Original Article

Use of Knowledge-sharing Web-based Portal in Gross and Microscopic Anatomy

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Abstract

Introduction: Changes in worldwide healthcare delivery require review of current medical school curricula structure to develop learning outcomes that ensures mastery of knowledge and clinical competency. In the last 3 years, Mayo Medical School implemented outcomes-based curriculum to encompass new graduate outcomes. Materials and Methods: Standard courses were replaced by 6-week clinically-integrated didactic blocks separated by student-self selected academic enrichment activities. Gross and microscopic anatomy was integrated with radiology and genetics respectively. Laboratory components include virtual microscopy and anatomical dissection. Students assigned to teams utilise computer portals to share learning experiences. High-resolution computed tomographic (CT) scans of cadavers prior to dissection were made available for correlative learning between the cadaveric material and radiologic images. Results: Students work in teams on assigned presentations that include histology, cell and molecular biology, genetics and genomic using the Nexus Portal, based on DrupalEd, to share their observations, reflections and dissection findings. Conclusions: New generation of medical students are clearly comfortable utilising web-based programmes that maximise their learning potential of conceptually difficult and labor intensive courses. Team-based learning approach emphasising the use of knowledge-sharing computer portals maximises opportunities for students to master their knowledge and improve cognitive skills to ensure clinical competency.

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Introduction

The extensive use of and the rate at which medical technology is becoming an integral force in medicine has impacted on the way in which physicians are being trained to practise within this new environment. Medical informatics and the era of interacting over web-based systems require competencies that need to be acquired over a formative period during the medical curriculum.[1]

In the new outcomes-based curriculum implemented 3 years ago at the Mayo Medical School (MMS), formal microscopic and gross anatomy lectures were replaced by short briefing sessions designed to allow students to spend more time in histology and gross anatomy laboratory, where the highest quality learning takes place.[2-4]

With the belief that the most meaningful learning of both histology and gross anatomy occurs during the laboratory session, elimination of classical lectures placed the responsibility on the learner to prepare for laboratory experience and team-based activities. Dissection of the human body, study of virtual microscopic slides, peer-teaching exercises, team-based learning and self-directed active learning were the most utilised learning tools for both courses.[3]

Medical education in the past focused on individual learner's performance; however, taking into consideration changes in the healthcare system, many medical schools are now placing more emphasis on team-based education, and assessing team performance.[5] Incorporating strategies of team-based learning in early stages of medical school curricula is essential in preparation for clinical experience where problem-solving requires cooperation and

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coordination among multiple team members. Following changes in the medical curriculum at MMS, the anatomy faculty introduced teamwork exercises that utilised web-based application. The goal of using the knowledge-sharing web-based portals was to combine the 2 important entities of web-based learning and active team learning to prepare medical students for the ever evolving world of medicine. This paper provides a perspective on our experience integrating team work and the use of knowledge-sharing web-based portals in the first year gross and microscopic anatomy.

After matriculation to MMS, 42 members of the Class of 2011 were divided into four-member learning teams (2 teams with 3 members). The team assignment was kept the same through 2 consecutive 6-week long didactic blocks. Block II of Basic Structure included Histology with Cell Biology and Genetics and Block III of Human Structure containing Gross Anatomy and Basic Radiology. Each learning team identified a leader who was responsible for directing the group work and steering the team towards achieving the course objectives. Leadership of the group was rotated in the middle of the course; therefore, each member of a team had an opportunity to serve this role during the combined 12 weeks of didactic time. One of the team assignments was to utilise the computer portals available on their personal laptop computers to share learning experiences with other team members and the entire class. Students used the Nexus Portal (updated version of MediaWiki) based on DrupalEd, which access was available from the course website.

Block of Basic Structure

In Block II Basic Structure, students were assigned to 11 microscopic anatomy teams which explored histology of tissues and organs using virtual microscopy system (Bacus Laboratories, Lombard, IL, USA) installed on their own laptops. Amongst advantages in this approach reported by other authors, the virtual microscopy increases accessibility of histology slides (virtual slide box resides on the dedicated server with 24 hours access) and eliminates problem of generating and maintaining teaching glass slide collection.[6,7] Through the use of this system, students were able to vary the magnification, tag specific structures of interest and formulate notes along the slides that could eventually be shared amongst the team and referenced for further discussion with faculty and or teaching assistants. In addition, students worked in teams on assigned microscopic anatomy presentations that include histology of organs and systems. The expectation was that students will research not only histology, but also associated cell and molecular biology, as well as clinical aspect of common diseases related to specific organs emphasising aspects of genetics and genomics.

Students used the same Nexus Portal to share their observations and reflections, as well as focused on clinical investigations related to the microscopic anatomy and genetics topics. In microscopic anatomy, students were given a list of criteria to address which included: (i) Microscopic anatomy of the system assigned and (ii) Role of genetics/genomics in disease processes affecting the system. Examples of topics presented by teams in Microscopic Anatomy included: lymphatic system, glands of digestive system, central nervous system, and eye and ear.

Having been assigned the topic within week 1 of the block, students were able to work with their groups for 5 weeks. During this time, both faculty and teaching assistants were able to provide feedback to students which guided and enhanced their efforts. Presentations were conducted using the web-site and thereby not restricted to the use of Power Point, providing a more dynamic system from which to work. Each team was allowed a 45-minute presentation in a formal classroom set-up during the last 3 days of the course and evaluated by both peers and faculty. At the end of the process, a fully searchable site was accessible after the block for all members of the class.

Block of Human Structure

The gross anatomy course was a 6-week long, 120 hours didactic course with a strong component of the laboratory. During this block, students were divided into 11 dissection teams and performed a full body dissection. High-resolution computed tomographic (CT) scans of cadavers imaged prior to dissection were made available for correlative learning between the cadaveric material and radiologic images. In addition, each dissection team was presented with a clinical chief complaint and diagnosis that had strong correlation with clinical anatomy. It was the team's responsibility to evaluate the cadaver as a simulated "patient". Students were offered assistance with their project throughout the course from faculty and teaching assistants. At the completion of the project, each dissection team presented their "patient" as a case-type presentation similar to those performed at the hospital. To support their presentations, student groups collaboratively worked to create a webpage on the medical school Nexus site to facilitate the sharing of each teams' work with their fellow colleagues.[2] At the end of the course, each team provided a short (approximately 5 to 10 minutes) presentation during gross lab.[3] In the gross anatomy section, students were given a list of criteria to address which included: (i) Chief complaint, (ii) History of present illness, (iii) Relevant family history, (iv) Social history, (v) Allergies, (vi) Physical exam (vii) Laboratory exam (viii) Radiographic exam, (ix) Differential diagnosis and (x) Proposed treatment. Examples of topics presented by teams in Gross Anatomy included:

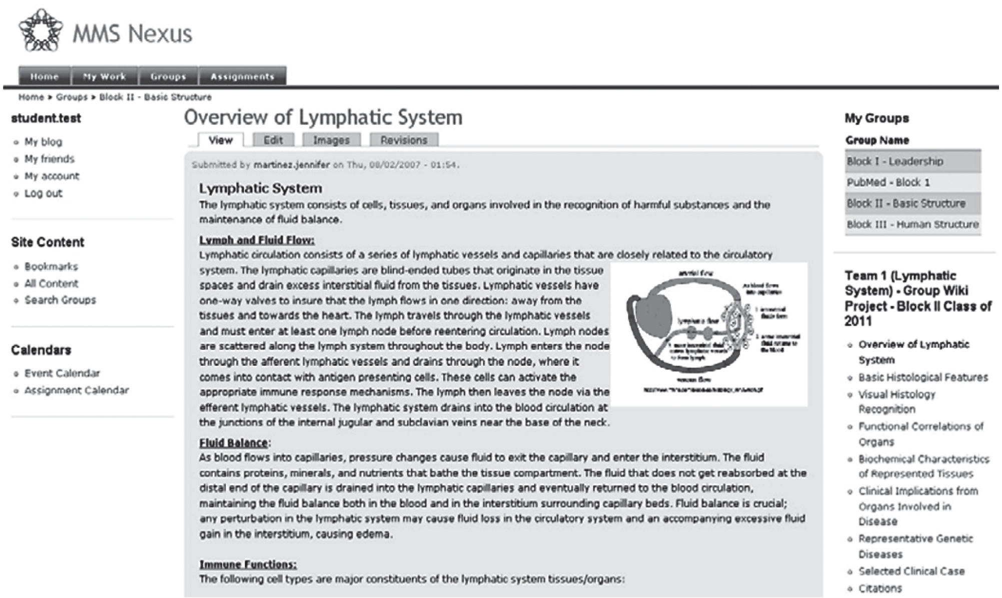

Fig. 1. A screen capture of the Block II webpage of Mayo Medical School Nexus Portal that shows a microscopic anatomy team's page on the lymphatic system. The right navigation menu allows students to easily navigate through web pages. The left navigation menu allows students to keep track of assignments on group calendars.

Erb-Duchenne's palsy, spontaneous pneumothorax, portal hypertension and epidural haemorrhage.[3]

Having been assigned the final diagnosis within week 1 of the block, students were able to work using a reverse learning method through discovery with their groups for 5 weeks. During this time, both faculty and teaching assistants were able to provide feedback to students via the web-site portal. All editing of webpages are done using a web interface. Students do not need to understand the HTML language to edit webpages, but instead they can edit pages using a toolbar similar to what is used in most word processing applications. Presentations were conducted using the web-site through computers based in the laboratory beside the cadaver, thereby simulating the patient bedside presentation. Each team was allowed a 5- to 10-minute presentation in an informal bedside set-up to the neighbouring group during the end of the course and evaluated by both peers and faculty. Student peer evaluations counted towards a total of 10% of the final grade based on group and leadership performances. At the end of the process, a fully searchable site was accessible after the block for all members of the class.

Discussion

Competencies with e-media have become an important goal for post-medical education graduates in recent times. In a study done in 2006, it was noted that e-learning is most likely to be one of the most important developments in graduate and postgraduate medical education delivery.[8] As team-based learning fosters early interaction and prepares medical students for the team-based world of medicine, e-learning has become an essential component of learning in a rapidly evolving field of medical education. In recent years, a growing number of publications in medical education have been dedicated to computer-assisted instructions (CAI) and web-based learning (WBL).[9-11] In reviewing advantages and disadvantages of e-learning methodologies, Berman et al[11] pointed out that CAI is more efficient than some other teaching methodologies. Early implementation of such instructions may be advantageous in medical curriculum where students can achieve the same level of proficiency in less time. In an article by Cook,[10] the potential advantages of web-based learning were noted to include the increased possibilities for distance learning, flexible scheduling, ease in updating, individualised instruction and the availability of novel instructional methods.[10] A study showed that residents preferred learning with web-based modules and agreed that it took less time doing so than paper-based formats. It was also shown that web-based learning represents an effective, well accepted, efficient tool in medicine today.[12] Future studies that would help focus on the aspects of web-learning that will enhance its power as a learning tool in addition to defining its role in medical education would be beneficial.

One of the popular medical e-learning tools today are medical wikis and blogs developed to support medical education.[13] Platform for this new learning approach is provided by MediaWiki, a free and open source wiki software originally written for Wikipedia.[14] Functionally, MediaWiki works as an online content management system and knowledge-sharing portal.[14] The advantages of this tool include allowing students to practise skills in applying web-based technologies to content applications. This becomes important as the electronic media of wireless devices, smartphones, laptop and tablet computers, and personal digital assistants (PDAs) have become essential delivery methods in medical education.[1,15] Therefore, the early integration of WBL in medical education is being focused on as a means to prepare medical students for the healthcare system they will become a part of, which increasingly depends on the electronic media (i.e. electronic medical records).

Although, web-learning portals have become very popular in recent time, it is important to note that it does address all the challenges faced in medical education. Despite being a great addition to current teaching methods, it should by no means replace traditional teaching methods such as text, lectures and small group discussions. Medical educators will have to assume the role of defining the contribution of web-based learning in the curriculum. The importance of this lies in the fact that no evidence exists that definitively proves that students learn more from web-based programmes versus traditional methods although the students may learn more efficiently. In order to achieve quality results in education, the most important factor is in designing educational programmes and curricular regardless of the media utilised or method of delivery. This is because a poorly-designed educational programme will not be improved by being presented on a web page.

While web-based learning is a fascinating tool for educators to utilise, it is still in the early stages and as a result many research questions remain unanswered. Such questions include information on the relative costs of web-based learning programmes. To establish the role of web-based learning in education, research trials clearly compare the strength and weakness of different educational methods would lend concrete evidence to the benefits of web-based learning in 21st century medical education.

The new generation of medical students are clearly at ease utilising web-based programmes that can maximise their learning potential in the often conceptually more difficult and labour intensive courses such as microscopic and gross anatomy. Team-based learning approaches with an emphasis on the use of knowledge-sharing computer portals clearly maximises opportunities for students to master their knowledge and improve cognitive skills in order to ensure clinical competencies.

Implementation of teaching and learning strategies through web-based systems promote e-learning and team-based interactions in the early phase of medical curriculum. Preliminary data based on student responses to the use of technology in the classroom showed positive trends towards e-learning. The importance of basic sciences such as anatomy, clinical application, active learning, and group problem solving cannot be overestimated in medical education.[16-18] As healthcare moves towards an electronic clinical environment, it is important to facilitate medical education through an electronic learning environment. It becomes even more essential therefore for medical students to master this important interaction early on in their medical career to be well prepared for a future career in the electronic clinical environment.

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