in the field of clinical problem understanding and makes learning more comprehensive and meaningful by stimulating intellectual curiosity (27). Applying the reform method by trained professors, in addition to increasing students' motivation and pushing them towards self-learning, can even lead to the establishment and management of integrated educational hospitals (3, 28).

Integrative learning in the health professions essentially involves the ability to link concepts from different but related fields, engage in higher-order thinking, and apply them in response to clinical problems that affect patient care. The lack of published educational articles in the field of integration shows the lack of consensus in reviewing traditional educational curricula or the lack of publication of educational experiences in this important matter. This causes the loss of opportunities for the best educational practice based on international standards.

Considering all above, our goal is a truly needs-based, differentiated learning experience in a lower-middle-income country and the results of our pilot study were satisfactorily in line with this goal.

We hope that health professions educators and integrated curriculum developers will benefit from our study and draw attention to recent international definitions of integrated learning, teaching, curriculum and teaching.

Conclusion

Consequently, incorporating relevant and more recent anatomy sessions into clinical education can help students review basic science concepts and apply them to clinical practice that result in knowledge gain and improvement of summative scores. This allows for the development of clinical skills and ultimately safe patient care. By proposing a new curriculum, it seems possible to train physicians who may lead changes in the health care system and have a positive impact on the well-being of the individuals and communities in which they work.

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Conflict of interests: There is no conflict of interest.

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