Effectual Methods Towards Teaching Human Anatomy and Physiology in Engineering

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ABSTRACT

The fusion of medicine and electronics in Engineering led to the creation of Medical Electronics Engineering which brought in innovations in the development of Medical devices. In this era of Biomedical Engineering (BME), there is an urging necessity for engineers with the knowledge of both medicine and engineering concepts. In order to fulfil this necessity, there arises need for introducing the subject the fundamentals of Anatomy and Physiology to the students with the engineering background, who may have no knowledge of biology. The huge amount of medical terminologies being an essential part of the subject raises the challenge of making the engineering students feel comfortable to comprehend them within the short period of a semester. The elementary way to teach this would be to have a faculty from a medical school. These faculties are trained to deliver this subject over a period of eighteen months and so to concise the content to deliver the same within the engineering semester is highly impossible to this medical expertise. This lacuna led us to look for alternate effective processes to achieve the same. The psychology of the engineering students to adapt to methods traditionally used in the delivery of core subjects was looked into for devising these methods. The Usage of some familiar activity tools like crosswords and flowcharts were used in the teaching. These tools aided the students in learning difficult anatomical terminologies and remembering the various physiological processes. A result analysis done indicated a reasonable change in the performance of students.

Keywords: Crossword, Medical Electronics Engineering, Human Anatomy and Physiology, Flow Chart.

INTRODUCTION

The understanding of human anatomy and physiology is a vital requirement in the curriculum of medical electronics students. Students need to be cognizant of the various physiological systems and biological processes for the design and development of medical devices. Since most of the content that is being taught in Human anatomy and physiology is fact-based, students tend to absorb it in a passive manner. The challenge here is to ensure the active participation of students throughout the learning process.

Literature shows that research is on to find a solution to these challenges and many methods are investigated on to find the effective way out.

Human Anatomy and physiology is a part of the traditional engineering curriculum. The critical concern is the inability in general of many engineering students to participate in high- level anatomy and physiology course due to the necessity of lower-level prerequisites. Engineers are better prepared to solve problems when they have a first-hand understanding of the problem and its cause [1].

Physiology instruction should help prepare students to solve BME problems. Solving engineering problems requires both knowledge and innovation. Preparation for future learning is a proposed educational construct related to the ability to innovate. Because every problem cannot be anticipated, the preparation for future learning model suggests that instruction should focus on helping students develop their ability to learn as they encounter new situations by making connections to past learning [2]. Physiology instruction, then, should aim to develop a prior knowledge that can support future learning. What students learn in an introductory physiology course becomes the acquired knowledge from which new connections are made as they continue to learn both new physiology topics and those in BME.

The advent of commercial multimedia products from Primal Pictures, A.D.A.M and Pearson has allowed anatomy educators to utilise such new technology and implement it as an attempt to strengthen traditional ways of anatomy instruction. This gives the possibility to explore student perceptions of these innovative teaching methods, and in particular to explore the role of both teaching methodologies (i.e. traditional teaching versus multimedia augmented teaching). In summary, the primary aim of the project was to investigate whether learning human anatomy (with respect to visiospatial awareness, physiology and tissue recognition) was preferred using (1) cadaveric dominated programs, or (2) similar programs augmented with multimedia [3].

The Biotronic Engineering major focuses on integrating electronic and computer systems engineering with human biology and applied sciences to solve problems related to medical systems and devices. Moreover, it covers the design, build and maintenance of medical instrumentation and devices that save people's lives or help keep them alive. This is designed for students who wish to become professional engineers with special knowledge of medical instruments and healthcare [4].

In purview of the existing proposals and methods we proposed to use two techniques to ease the understanding of Human Anatomy and Physiology by the Engineering students viz: Crosswords as they are useful teaching tools that ensure and helps facilitate critical thinking [5-7]. These puzzles reinforce the concepts that have previously been delivered during a lecture. As these are engineering students, learning through flowcharts would be akin to learning computer code and programs. This helps them understand and relate to something they are familiar with. Therefore, by using flowcharts to teach biological processes, we ensure that students understand these concepts in a framework that is familiar to them. Hence, the students grasp them faster and easier.

DESIGN AND EXECUTION

These crossword puzzles were designed and created by making use of resources freely available online. The course on Anatomy and Physiology lasts for 13 weeks. The lectures periodically occur 3

times every week. The concepts that have been taught during a month are reinforced and at the same time assessed using these new teaching tools of crosswords and flowcharts.

Definitions and one line explanations of biological organs and processes were provided as hints for students to grasp and understand the concept completely. For example, if the word across or down were trachea, then the hint that would be given would be: "The air tube that extends from the larynx into the thorax, where it splits into the right and left bronchi." Similar to this, important organs and processes from all the various organ systems like digestive, cardiovascular, respiratory, nervous, etc. formed a crossword puzzle each.

After a lecture on each of these systems in class, printed handouts of these crossword puzzles were given to each student to solve (Figure 3). The students have 30 minutes to solve each puzzle. These were then evaluated to understand how much each student has grasped the terms and definitions of these biological processes.

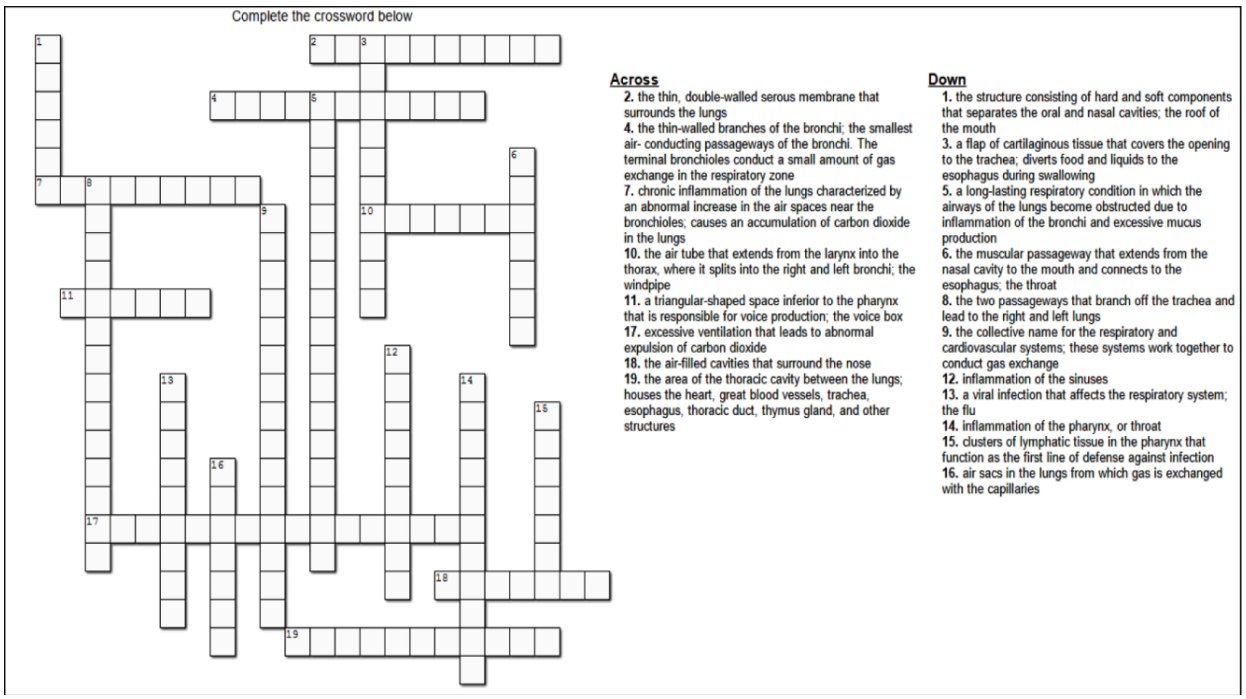

Fig. 3: Crossword without Solution

One of the advantages of using crossword puzzles to reinforce these terms and definitions is that the puzzles are self-correcting. The length of the word and some, already filled-in letters, give the student enough hints as to what the actual term would be (Figure 4).

Flowcharts are a graphical representation of a process that explains the order of various functions and the steps involved. For example, the task would be to explain the passage of air through the respiratory system with the help of a flowchart (Figure 5). Therefore, the students would be forced to think in terms of the steps involved in breathing and how air flows in, the organs through which the air traverses and eventually how oxygenation and deoxygenation of air takes place.

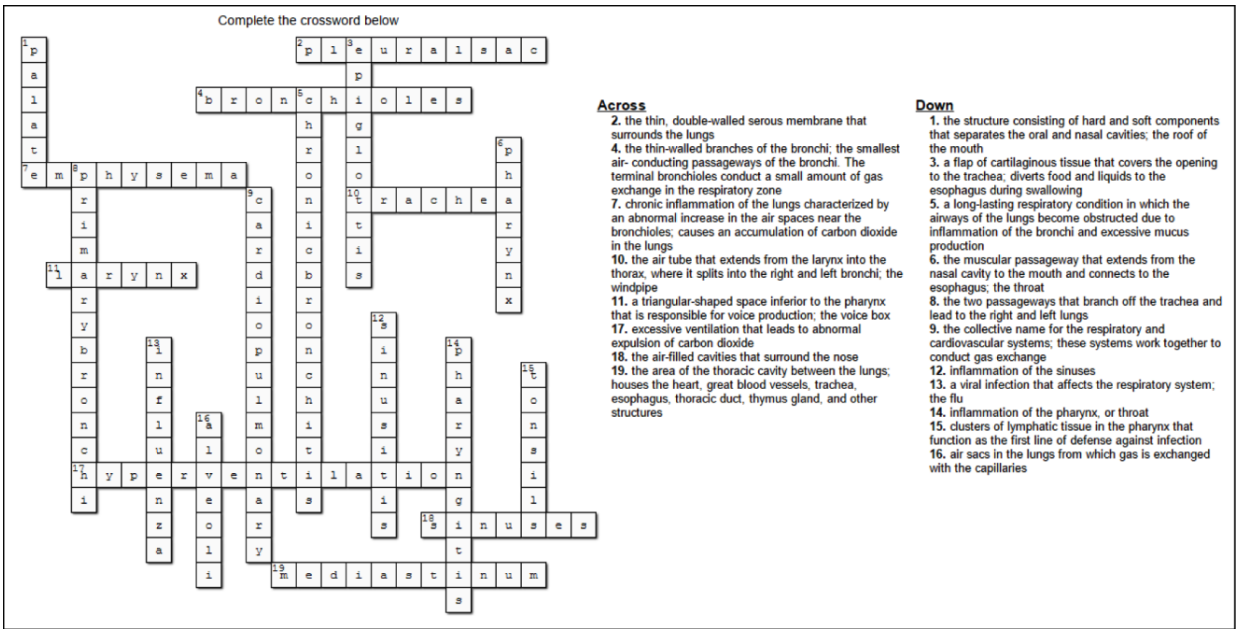

Fig. 4: Crossword with Solution

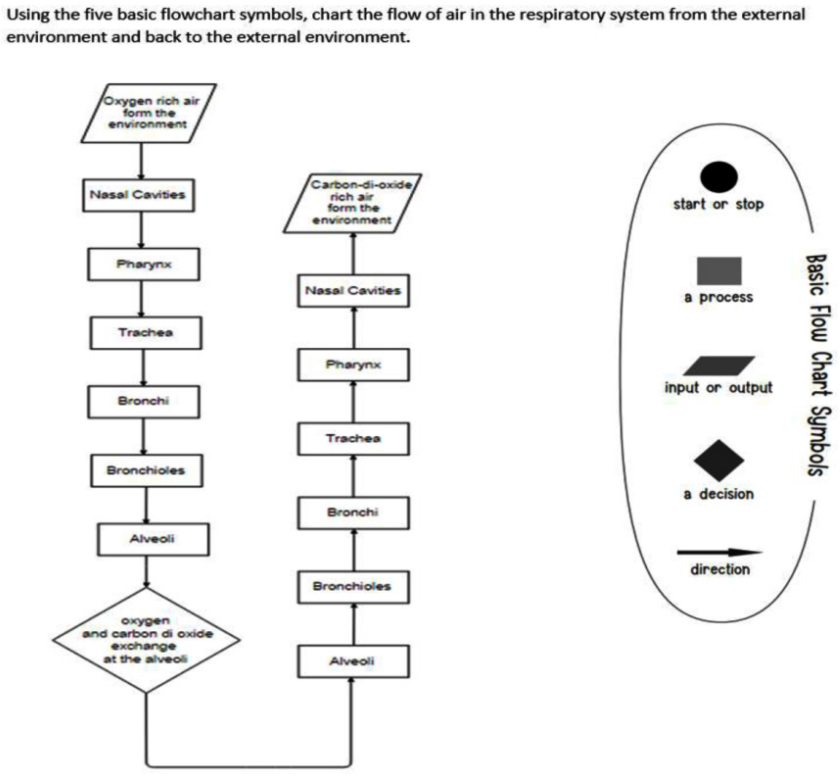

Fig. 5: Flowchart for Respiratory System

These flowcharts would incorporate the symbols to understand how and where the processes start/stop, arrows to show the path it traverses through the body and the various systems/functions it involves; Input/output symbols to show where and how it enters and exits various systems/functions; Process symbols to understand what processes happen at each of these components.

EVALUATION

To evaluate the impact of crossword puzzles and how it made a difference to the students, we evaluate their progress by comparing the results of their first crossword puzzle against the results of the second crossword puzzle (Figure 1). Similarly, we compared the results of the first flowchart against the second flowchart (Figure 2) to demonstrate the impact these puzzles have made on the students and how they have been able to grasp concepts easier. The results clearly indicate the improvement in adaption of students to the medical terminologies, thus improving their performance.

These methods were extended to all physiological systems and the effects were visible in the marks obtained and also the improvement in their answering the theoretical answers too in their other versions of evaluation procedures.

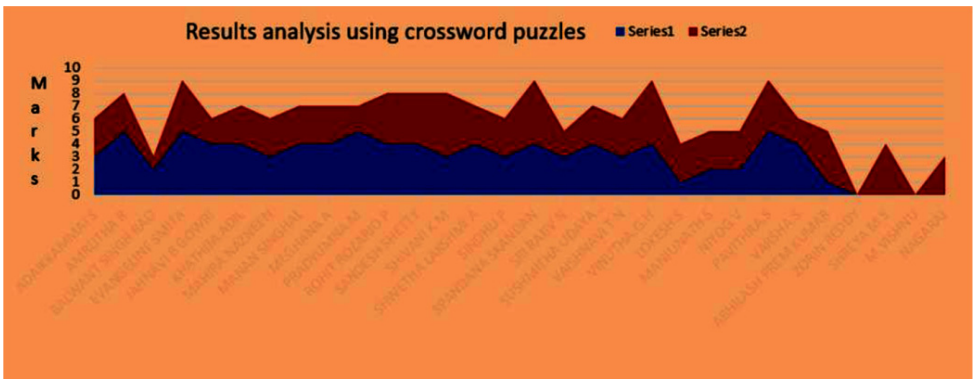

Fig. 1: Result Analysis Using Crossword Puzzles

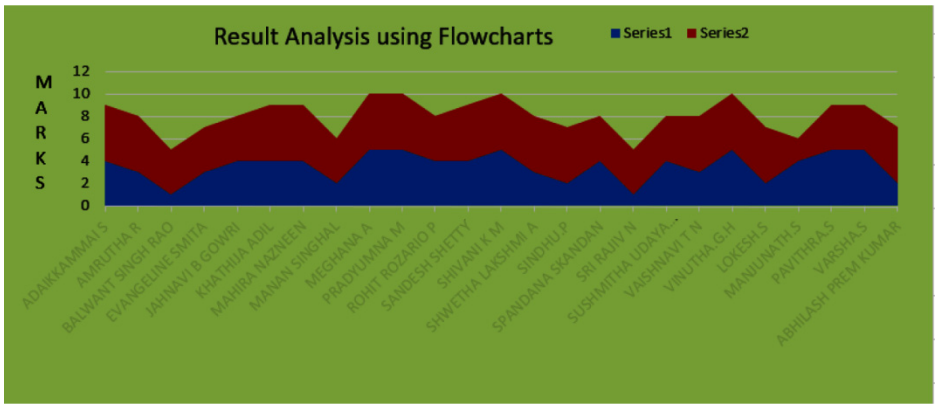

Fig. 2: Result Analysis using Flowcharts

CONCLUSION

Students find it easier to grasp complex biological concepts with the help of crossword puzzles and flowcharts. They take unknown concepts and bring more meaning to them by changing the context in which they are perceived. These puzzles help the classroom to change from a passive learning one to an active learning classroom.

REFERENCES

[1] J. Dicecco, J. Wu, K. Kuwasawa, And Y. Sun, "A Novel Approach to Physiology Education for Biomedical Engineering Students", Adv Physiol Educ 31: 45–50, 2007; Doi:10.1152/Advan.00054.2006.
[2] Regina K. Nelson, Naomi C. Chesler, And Kevin T. Strang, "Development of concept- based physiology lessons for biomedical engineering undergraduate students", Adv Physiol Educ 37: 176–183, 2013; doi:10.1152/advan.00038.2012.
[3] ANG Eng-Tat, George Yip, Erle Lim Chuen Hian, Kapil Sugand, "Learning undergraduate human anatomy – reflections on undergraduate preferences in Singapore: a pilot study", Journal of the NUS Teaching Academy Volume 4, Number 1, March 2014.
[4] Hamid GholamHosseini, Krishnamachar Prasad, "Biotronic Engineering Curriculum Design: Integrating Electronic Engineering and Applied/Health Sciences", A tale paper.
[5] Samit Shah, Launa M. J. Lynch, And Lilia Z. Macias-Moriarity, "Crossword Puzzles as a tool to Enhance Learning about Anti-Ulcer Agents", Am J Pharm Educ. 2010 Sep 10, 74(7): 117.
[6] Carlos Mario Zapata Jaramillo, Bell Manrique Losada, Michael J. "Mick" Fekula,"Designing and Solving Crossword Puzzles: Examining Efficacy In A Classroom Exercise", Developments in Business Simulation and Experiential Learning, Volume 39, 2012, Pg(213-222)
[7] Tricia M. Davis, Brooke Shepherd, Tara Zwiefelhofer,"Reviewing for Exams: Do Crossword Puzzles help in the Success of Student Learning?", The Journal of Effective Teaching.
[8] Yoder Jd, Hochevar Cm. "Encouraging active Learning can Improve Students' Performance on Examinations". Teach Psychol. 2005;32(2):91–95.

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