Egyptian Journal of Veterinary Sciences

https://ejvs.journals.ekb.eg/

Comparative Morphological Studies on the Lungs of Domestic Animals (Bases for Developing Electronic Learning Module)

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Abstract:

NUMEROUS countries, including Egypt, are confronted with higher education challenges, particularly during times of crisis. The adoption of e-learning has been globally recognized as an effective solution to overcome these challenges. The e-learning module was developed based on the anatomy of the lungs in native breeds of domestic animals, such as donkeys, buffaloes, goats, camels, and dogs, using various techniques such as gross anatomy, radiography, and preparation of museum specimens .The study revealed that there was a correlation between the pattern of lobar bronchi and the lobation of the lungs of various animal species. Generally, the right lung of animals usually has four lobes (cranial, middle, caudal, and accessory), while the left lung commonly has a cranial and caudal lobe. Moreover, the number of lobes in some animals may vary.

The development of the e-learning module involved electronic tools, a Learning Management System (LMS), a hosting platform (http://vetmed-academy.com), different learning strategies, and a post-course evaluation survey. Upon implementing the e-learning module, a survey of 45 undergraduate students showed positive feedback regarding course expectations, structure, content, quizzing, timing, e-learning pace, navigation, multimedia, and interactivity. Nonetheless, the responses regarding Information and Communication Technology (ICT) and internet services issues were less favorable.

According to the study, digital technologies play a crucial role in facilitating effective e-learning by providing infrastructure, devices, resources, content, and related services. Additionally, Information and Communication Technology (ICT) has become an indispensable tool for delivering curricula to learners across the globe.

Keywords: Gross anatomy, Lungs, domestic animals, E learning module.

Introduction

The higher education system in Egypt is encountering a range of challenges, one of which is the substantial rise in student numbers. This has put a significant strain on the current infrastructure and resources, creating obstacles to developing effective educational processes. Furthermore, unforeseen crises such as the COVID-19 pandemic have further complicated matters. Additionally, as per research of [1], the continuous surge in Egypt's population has resulted in the massificiation of education, which has negatively impacted the quality of education and its results, despite the increasing opportunities for learning. E-learning is one of several new forms of learning that have emerged due to rapid technological advancements [2]. The effectiveness of e-learning in supporting and maintaining the learning journey has been widely acknowledged, particularly in scenarios where in-person classes are not possible. The current global health crisis has further emphasized the importance of this approach, as it has disrupted conventional teaching and learning methods worldwide [3]. It is essential to evaluate the social, economic, and environmental impacts of e-learning implementation to ensure that e-learning programs are equitable, sustainable, and accessible in the long term [4].

For this project, an e-learning module was developed using scientific anatomical data. This data was collected via various anatomical techniques in order to study the lung anatomy of native domestic animals like donkeys, buffaloes, goats, camels, and dogs.

The present study aims to develop creative forms of e-learning that allow students to learn at any time and from anywhere.

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(Received 29 May 2024, accepted 13 August 2024)
DOI: 10.21608/EJVS.2024.293563.2129

The study main objectives are:

- To develop e-learning module as cutting-edge methods for teaching and learning the anatomy of the animal's lungs,

- Encourage the use of virtual learning to ensure every student has access to it around the clock,

- Reduce learning expenses, swap animal cadavers with expertly prepared specimens,

- Provide compensation for the decreased number of hours spent in direct instruction and the shortage of teachers,

- Enhance the efficacy and efficiency of the educational system, and

- Implement the findings of scientific research to enhance teaching and learning methods.

Material and Methods

Animals.

The study was conducted on lungs of ten seemingly healthy donkeys of varying ages (3 to 5 years), ten sets of dog's lungs acquired from the Department of Surgery after experimental research conducted by [5]., five sets of lungs of buffalos, goats, and camels obtained from the slaughterhouse.

The donkeys were subjected to intravenous administration of xylazine [6], then properly bled through the common carotid artery and finally, an embalming mixture of 15% formalin, 15% glycerin, 5% methanol, 10% phenol, and 55% water [7] was injected via cannulation of the common carotid artery under a suitable pressure.

Techniques.

The anatomy of the lungs was studied through the following techniques:

Gross Anatomy study

Through thoroughly dissection.

Radiographic study.

Using SIMENS MULTIX at K.V. 70 and M.A./S. 32, after filling the bronchial tree with barium sulfate suspension ($BaSO_4$; M.W. 233.39; OXFORD LAB FINE CHEM LLP).

Museum specimen's preparation.

According to El-Nady Technique [8].

Developing E-learning modules.

The e-learning modules were created using scientific anatomical data collected from the specimens studied in this work. Graphs from previous works were modified as needed. The nomenclature used followed NAV and Illustrated nomenclature [9- 10].

Programs.

Paint 3D, PPT, PS.

E-Learning Authoring App.

Camtasia recording, Camtasia studio for screen recorder and video editor for Windows PC [11].

Articulate Studio, which make turning PowerPoint presentations into E-learning courses a snap

Learning Management System (LMS).

Moodle - Open-source learning platform Moodle.org

Hosting platform.

The hosting platform offers a software application for uploading, storing, and sharing E-learning modules. It supports open access via a website **(http://vetmed-academy.com)**, [12]**.**

Strategies.

Student-Central Learning, Collaborative Learning, Flipped Learning, and Peer Learning.

E-learning survey.

A specially designed revised survey questionnaire was given to all 45 first-grade students during the 2023-2024 academic year as part of the Special VDP and PA programs. The students initially learned about the anatomy of the respiratory system through traditional teaching methods and then were exposed to e-learning via the website http//:vetmed-academy.com. Subsequently, there was a discussion between the course consultant and the students to evaluate the impact of the e-learning module. [13-14].

Results

General Gross morphology of the Lungs (Pulmo dexter et sinister) (Figs. 1, 2, & 3).

Generally, the lungs were referred to as a pair of spongy texture, air-filled semi-cone respiratory organs situated freely in the pleural sacs within the chest cavity. The right and left lungs *(Pulmo dexter et sinister)* are separated by the mediastinum and covered with visceral pleura except at the area of adhesion. The lungs had a light brown to light rose color. Each lung had three borders, three surfaces, an apex, and a base.

The borders were represented by the ventral border *(Margo ventralis)*, dorsal border *(Margo dorsalis),* and basal border *(Margo basalis).*

The thin, sharp, and irregular ventral border corresponds to the ventral costo-mediastinal line of pleural reflection and is notched forming the cardiac notch ***(****Incisura cardiaca pulmonis dextri et sinistri)* that appeared wider and deeper in the left lung than that in the right one (area of cardiac auscultation).

The thick, rounded dorsal border (vertebral border) was bounded by the costal and the vertebral part of the medial surfaces. and fitted into the deep paravertebral gutter.

The basal border separated the base of the lung from the costal surface and depth into the costo-phrenic recess/sinus.

The pulmonary surfaces were represented by the costal surface *(Facies costalis)*, medial surface *(Facies medialis)*, and Basal, diaphragmatic, surface *(Facies diaphragmatica)*.

The coastal surface made touch with the coastal pleura and the overlying chest wall and presented coastal impressions.

The medial surface was distinguished into dorsal (vertebral) and mediastinal parts. The dorsal (vertebral) part *(Pars vertebralis)* faced the bodies of the related vertebrae and the intervertebral discs. It presented aortic and esophageal impressions *(Impressio aortica)* and *(Impressio esophagea)*, and azygos vein impressions, in addition to the impression of the caudal vena cava (*Sulcus venae cavae caudalis*) in the right lung only. The mediastinal part *(Pars mediastinalis)* of the medial surface, related to the heart and pericardium had a cardiac impression *(Impressio cardiaca)* which appeared deeper on the left lung than that of the right one.

The diaphragmatic surface constituted the base of the lung. It appeared concave and related to the thoracic surface of the diaphragm. The diaphragmatic surface *(Facies diaphragmatica),* continued laterally with the costal surface in opposition to the costo-diaphragmatic pleural line of reflection.

The blunt apex *(Apex pulmonis)* of each lung was represented by the cranial pulmonary lobe and reached the level of the first rib, while the base of the lung appeared concave and rested on the dome of the diaphragm.

The Hilum of the lung *(Hilus pulmonis)* is identified as a large depressed area near the center of the medial surface, through which various structures enter and leave the lung.

The pulmonary root *(Radix pulmonis)* was represented by the structures entering (principal bronchus, pulmonary artery, bronchial artery, and pulmonary nerve plexus) and leaving (pulmonary veins, bronchial veins, tracheobronchial lymph nodes, and pulmonary lymphatics) the lung.

The root of the lung was enclosed by a short sheet of pleura which joined the visceral mediastinal and costal pleurae. Caudal to the Hilus, the area of adhesion of both right and left lungs could be recognized as not covered by pleura and bounded dorsally and ventrally by lines of reflection of the pulmonary ligament ***(****Lig. Pulmonale)****.***

Fissures and lobes of the lungs.

Based on the external interlobar fissures, the left lung in all examined species, presented cranial and caudal lobes, whereas the right lung is made up of cranial, middle (missed in the donkey, and camel), caudal, and accessory lobes.

The accessory lobe passed dorsal to the caudal vena cava and was located medial to the plica vena cava.

The interlobar fissures were deep (dog), moderate (buffalo, and goat), and poor (donkey, and camel in which only the cranial and caudal lobes are separated by the cardiac notch). The interlobular septa that divided the lobes into lobules were clear in buffaloes, and camels, moderate in goats, and missed in dogs and donkeys.

The pleura (Fig. 4),

It was a double layered serous membrane folds back on itself to form two layered membranous pleural sacs. The outer layer lined the chest wall and called parietal pleura (*Pleura parietalis*), it divided into three subdivisions; the costal pleura (*Pleura costalis*), mediastinal pleura (*Pleura mediastinalis*) and diaphragmatic pleura (*Pleura diaphragmatica*). While the inner layer covered the lung and other neurovascular structures of the mediastinum and bronchi called the visceral pleura (*Pleura pulmonalis*) which connected to the mediastinal pleura caudally by the pulmonary ligament (*Lig. Pulmonale*).

The diaphragm (Fig. 5).

Was a dome-shaped musculotendinous structure separating the chest and abdominal cavities. It formed the caudal boundary of the chest cavity. It consisted of central tendinous part (*Centrum tendineum*) surrounded by peripheral muscular part (costal, sternal and lumber parts).

The costal muscular part (*Diaphragma Pars costalis*) attached to the ribs and costal arch. The sternal part (*Diaphragma Pars sternalis*) attached to the dorsal surface of xiphoid cartilage. The lumbar part (*Diaphragma Pars lumbalis*) consisted of two Crura (right and left) attached to the lumbar vertebrae, the right crus (*Crus dextrum*) was larger than the left crus (*Crus sinistrum*). All muscular parts were continued with the central tendinous part.

There were three openings in the diaphragm for the passage of various structures which entered or leaved the thorax and abdomen. Aortic hiatus (*Hiatus aorticus*) presented in median plane in between the right and left Crura, ventral to last thoracic vertebra and acting a passage for the aorta, the azygos vein and the cisterna chyli, the esophageal hiatus (*Hiatus esophageus*) located in the right crus slightly left to the median plane, at the level of 11^{th} thoracic vertebrae and serves as a passage for esophagus and

dorsal and ventral esophageal vagal trunk. The third opening, the caval foramen (*Foramen venae cavae*) located in the central tendon at the level of 8th thoracic vertebrae, and through which the caudal vena cava leaved the thorax.

Salient Morphological Features of the Lungs of Individual Studied Animals.

Lungs of donkey (Fig. 6, 7, &8 A & B).

The donkey's left lung was divided into two lobes - the cranial lobe and the caudal lobe ***(****Lobus cranialis et caudalis****)***. On the other hand, the right lung had three lobes - the cranial lobe, the caudal lobe, and the accessory lobe *(Lobus cranialis, caudalis et accessorius)*. The external appearance of either the right or left middle lobes were not distinguishable. The fissures that separated the lobes were concise and located at the cardiac notches between the cranial and caudal lobes *(Incisura cardiaca pulmonis dextri et siniteri)*. However, the division of the pulmonary lobes into smaller lobules by connective tissue septa was not pronounced. The cranial lobes of both lungs were undivided externally.

Lungs of the buffalo (Fig. 9).

The left lung is made up of two lobes - the cranial lobe *(Lobus caudalis)* and the caudal lobe *(Lobus caudalis)*. The cranial lobe is further divided into two parts - the cranial part *(Pars cranialis)* and the caudal part *(Pars caudalis)*. In contrast, the right lung has four lobes - the cranial lobe *(Lobus cranialis)*, the middle lobe *(Lobus medius)*, the caudal lobe *(Lobus caudalis)*, and the accessory lobe *(Lobus accessorius)*.

The right cranial lobe is divided into two parts - the cranial part *(Pars cranialis)* and the caudal part *(Pars caudalis)*. The right cranial lobe is ventilated by the right cranial bronchus, which branched off from the trachea (Tracheal bronchus). This bronchus subsequently divides into the cranial and caudal segmental bronchi, which supply air to the corresponding cranial and caudal parts of the cranial lobe.

The interlobar fissures were clearly defined and moderately demarcated.

The interlobular septa were well defined and divided the lung's lobes into distinct lobules.

Lungs of the goat (Fig. 10).

The left lung consisted of two lobes; the cranial lobe *(Lobus caudalis)*, and caudal lobe *(Lobus caudalis)*. The cranial lobe was ventilated via the cranial lobar bronchus that detached from the trachea. It divided into cranial and caudal segmental bronchi ventilating the cranial part *(Pars cranialis)* and caudal part *(Pars caudalis)* of the cranial lobe.

The right lung consisted of four lobes; the cranial lobe *(Lobus cranialis)* which was divided into the cranial part *(Pars cranialis)* and caudal part *(Pars caudalis),* middle lobe *(Lobus medius),* the caudal lobe *(Lobus caudalis),* and accessory lobe *(Lobus accessorius)*. The right cranial lobe ventilated by the right cranial bronchus that erupted from the trachea (Tracheal bronchus) which subsequently divided into cranial and caudal segmental bronchi to the corresponding cranial and caudal parts of the cranial lobe.

The interlobar fissures were clear and well-demarcated between various lobes of both the right and left lungs.

The interlobular septa, which divided the lung's lobes into lobules were not cover the whole lungs and were less demarcated.

Lungs of the camel (Fig. 11).

The camel's right lung comprised the right cranial lobe *(Lobus cranialis)*, right caudal lobe *(Lobus caudalis),* and accessory lobe *(Lobus accessorius),* however, the middle lobe was missing. The left lung consisted of cranial lobe *(Lobus cranialis)* and caudal lobe *(Lobus caudalis)*. The cranial lobes were thin, tiny, and not divided, while the caudal lobes were highly developed and nearly four times larger than the cranial ones.

The right cranial lobe was ventilated by the cranial lobar bronchus that erupted from the trachea (tracheal bronchus) before its bifurcation to the principal bronchi.

The interlobar fissures were not clear, while the interlobular connective tissue septa were well-defined dividing the lung's lobes into several lobules.

Along the basal margins of the lungs, the visceral pleura possessed a fibrous curtain of pleural threads or extensions that extend into the pleural cavity of the costo-phrenic recesses.

Lungs of the dog (Fig. 12).

The right lung consisted of four lobes; cranial lobe *(Lobus cranialis),* middle lobe (Lobus medius), caudal lobe *(Lobus caudalis)*, and accessory lobe *(Lobus accessorius)*.

The left lung had two lobes; cranial *(Lobus cranialis),* and caudal lobe *(Lobus caudalis)*. The left cranial lobe is divided into a cranial part *(Pars cranialis),* and a caudal part *(Pars caudalis).* Both portions shared a common lobar bronchus.

On either side of the lungs, the pulmonary lobes were deeply separated by marked interlobar fissures.

The division of the lobes by connective tissue septa into pulmonary lobules was invisible.

E-Learning Module

Module (1)

Title

Gross Anatomy of the lungs and Comparative lungs in Domestic Animals

Welcome

Welcome to our regular online e-learning platform. Throughout this meeting we will present anatomical analysis of the lungs and lungs comparative of the domestic animals (donkey, buffalo, goat, camel and dog).

This module will be informative and allowing to understand more about these points in detail with quizzes (Formative assessments) for monitoring progress, student's satisfaction and providing feedback through the module. At the end, a test (Summative assessment) will measure overall performance and understanding.

The module aims to contribute to the existing knowledge of animal's anatomy, and particularly in relation to respiratory systems.

Instructions

To fully benefit from the course, it is vital that you.

- Take part in the hands-on labs conducting in the dissecting hall to develop your practical skills.
- Peruse the carefully curated specimens on display in the Department's museum.
- Access the Department's notes, online resources, and library materials for enhancing your academic performance.
- Contact the course consultant, in case you require additional support, via the different channels, including face-to-face meetings and other modes of communication (Facebook, WhatsApp, Telegram, Skype, …)

Learning objectives

Upon completion of this module, the student will be able to.

- Recognize the anatomical morphology of the lungs.
- Differentiate the lobes of lung in domestic animals.
- Analyze the points of differentiation of lung between the domestic animals.
- Appreciate the significance of knowledge the lungs of domestic animals.

Contents

The module's content will be presented in the following format:

A. Text

Anatomy of lungs and comparative lungs

B. Active learning

Anatomy of lungs and lungs comparative.pptx

C. Windows media video

Anatomy of lungs & comparative lungs

D. Practice activities

TO the dissecting hall

Under the supervision of your consultant, and with the aid of your practical notes, dissect the lungs and discuss the points of differentiation of lungs of donkey, buffalo, goat, camel and dog with your peers.

E. Web-Based Learning Tutorial

1- https://vetmed-academy.com/moodle/
2- Respiratory System The University of Nottingham - ppt video online download
3- https://guides.library.upenn.edu/VetStudy-Anatomy
4- https://www.youtube.com/watch?v=-S25qRjCwWA
5- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8653125/
6- Veterinary Anatomy Site Map
7- (PDF) Respiratory system of domestic animals, Lecture 1

F. Knowledge checks & assessments

Formative assessment of lungs and comparative lungs

Summative assessment of lungs and comparative lungs

Summary

The lungs are organ of respiration, they are air filled, semi cone in shape, locate in the chest cavity. The lung has apex and base, it has three surfaces; costal, diaphragmatic and medial and three borders; dorsal, basal and ventral. On the mediastinal surface there is pulmonary hilus through which the pulmonary root pass.

The degree of lobation and lobulation of the lungs varies regarding individual species. The interlobar fissures are unclear in donkey and camel, while they are clear in buffalo and goat and very deep in dog. The lobulation of lung is clear in buffalo and camel, moderate in goat, and missing in dog and donkey.

G. Contact Information

Contact us with questions, comments or feedback
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H. Resources:

MODULE (1)

How we get and use resources

- Author' Self-Research
- Studies (1ry. Data).
- Modified data from
- previous studies (2ry. Data).
- Web sites' links.

I hope you enjoyed with our learning modules. We are waiting for your evaluation via the answering of the provided survey.

Thanks a lot.

E-learning survey

A specially designed revised survey questionnaire was given to all 45 first-grade students during the 2023-2024 academic year as part of the Special VDP and PA programs. The students initially learned about the anatomy of the respiratory system through traditional teaching methods and then were exposed to e-learning via the website http//:vetmed-academy.com. Subsequently, there was a discussion between the course consultant and the students to evaluate the impact of the e-learning module.

Here are the key comments from the student survey dialogue:

- *Expectations for Covered Topics:*

Students were expecting all courses of anatomy to be covered.

- *Useful Elements of the E-Learning Course:*

The most useful and interesting parts of the e-learning course included interactive power point presentations, video clips, and all media content.

- *Frustrating Technical Problems:*

The most frustrating technical problems encountered during the course were related to internet connection issues and difficulties accessing the site due to internet problems.

- *Enhancing Comprehension of Course Materials:*

Suggestions for enhancing comprehension included opening a chat channel for questions and answers through a provided link.

- *Improving the E-Learning Course:*

To improve the e-learning course, students recommended keeping the course open and accessible at all times.

- *Suggestions for Other E-Learning Modules:*

Students expressed a need for online courses covering all aspects of anatomy.

Discussion

From the descriptive aspect, the present work declared similar findings to that recorded by [15-17] that the lungs of all investigated animals have an apex and a base, three surfaces (costal, medial, and diaphragmatic), and three borders (dorsal, ventral, and basal). The lungs also have a pulmonary hilus on the mediastinal surface, and there is an area of adhesion between the two lungs caudal to the hilus.

In the right lungs of both donkeys and camels, there are three lobes, namely the cranial, accessory, and caudal lobes. Meanwhile, the left lung consists of only the cranial and caudal lobes. This finding is consistent with previous studies conducted by [15-16, 18-19] in dongs; [20-21] in equines, as well as [22-[23] in camels. However, [24-25] reported the presence of four lobes in the right lung of equines named cranial, middle, accessory, and diaphragmatic lobes.

Different animal species exhibit varying degrees of lobation in their lungs, which depends on the depth of interlobar fissures. In the buffalo and goat, the right lung has four lobes, including a divided cranial lobe, middle, accessory, and diaphragmatic lobes. The left lung has two lobes, including a divided cranial lobe and a diaphragmatic lobe. Several studies, including [16, 21, 26-30], have reported similar results. In one case of goats, the current study confirmed the non-division of the right cranial lobe, which was previously noted by [31]. In dogs, the right lung has cranial, middle, accessory, and caudal lobes, while the left lung has a divided cranial lobe and caudal lobe. Some studies, such as [15-16, 32], have accepted these findings. However, [33] reported three lobes in the left lung, including cranial, middle, and caudal.

The degree of lobulation in animal's lungs, depends on the clarity of interlobular septa. Like equines [16-18, 20-21], the donkeys, for instance, lack lobulation altogether due to unclear interlobular septa. It is a well-established that the lobulation of the lungs is clear in buffalo [27, 34], and camel [22-23], moderate in goats [16, 26], but entirely missing in dogs and donkeys. The thickness of the interlobular septa and separation of the lung into lobules play a crucial role in determining the movement of air between lobules, which is known as collateral ventilation. According to extensive studies by [35-37], collateral ventilation in buffalo and camel lungs may be almost non-existent compared to that in dogs, donkeys, and to some extent, goats. Moreover, a high degree of lobulation makes pulmonary segments more independent, limiting the spread of airborne diseases, as conclusively reported by [38].

In accordance with the present study, various researchers such as [16, 20-21] have observed that the formation and orientation of pleural sacs in different domestic animals are similar. In all animals, a double-layered serous membrane forms the pleural sacs, which are further divided into parietal pleura and visceral pleura. The parietal pleura consists of costal pleura, mediastinal pleura, and diaphragmatic pleura, while the visceral pleura covers the lungs and associated neurovascular structures. However, [39-40] have suggested that camels have a unique feature in their lungs - a pleural curtain beyond the basal border of the caudal lobe that forms a lace-like fringe. This extension creates more space for the lungs to expand during deep breathing. Additionally, [40] have proposed that the pleural curtain's position in the costophrenic recess and the possible presence of phagocytic cells may allow it to stir, sample, and clean the pleural fluid.

In according with [39, 17, 21] the diaphragm was a respiratory muscle which separated the chest and abdominal cavities, consisted of central tendinous part surrounded by peripheral muscular part (costal, sternal and lumber parts). It had three openings for the passage of various structures entered or leaved the thorax and abdomen; aortic hiatus, esophageal hiatus and caval foramen**.**

The challenges facing higher education in Egypt [1] and many other countries, especially those with limited resources or facing national or regional crises [14], resulting in a cycle of unsustainability across various social and economic aspects. Many studies have been carried out to find scientific solutions to the most of such education challenges. As a result, many countries have begun exploring non-traditional solutions to address these shortcomings and improve the educational process to achieve desired educational outcomes and overcome the challenges.

The current study agrees with [41] that E-learning refers to the learning process that involves interaction with digitally delivered content, network-based services, and tutoring support. It can take place using computers, either from a distance or in a face-to-face classroom setting (computer-assisted learning). The authors added that E-learning is a departure from traditional methods of education or training, as it is based on personalized, flexible, individual, self-organized, and collaborative learning, using a community of learners, teachers, facilitators, and experts, all mediated by ICT.

The current study is in a line with [14, 42], in that e-learning, as a viable solution, has major advantages such as making education more available to learners anytime, anywhere; reducing education costs; avoiding scheduling and booking instructors; putting the responsibility for learning in the hands of learners; using fast, effective learning as a competitive edge; letting students learn at the best time and place; and increasing the scope of offerings. [43] added that universities are increasingly adopting e-learning due to cost-saving benefits over traditional learning methods.

According to [44], e-learning courses provide a flexible and versatile learning system that enables individual learners and organizations to tailor their training to fit their specific circumstances. Moreover, **[45]** declared that E-learning has become quite popular and appreciated among students all over the world. However, [14] demonstrated that although long-distance learning and e-learning offer numerous benefits, including increased accessibility and flexibility, there are still some challenges, such as the lack of face-to-face interactions and the need for a reliable internet connection and higher IT technology. According to [46], the evolution of online education has been closely linked to the advancements in internet technologies. Moreover, [47-49] added that the interactive learning environments such as e-learning require active participation of students, which is uncommon in developing countries. In this connection, and in a statistical study, [50] reported that even though

Egypt is a developing country with a high rate of illiteracy, the majority of higher education students access the internet from their homes daily and are frequent technology users. According to [49] comment, technology has greatly improved higher education by catering to the unique learning needs and styles of students. Various innovations such as learning management systems (LMS), adaptive learning software, and video conferencing have transformed how and where students study.

The present study agreed with [49-50] in that it is crucial to understand hybrid and blended learning and adapt these frameworks to achieve learning outcomes as reopening guidelines for higher education institutions continue to develop. [50] defines blended learning as the seamless integration of traditional class instruction with digital, online learning. [49-50] showed that, Hybrid learning refers to an educational approach that combines traditional classroom teaching with online or distance learning techniques, such as experiential learning and remote course delivery.

[51] added that, the goal of hybrid learning is to use an optimal blend of teaching strategies that efficiently deliver content while still catering to the individual learning needs of students. The supplementary learning strategies are designed to complement, rather than replace, traditional face-to-face instruction. For instance, if a class meets twice a week, a hybrid learning lecturer can schedule one day for an in-person lecture and the other for a hands-on lab or online assignment.

The current study supports [16] observation that E-learning modules typically adhere to a well-structured format. This format typically includes an engaging introduction, a task or final project, a set of questions or steps, online resources for studying, an assessment of performance, and a conclusion that encourages self-reflection on the lessons learned. This framework is based on the findings of [52-54], who have comprehensively described the essential components necessary for designing a successful e-learning program. In the present work, similar elements were used in the preparation of the E-learning modules.

Conclusion

The present work concluded that, from an anatomical perspective, the respiratory system is a complex network of tissues and organs that support breathing in animals. Different animal species exhibit varying degrees of lobation in their lungs, which depends on the depth of interlobar fissures. In the buffalo and goat, the right lung has four lobes, including a divided cranial lobe, middle, accessory, and diaphragmatic lobes. The left lung has two lobes, including a divided cranial lobe and a diaphragmatic lobe. The degree of lobulation in animal's lungs, depends on the clarity of interlobular septa. It is a well-established that the lobulation of the lungs is clear in camels, and buffalo, moderate in goats, but entirely missing in dogs and donkeys. The thickness of the interlobular septa and separation of the lung into lobules play a crucial role in determining the movement of air between lobules, which is known as collateral ventilation. E-learning has been widely adopted by educational institutions globally as a reliable solution to overcome educational challenges, especially in emergency situations. Its effectiveness in facilitating and sustaining the learning journey, even when students are unable to attend educational facilities fully or partially, has been pivotal. This has been particularly crucial during times of national crises. Digital technologies, such as infrastructure, digital devices, resources, content, and relevant services, are undoubtedly the fundamental building blocks of effectiveness. Furthermore, Information and Communication Technology (ICT) has unequivocally emerged as a critical instrument for delivering curricula to learners on a global scale. Upon analyzing the data gathered from post-studies of e-learning modules, the survey results were overwhelmingly positive in regards to course expectations, structure, content, quizzing, timing, e-learning pace, navigation, multimedia, and interactivity. Nevertheless, the responses regarding Information and Communication Technology (ICT) and internet services issues were less favorable. It is also notable that the majority of students expressed a preference for blended learning, which involves a combination of face-to-face and electronic learning.

Acknowledgments.

Lot of thanks for Dr. Nehal L. Khalil, Assistant professor of Educational Psychology, Faculty of Education, Suez Canal University for revising the questioner survey

Funding statement.

This study didn't receive any funding support

Declaration of Conflict of Interest.

The authors declare that there is no conflict of interest

Ethical of approval.

This study follows the ethics guidelines of the Faculty of Veterinary Medicine, Suez Canal University, Ismailia, Egypt. (ethics approval number (19/ 2020)

TABLE 1. A summary of the main comparative points of the lungs of the animals investigated: donkey, buffalo, camel, goat, and dog.

Lobes	Donkey	Buffalo	Camel	Goat	Dog
R. Cranial lobe	Not divided	Cr. + Ca. +	Not divided	Cr. + Ca. +	Not divided
R. Middle lobe	--	+	--	+	+
R. Caudal lobe	+	+	+	+	+
R. Accessory lobe	+	+	+	+	+
L. Cranial lobe	Not divided	Cr. + Ca. +	Not divided	Cr. + Ca. +	Cr. + Ca. +
L. Caudal lobe	+	+	+	+	+
Pleural curtain on the basal border	--	--	+	--	--
The right cranial tracheal bronchus	--	+	+	+	--
The interlobar fissures	Absent	Moderate	Absent	Moderate	Deep
Interlobular septa	Missing	Marked	Marked	Faint & restricted	Missing

TABLE 2. E-learning survey

No.	Item	Not at all	Poor	Satisfactory	Good	Very good
1.	**Course Expectations**					
A	Please, indicate your level of comprehension regarding the expectations of the course.					
B	----------					
2.	**Course Structure and Content**					
A	Please indicate your satisfaction level with the structure of the course.					
B	How well did the course content align with its intended objectives?					
C	Was the content organized logically and presented in a clear manner?					
D	Did the content effectively convey and clarify the knowledge, skills, and concepts it intended to present?					
E	How would you rate the quality and quantity of the material covered?					
F	Please provide a rating for how much you enjoyed the course.					
G	Comment ----------					
3.	**Quizzing**					
A	Please rate the relevance of quizzes and questions.					
B	Evaluate the quality of quizzes and questions.					
C	Was there variety in the types of quizzes?					
D	Did the quizzes effectively evaluate the course material presented?					
4.	**Timing**					
A	Please rate the relevance of quizzes and questions.					
B	Was the amount of time taken to complete this module suitable for the content it covered?					

5.	**E learning pace and navigation**					
A	How would you rate the speed at which the e-learning course progressed?					
B	How would you rate the ease of navigation?					
C	Please provide your rating for the e-learning access or Learning Management System (LMS) setup.					
6.	**Multimedia**					
A	Rate the quality of the photography used in the course.					
B	Please rate the amount of multimedia, including audio, video, and animation, that was used in the course.					
C	Please rate the quality of the multimedia content (such as audio, video, and animation) used in the course.					
D	Did you find frustrating technical problem encountered during the course?					
E	Comment ----------					
7.	**Interactivity**					
A	Is this e-learning course contained opportunities for interactive learning.?					
B	Was the interactivity appropriate for the content?					
C	Please rate your level of knowledge on the subject.					
D	Would you like to attend this course through online classes, in-person classroom sessions, or blended learning?	Online	Personal classrom		Blended learning	
E	Did you find the content of the module helpful?					
F	Can you explain how the modules presented the material?					
G	Did you find the materials in the module interesting?					
H	Did you find the online teaching sessions interesting?					
I	Please provide a rating for the technical quality of the course materials.					
J	Have you faced any technical issues while accessing or using the modules?	little	some	minor	moderae	major
K	Could you please rate the course's modules overall?					
	Comments ----------					
	Comments ----------					
L	How likely are you to recommend this eLearning Module to others?					
	Comments ----------					

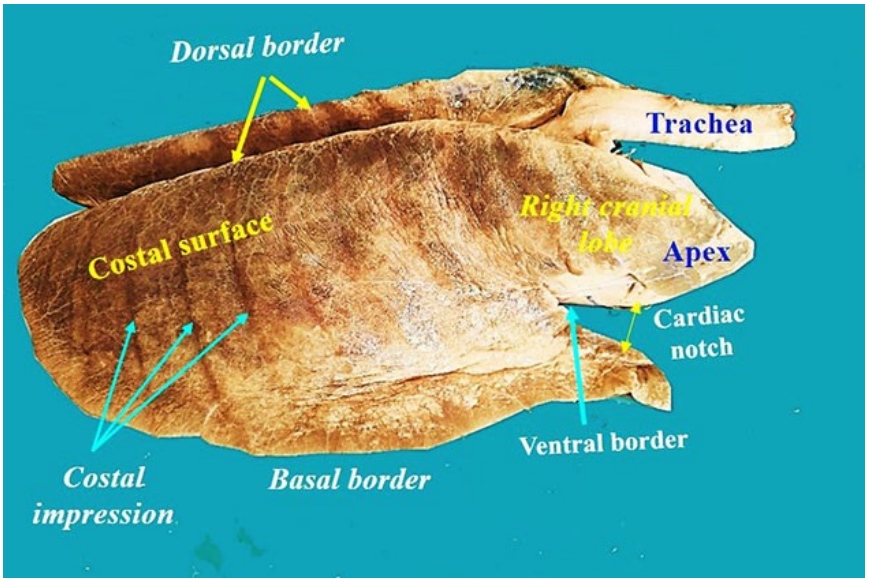


Fig. 1. Photograph of the resected lungs of the donkey showing their morphological features.

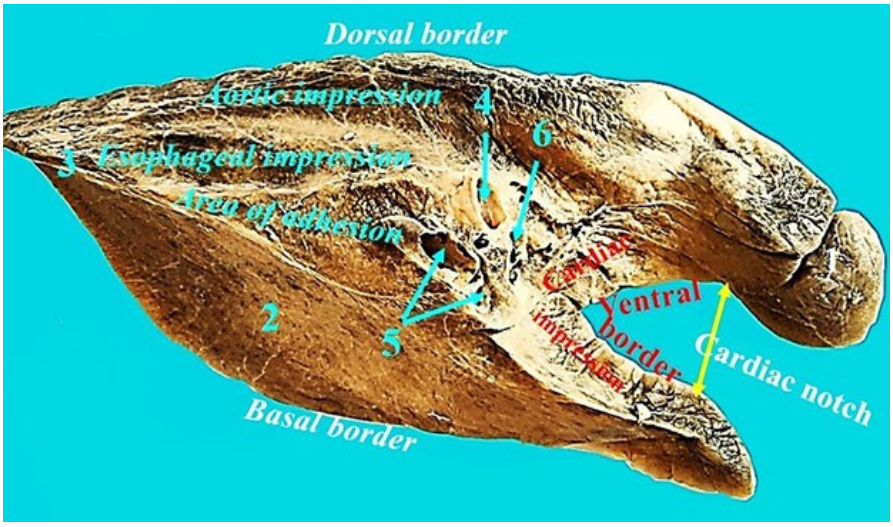


Fig. 2. Photograph of the resected left lung of the donkey (medial view) showing: 1. Apex, 2. Base (diaphragmaticsurface), 3. Pulmonary ligament, 4. Left principal bronchus, 5. Pulmonary veins, 6. Pulmonary artery.

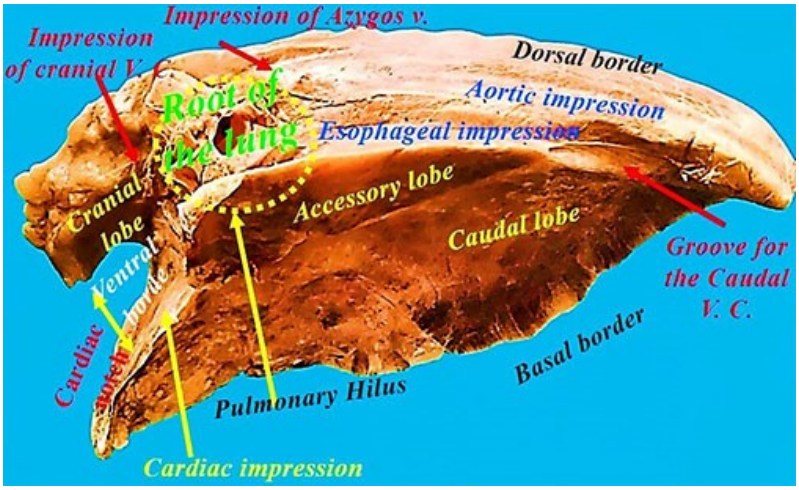


Fig. 3. Photograph of the resected right lung of the donkey (medial view)

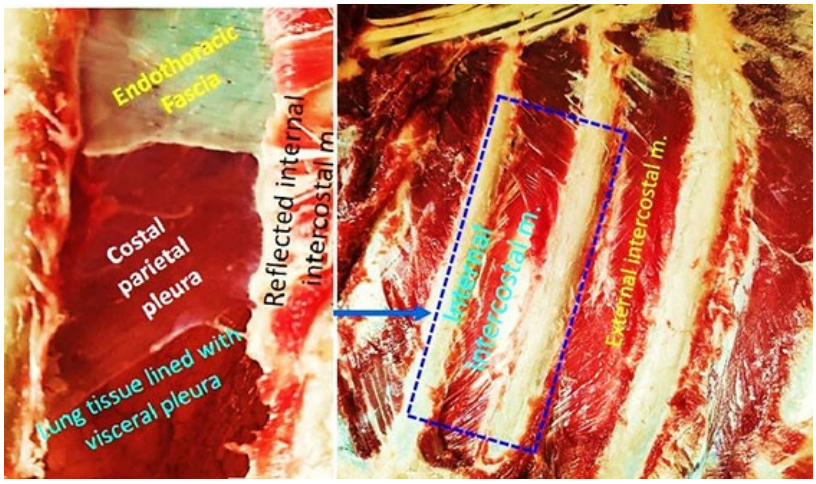


Fig. 4. Donkey's thoracic wall after carful dissection to demonstrate Endothoracic fascia, costal parietal pleura, and lung tissue.

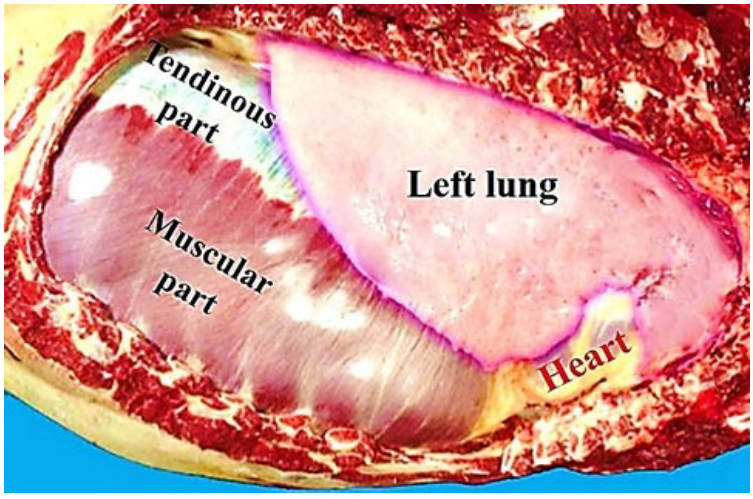


Fig. 5. Open eft side of the chest of a donkey showing the diaphragm as a dome-shaped musculotendinous structure separated the chest and abdominal cavities. It has a respiratory role.

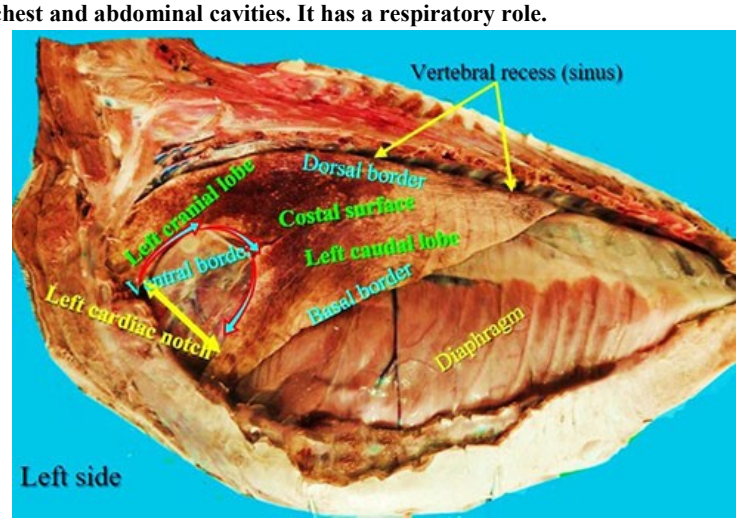


Fig. 6. Photograph of the left side of the open chest of the donkey showing the topography and morphology of the left lung.

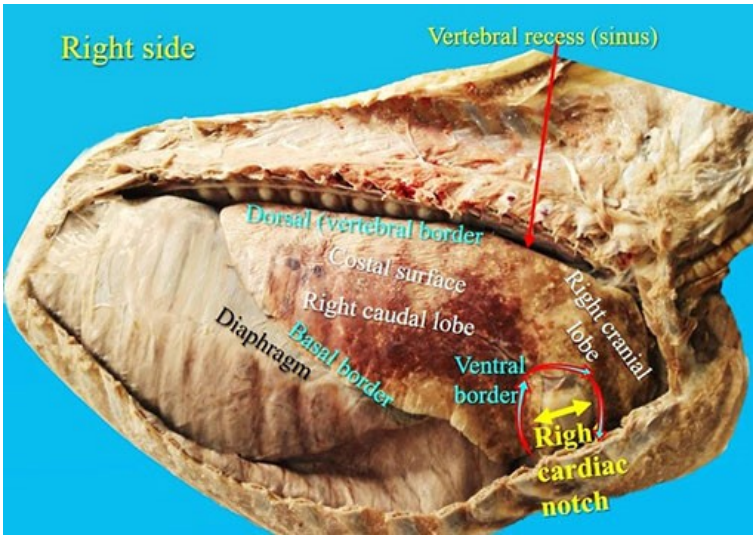


Fig. 7. Photograph of the open right side of the chest of the donkey showing the topography and morphology of the right lung.

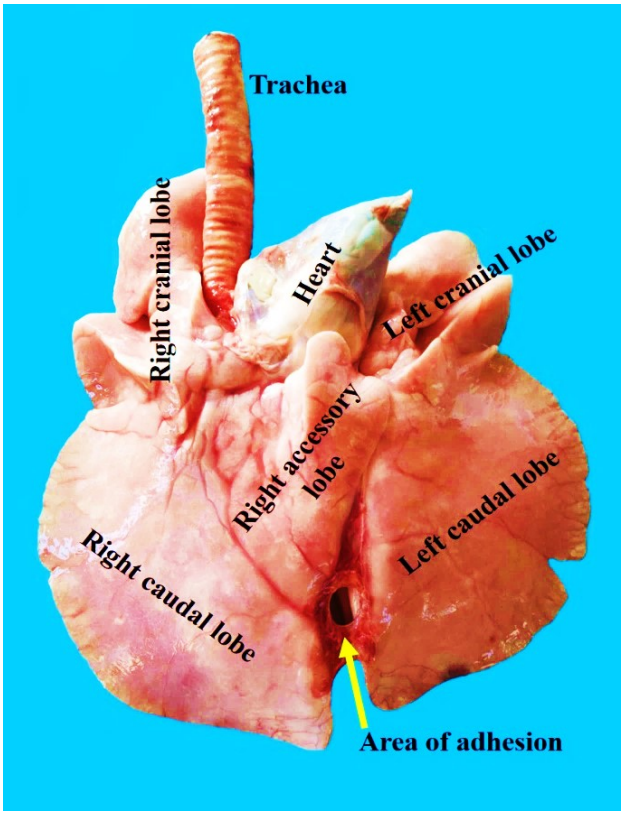


Fig. 8A. Photograph of the lungs of the donkey (Ventral view) showing its lobation.

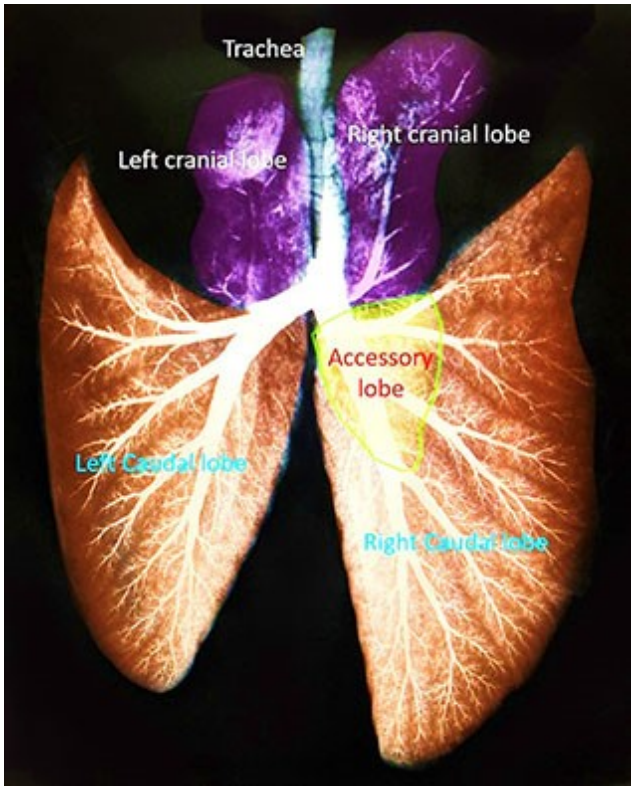


Fig. 8B. Treated Radiograph of the lungs of a donkey (Dorsal view) showing its lobation and bronchial tree.

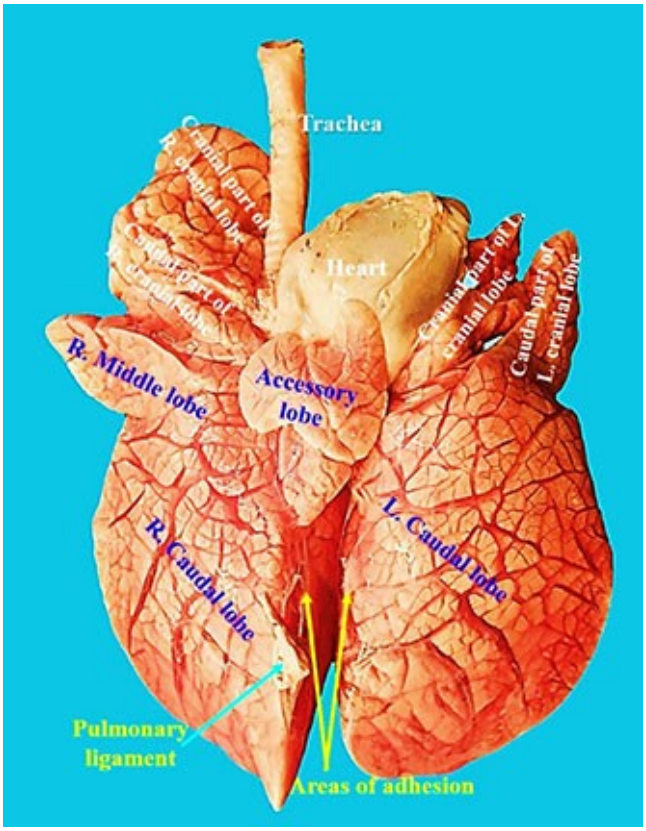


Fig. 9A. ventral view photo of buffalo lungs, displaying clear lobulation of the lung's lobes and distinct interlobar fissures.

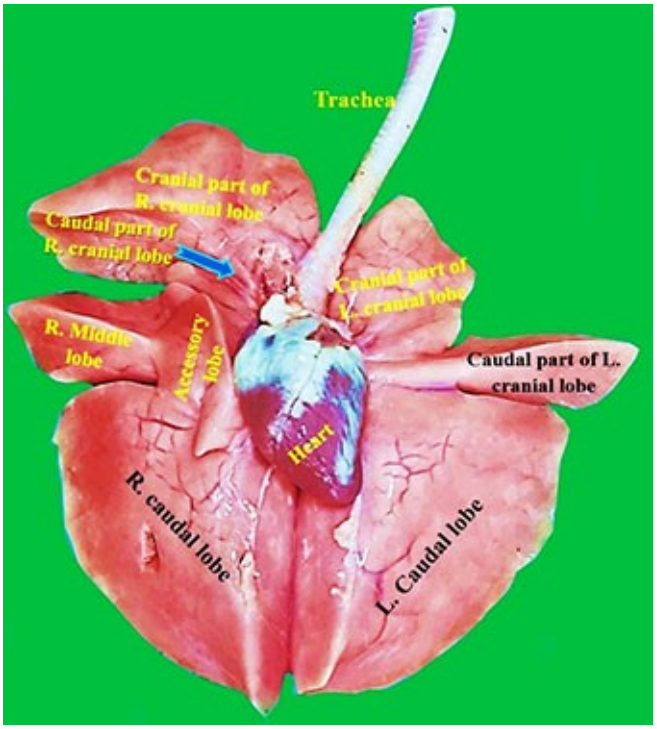


Fig. 10. An images of goat lungs viewed from the ventral side. Notice clear lobation and interlobar fissures, with faint lobulation in certain areas of the lobes.

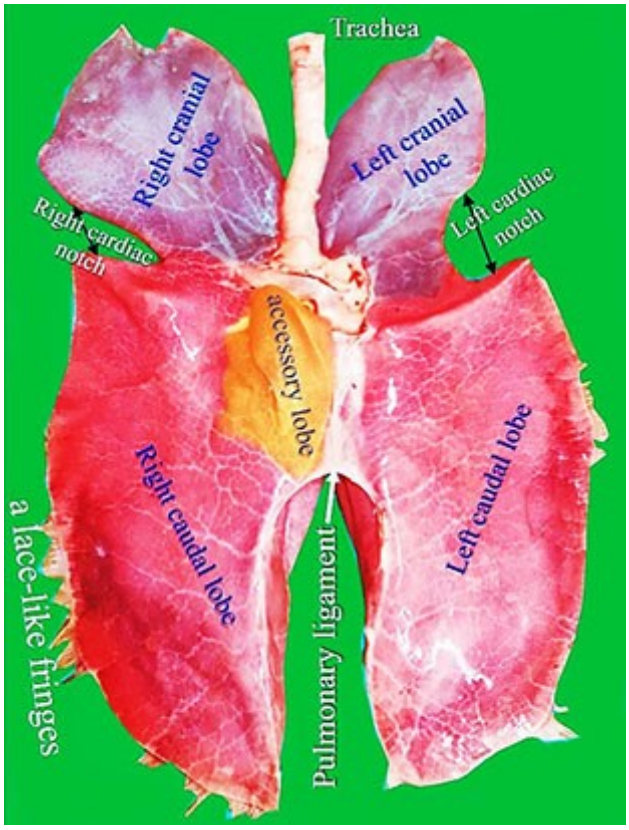


Fig. 11. Ventral view of the camel's lungs, you can see the clear lobulation of the lung tissue

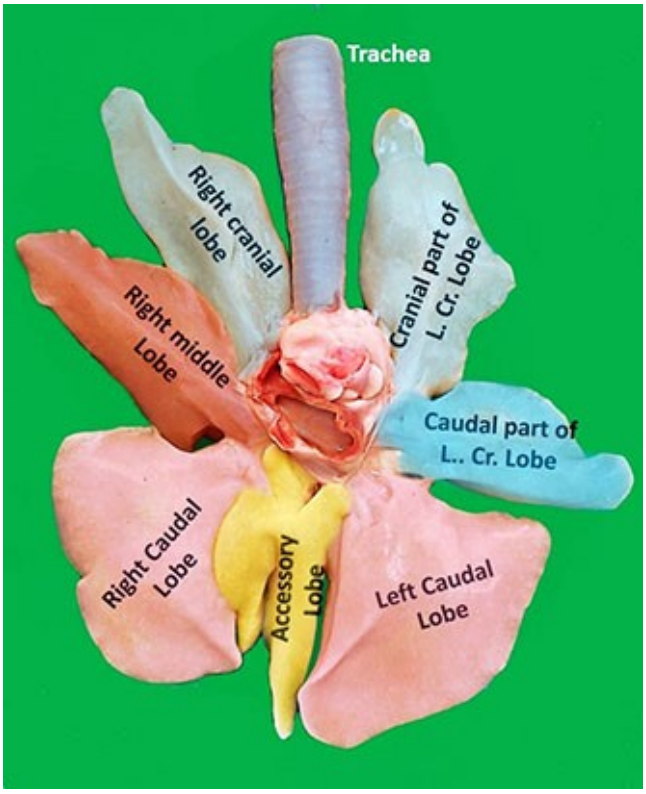


Fig. 12. The dog's lungs (Ventral view), show Various pulmonary lobes. ***Note the deep interlobar fissures and invisible interlobular septa.***

Biographical analysis of the data collected from the student survey.

1. Question related to course expectations

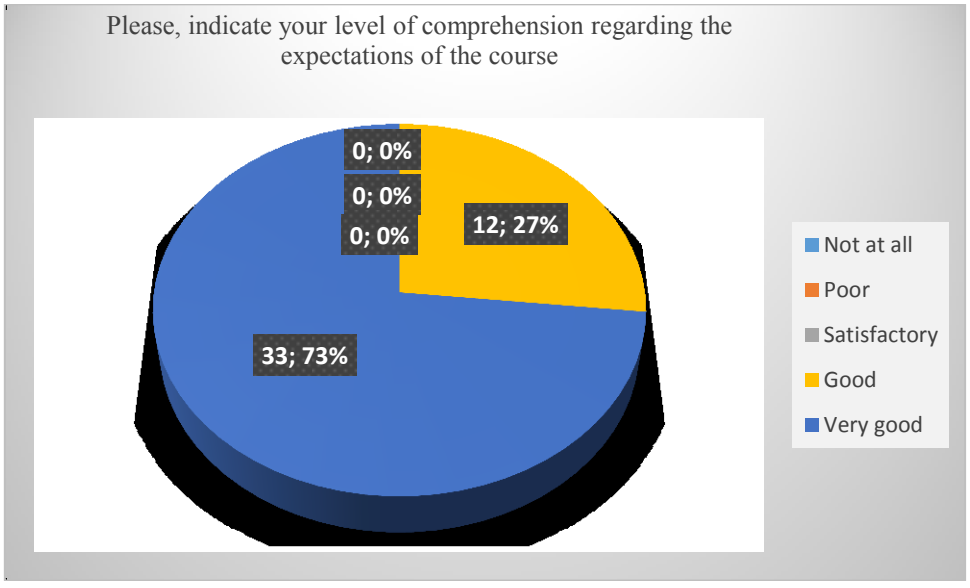


Fig. 13. A biograph showing the analysis of the data regarding the course expectations. (The positive data is 100%)

2. Questions related to course structure and contents

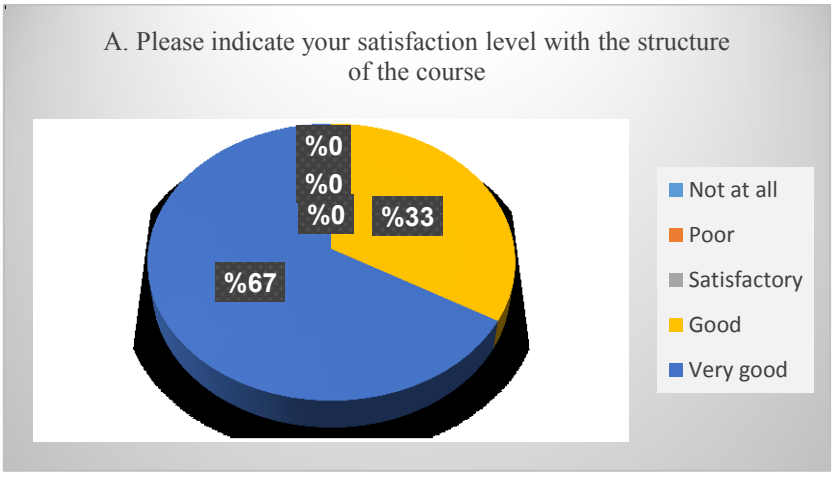


Fig. 14A. A biograph showing the analysis of the data regarding the satisfaction level with the Structure of the course. (The positive data is 100%)

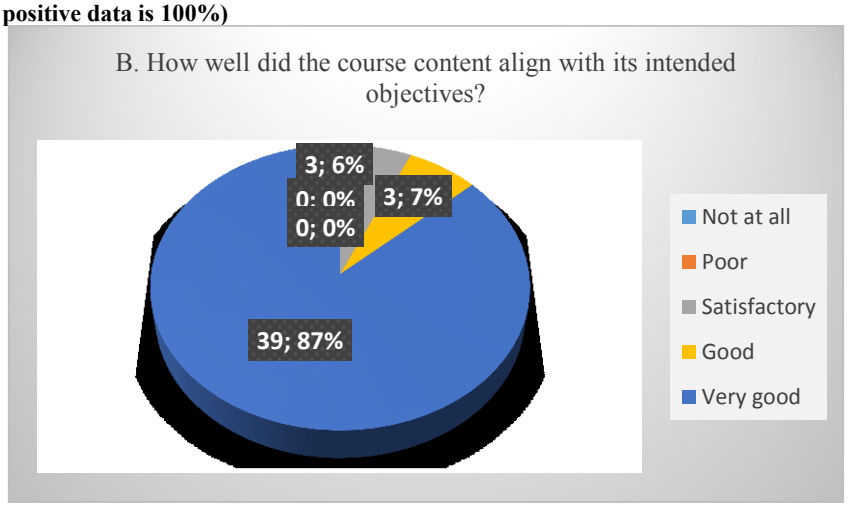


Fig. 14B. A biograph showing the analysis of the data regarding the alignment of the course contents with its objectives. (The positive data is 94%)

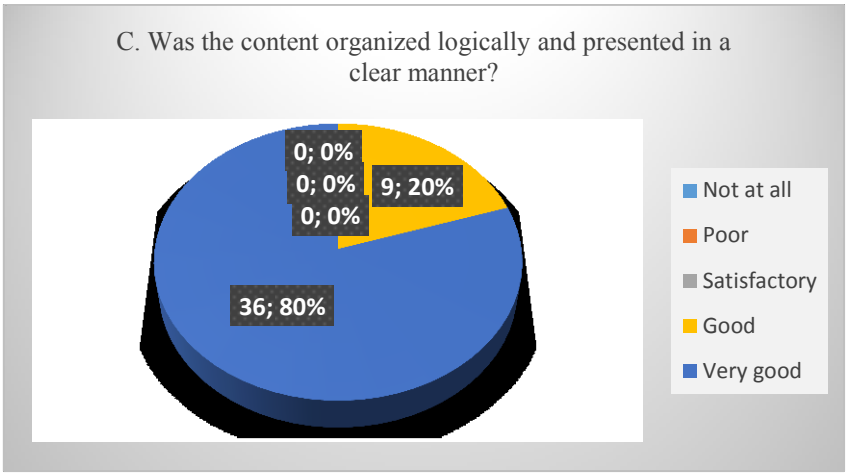


Fig. 14C. A biograph showing the analysis of the data regarding the clarity, and logical organization of the content (The positive data is 100%)

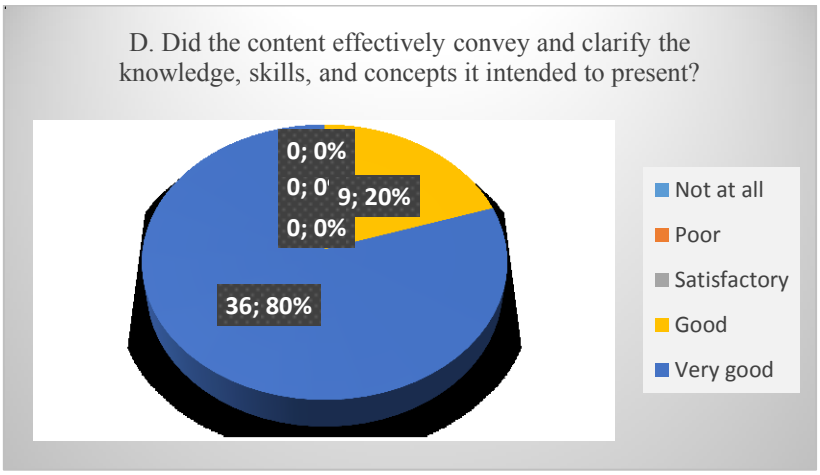


Fig. 14D. A biograph showing the analysis of the data regarding the effectiveness of the content and clarifying the knowledge and skills (The positive data is 100%)

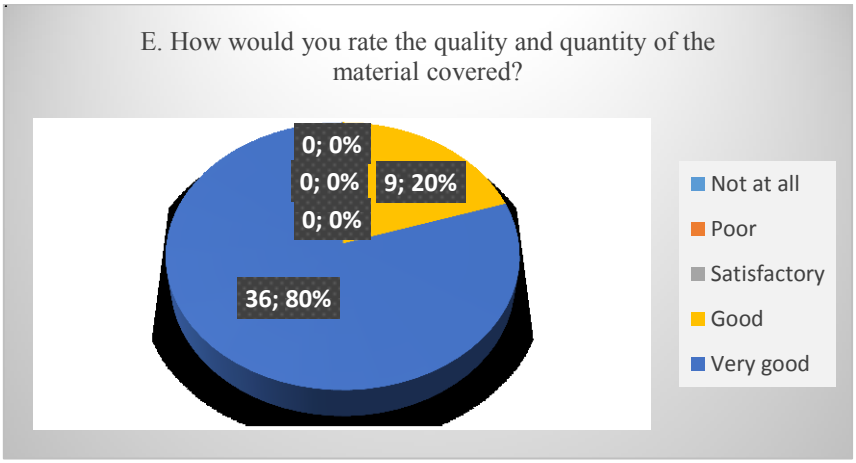


Fig. 14E. A biograph showing the analysis of the data regarding the quality and quantity of the covered material. (The positive data is 100%)

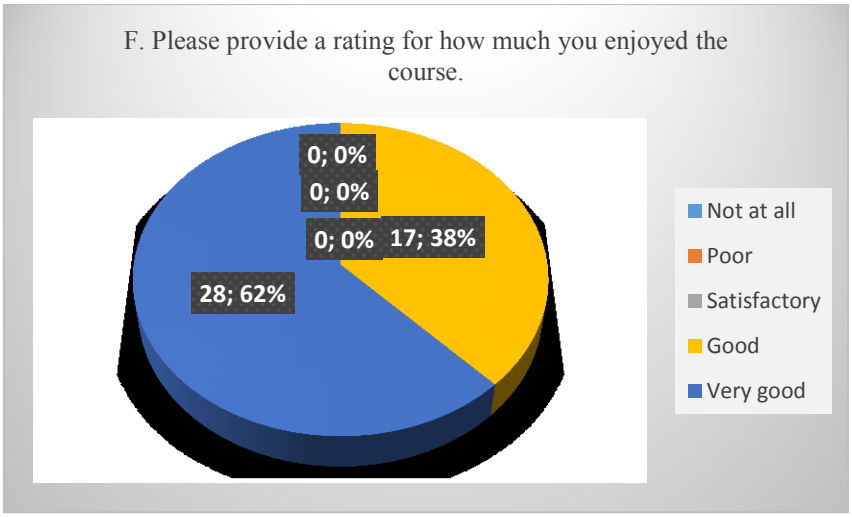
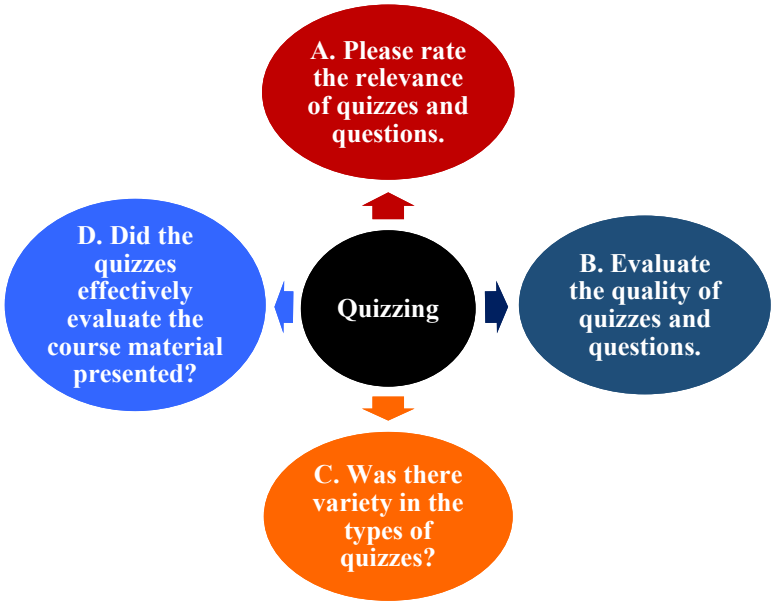


Fig. 14F. A biograph showing the analysis of the data regarding the enjoyment of the course. (The positive data is 100%)

3. Questions related to quizzing



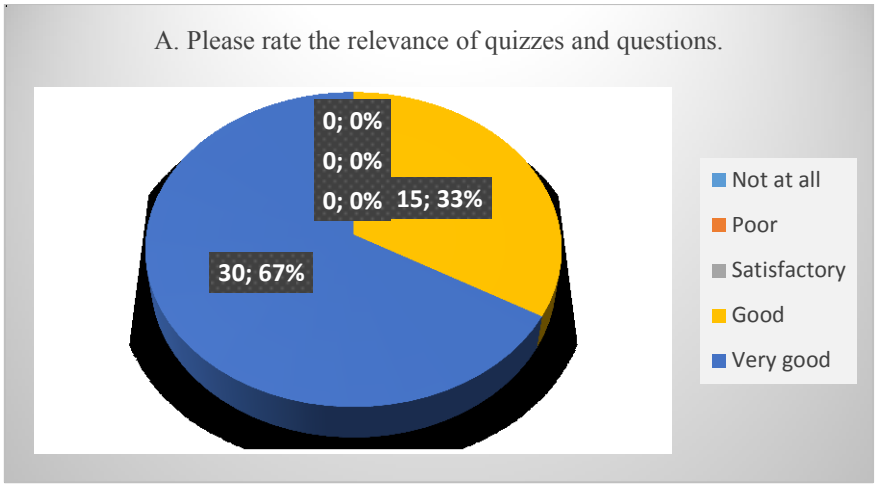


Fig. 15A. Biograph showing the analysis of the data regarding the relevance of quizzes and questions. (The positive data is 100%)

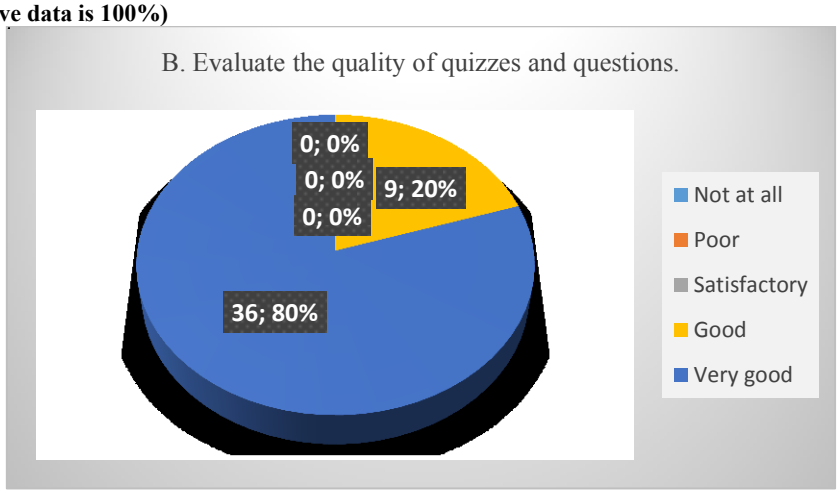


Fig. 15B. A biograph showing the analysis of the data regarding the quality of quizzes and questions. (The positive data is 100%)

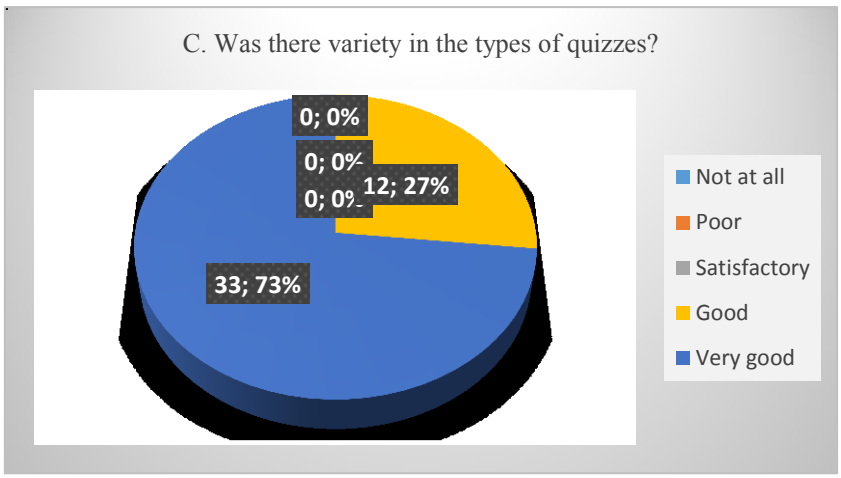


Fig. 15C. A biograph showing the analysis of the data regarding the verities of the quizzes and questions. (The positive data is 100%)

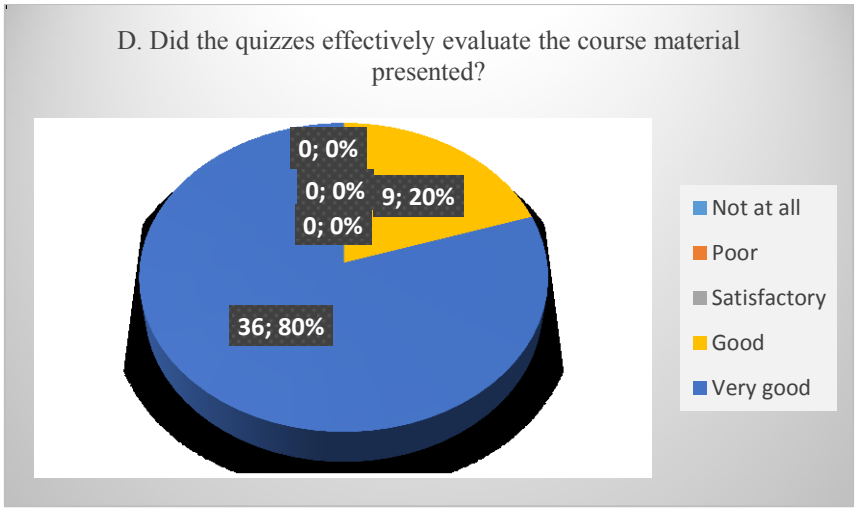
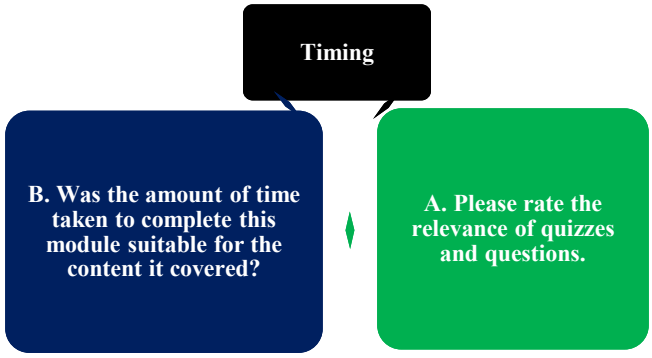


Fig. 15D. A biograph showing the analysis of the data regarding the effective evaluation of the quizzes to the course material. (The positive data is 100%)

4. Questions related to timing



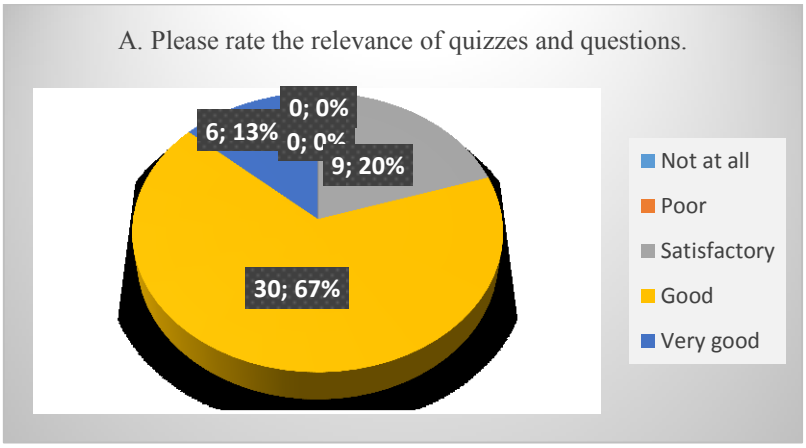


Fig. 16A. A biograph showing the analysis of the data regarding the relevance of quizzes and questions. (The positive data is 87%)

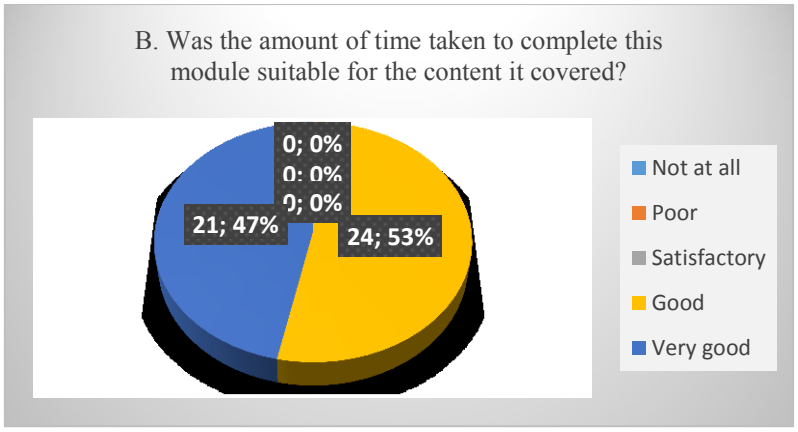
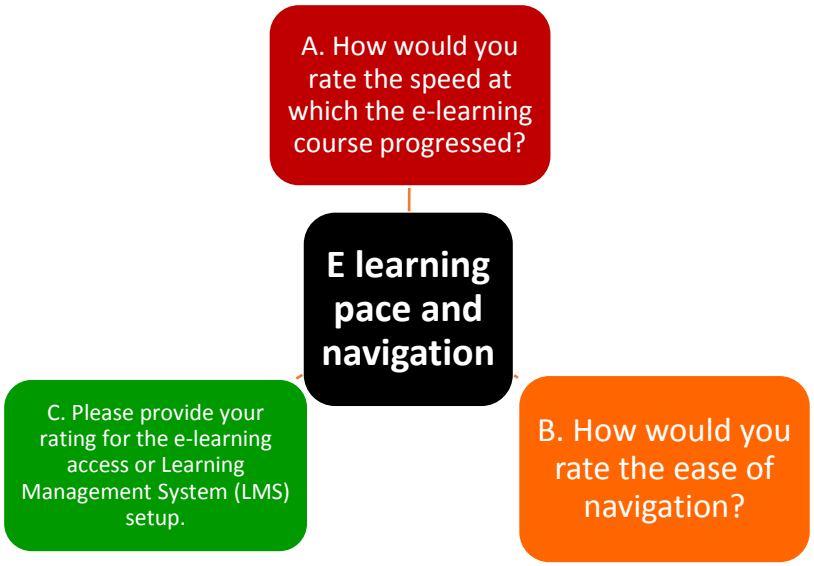


Fig. 16B. A biograph showing the analysis of the data regarding the suitability of the time taken to cover completion of the module. (The positive data is 100%)

5. Questions related to e learning pace and navigation



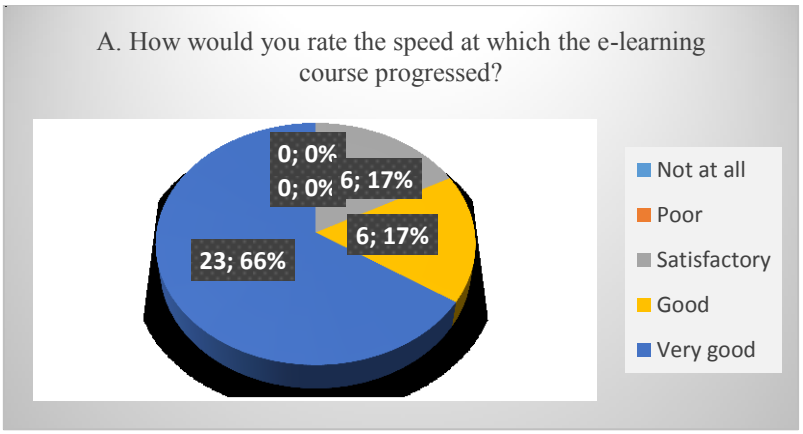


Fig. 17A. A biograph showing the analysis of the data regarding the speed at which the e learning course progressed (The positive data is 83%)

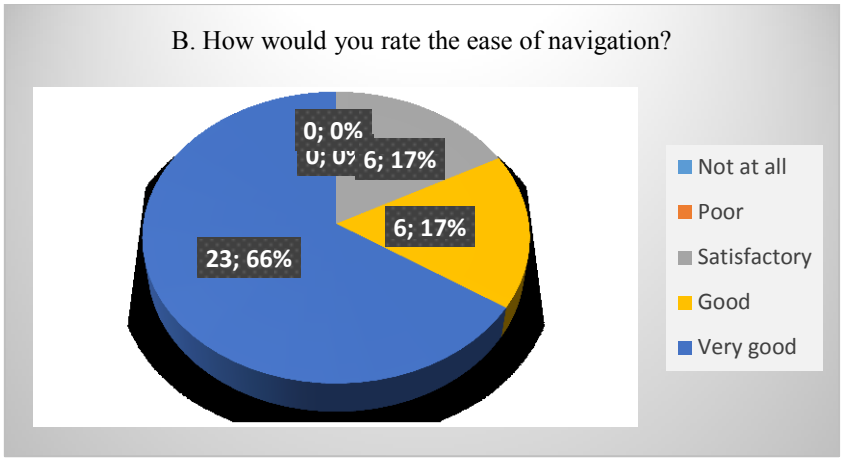


Fig. 17B. A biograph showing the analysis of the data regarding the ease of navigation (The positive data is 83%)

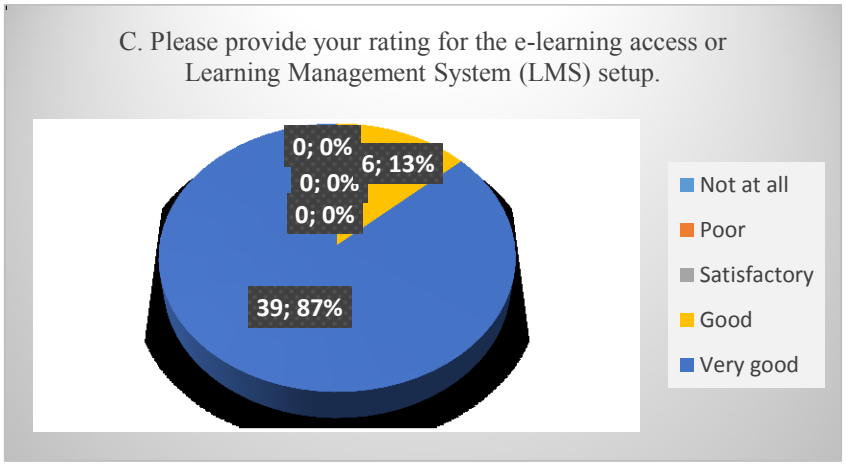
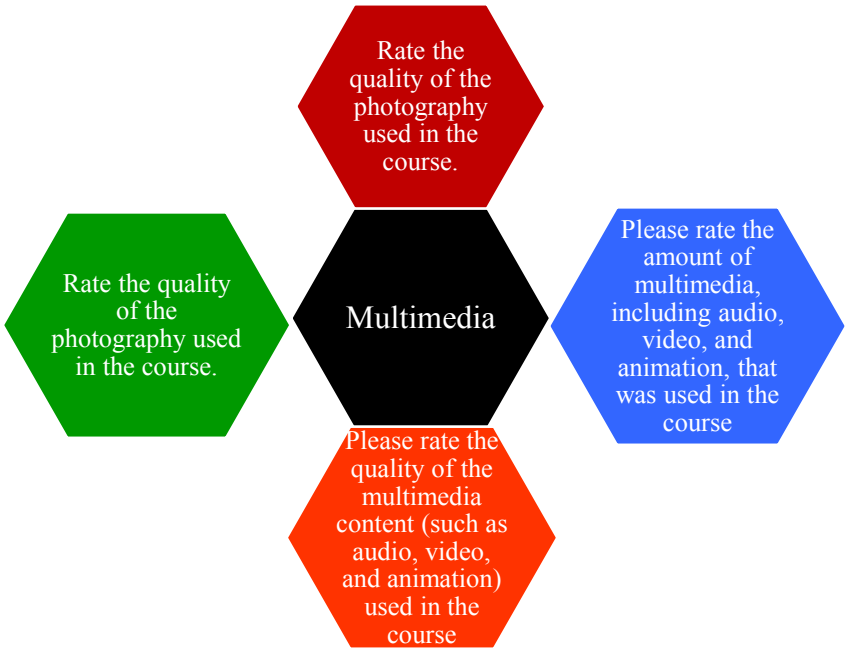


Fig. 17C. Biograph showing the analysis of the data regarding the Learning Management System (The positive data is 100%)

6. Questions related to the multimedia



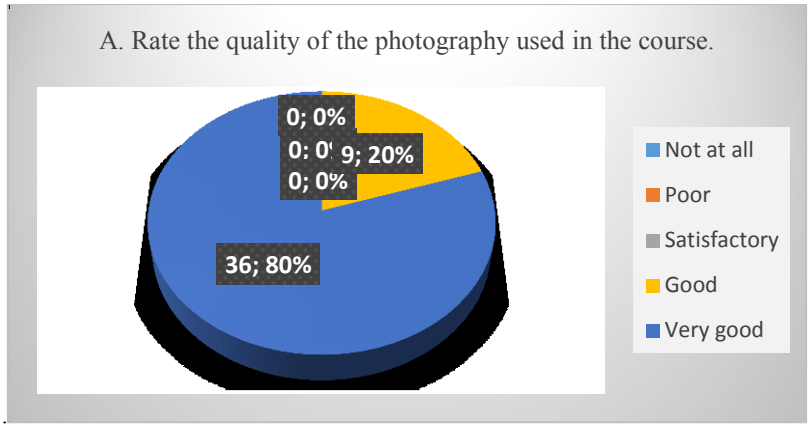


Fig. 18A. A biograph showing the analysis of the data regarding the quality of the photography used in the course. (The positive data is 100%)

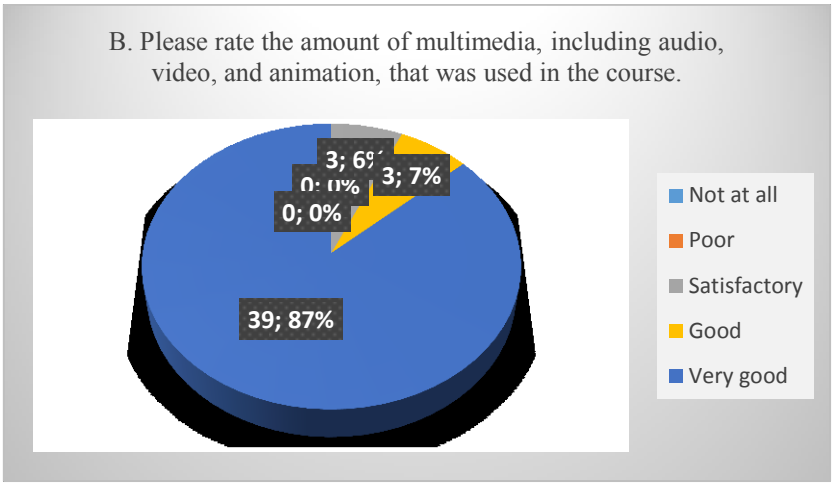


Fig. 18B. A biograph showing evaluation analysis of the amount of multimedia. Used in the course (The positive data is 94%)

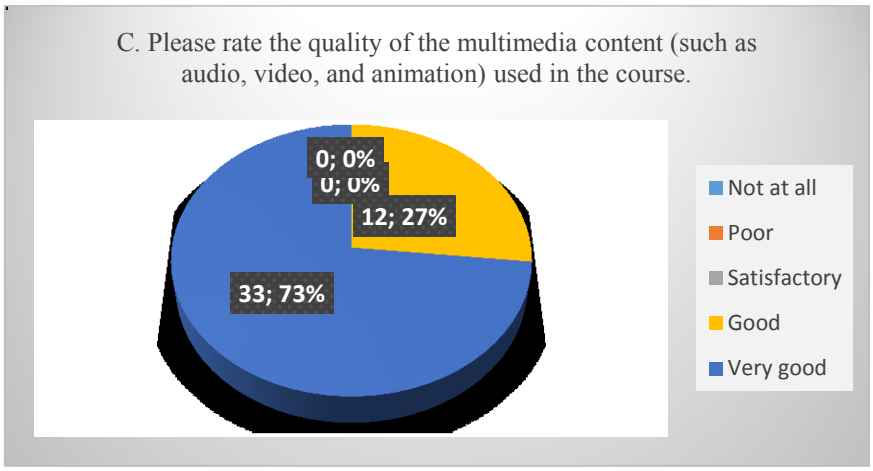


Fig. 18C. A biograph showing the analysis of the data regarding the quality of the multimedia content. (The positive data is 100%)

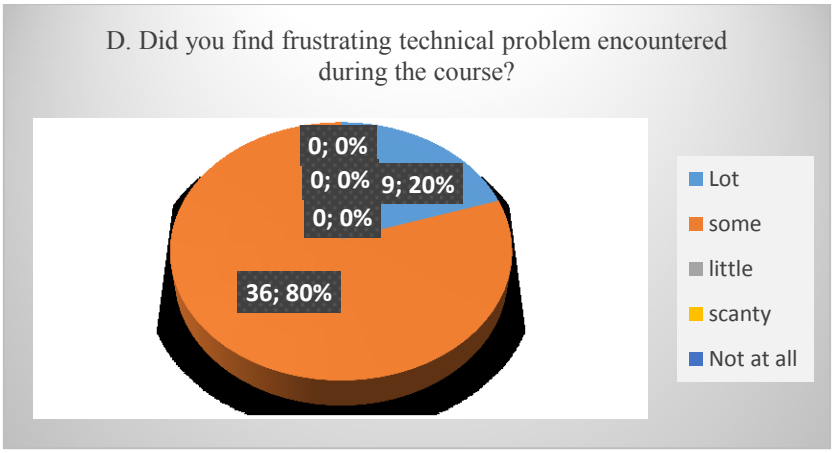
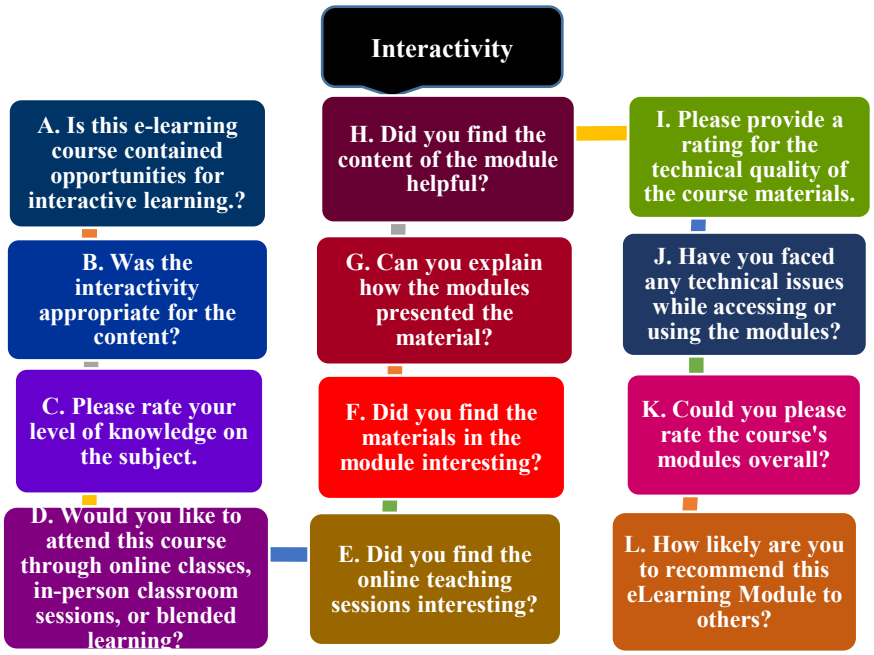


Fig. 18D. A biograph showing the analysis of the data regarding the encountered technical problems during the course (The positive data is 100%)

7. Questions related to interactivity



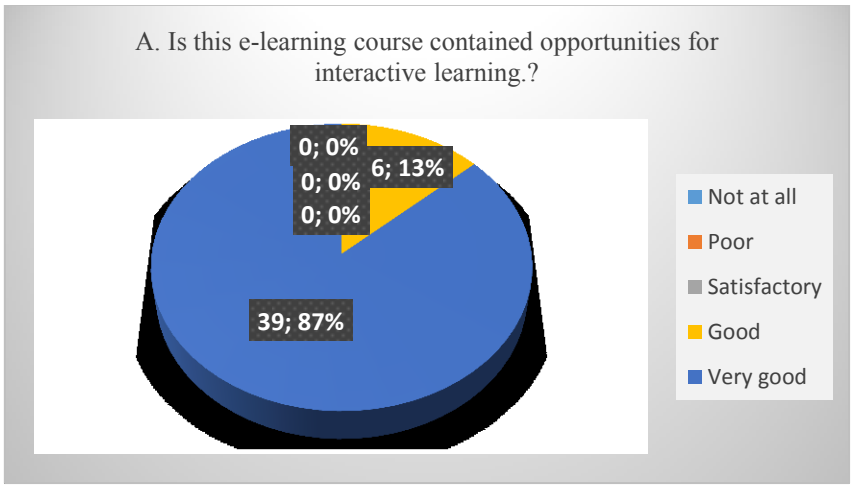


Fig. 19A. Biograph showing the analysis of the data regarding the opportunity of the interactive learning (The positive data is 100%)

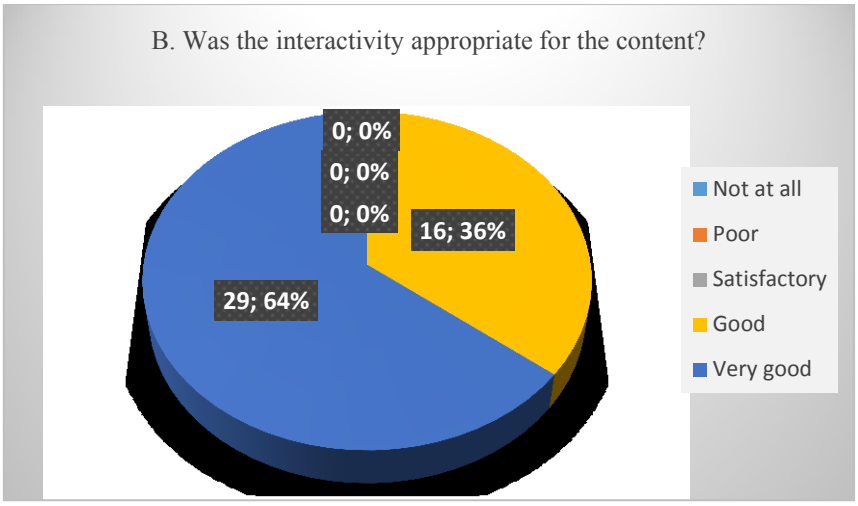


Fig. 19B. A biograph showing the analysis of the data regarding the appreciation of the interactivity for the course. (The positive data is 100%)

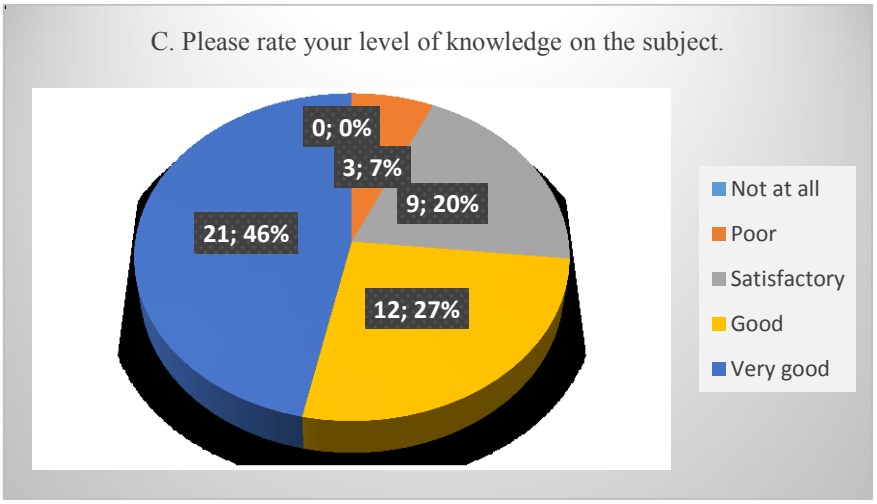


Fig. 19C. A biograph showing the analysis of the data regarding the level of the knowledge on the subject (The positive data is 73%)

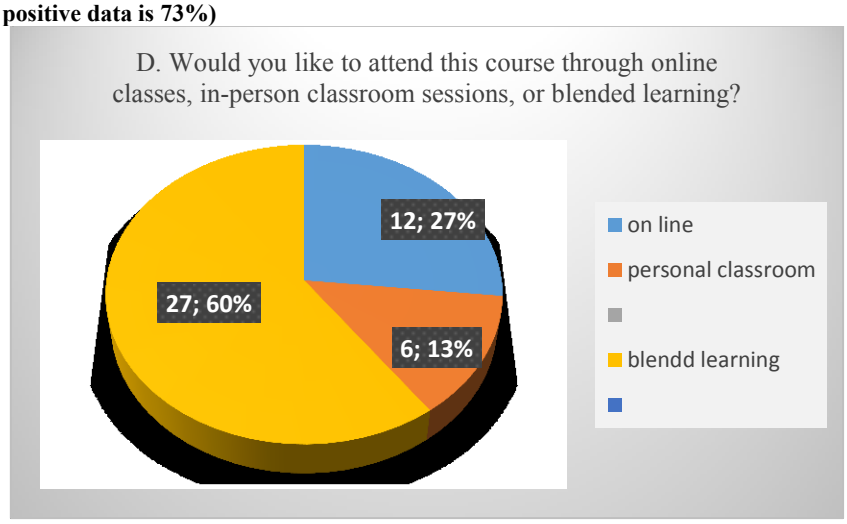


Fig. 19D. A biograph showing the analysis of the data regarding the mode of attendance to the course (on line 27 %, personal classroom 13%, and blended mode 60%)

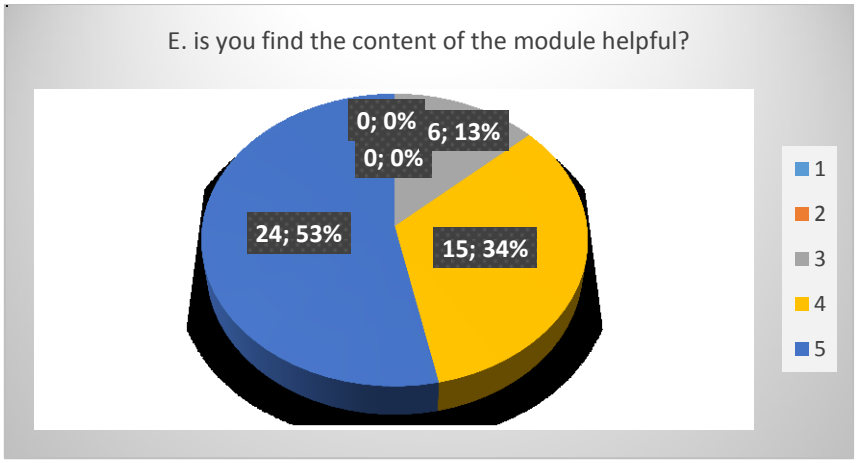


Fig. 19E. A biograph showing the analysis of the data regarding the helpful of the module content. (The positive data is 87%)

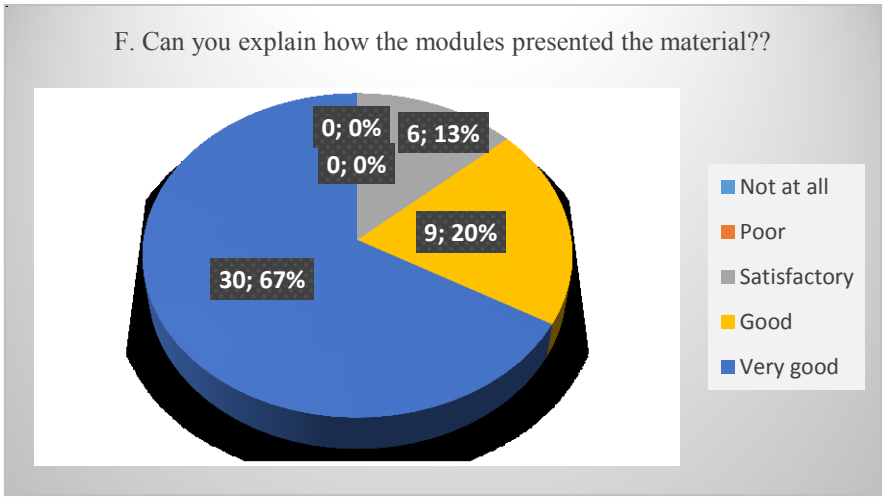


Fig. 19F. A biograph showing the analysis of the data regarding the presentation of the material through the module (The positive data is 87%)

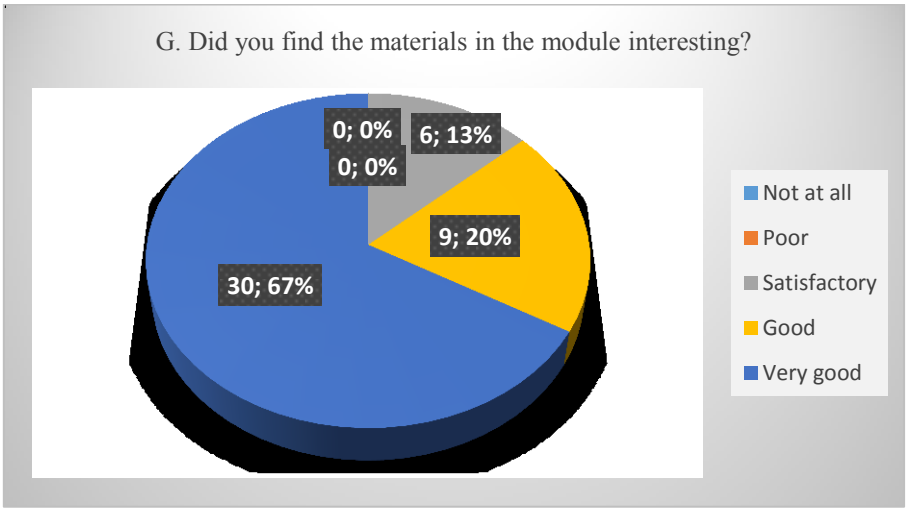


Fig. 19G. A biograph showing the analysis of the data regarding the module' material interesting (The positive data is 87%)

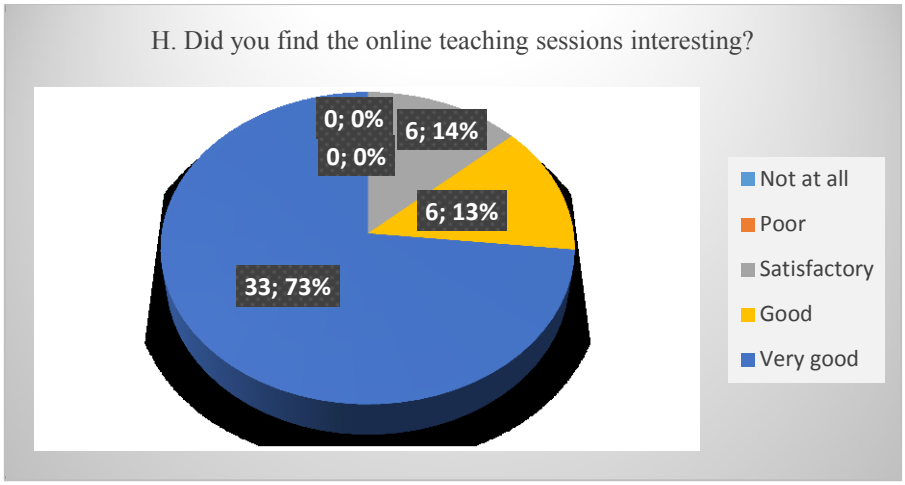


Fig. 19H. A biograph showing the analysis of the data regarding the interesting of the teaching sessions (The positive data is 86%)

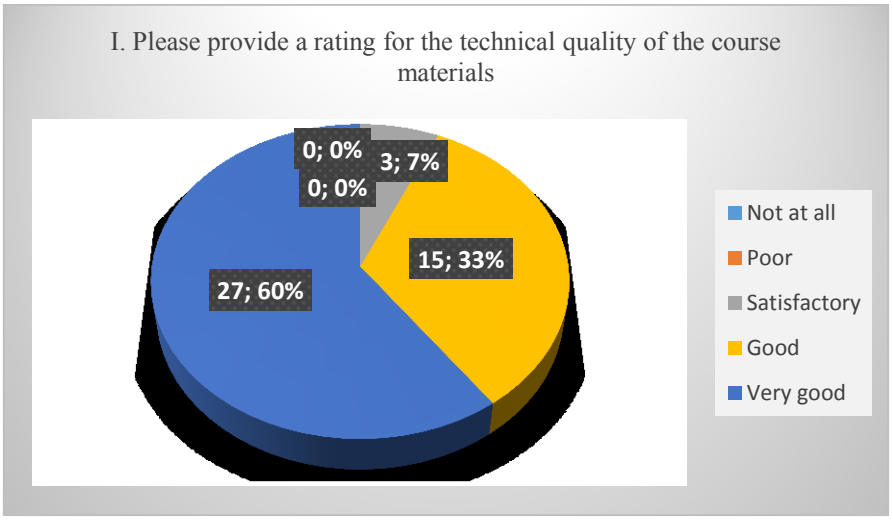


Fig. 19I. A biograph showing the analysis of the data regarding the technical quality of the course material (The positive data is 93%)

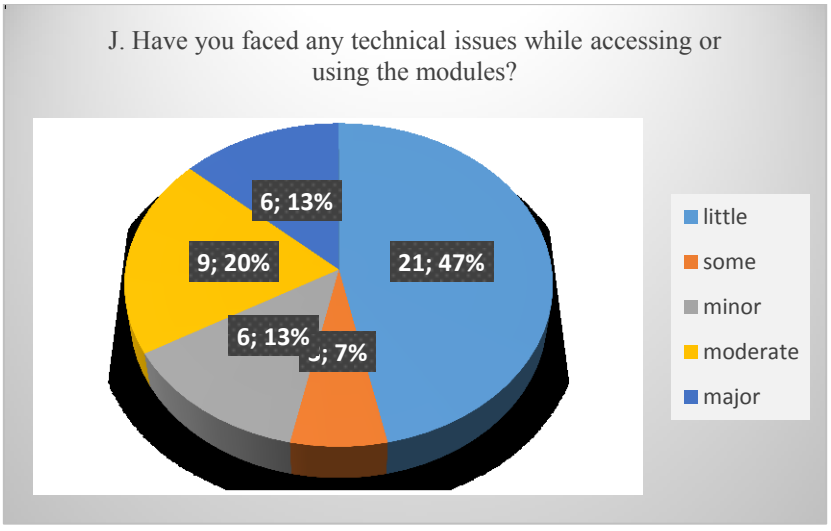


Fig. 19J. A biograph showing the analysis of the data regarding the finding of technical issues during module accessing. (The negative data is 46%)

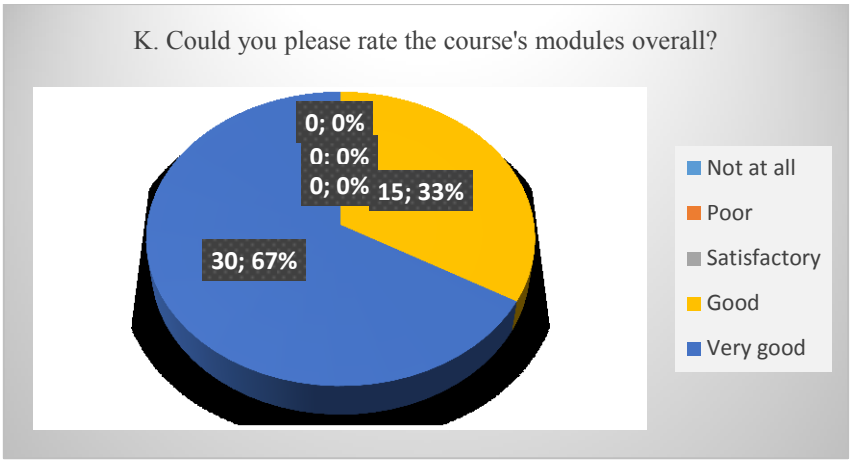


Fig. 19K. A biograph showing the analysis of the data regarding the course module overall. (The positive data is 100%)

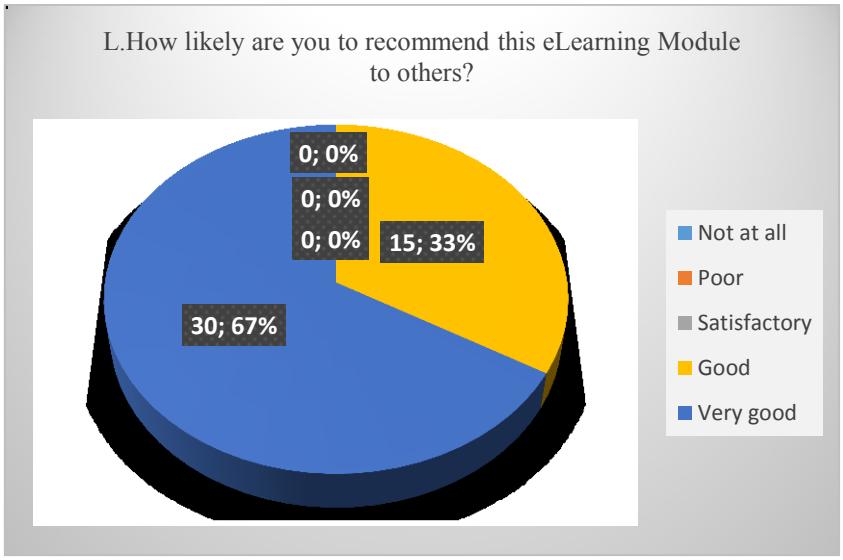


Fig. 19L. A biograph showing the analysis of the data regarding the recommendation of the module to others. (The positive data is 100%)

References

1. Ghada, B. Egypt's Higher Education; Challenges and Keys to Improvement. In the fourth series of "Faculty at the Forefront, held at The American University in Cairo (AUC) (2016).
2. Fitri, A. A Review on the Challenges of E-Learning on Higher Education in Indonesia., *ASSEHR,* **731**, 74–81 (2023). https://doi.org/10.2991/978-2-38476-010-7_10.
3. Maspul, K. A. and Amalia, F. *The importance of big data and internet of things development in learning activities post-pandemic in Indonesia*. 355575953, (2021). https://www.researchgate.net/publication/
4. Ahmad, S., Noor, A. S. M., Alwan, A. A., Gulzar, Y., Khan, W. Z. and Reegu, F. A. eLearning Acceptance and Adoption Challenges in Higher Education. *Sustainability*, **15**(7), 6190 (2023). https://doi.org/10.3390/su15076190,
5. Ahmed, M. F., Metwally, E., Mahmoud, Y. K., Abuzeid, S. M., El-Daharawy, M. H. and Hashem, M. A. Augmentation cystoplasty in dogs: A comparative study of different tunica vaginalis grafts. *Veterinary and Animal Science*, **16**, 100247, (2022).
6. Gomaa, N. A., Ghazy, A. E. and Atiba, A. S. Effect of Repeated Intravenous Administration of Xylazine on Sedation, Analgesia and ECG Parameters in Donkeys ***(Equus asinus)***. *Assiut Veterinart Medical Journal,* **61** (147), 124-130 (2015).
7. Arango, L. T. and Alzate, A. G.- Preservation of Animal Cadavers with a Formaldehyde-free Solution for Gross Anatomy. *Journal of Morphological Sciences*, **35**(2), 136–141. (2018).
8. Elnady, F. The Elnady Technique: An innovative, new method for tissue preservation., *ALTEX-Alternatives to Animal Experimentation,* **33**(3), 237-242 (2016).
9. *Nomina Anatomica Veterinaria*, SIXTH EDITION, prepared by the International Committee on Veterinary Gross Anatomical Nomenclature (I.C.V.G.A.N.),

Published by the Editorial Committee Hanover (Germany), Ghent (Belgium), Columbia, MO (U.S.A.), Rio de Janeiro (Brazil) With permission of the World Association of Veterinary Anatomists (W.A.V.A.) (2017)

10. Constantinescu, G. M. *Illustrated Veterinary Anatomical Nomenclature*, 4th Edition, Library of Congress Cataloging-in-Publication, (2018).

11. TechSmith Camtasia: Instantly Smooths Out Audio and Cursor Path in Newest Release. www.techsmith.com › video-editor, (2019).

12. http://vetmed-academy.com E.learning Sys (vetmed-academy.com)

13. Elsaid, F. A. *Interactive electronic learning modules for studying veterinary anatomy: development, integration and impact on learning*. MVSc. Thesis, Department of Anatomy and Embryology, Faculty of Veterinary Medicine, Suez Canal University(2020).

14. Abdallah, F., Emam, H. E. and Abuzeid, S. M. The anatomy of the nasal cavity of the donkey (a model for electronic learning modules) ". *SCVMJ,* **XXV** (1), 83-103 (2020).

15. Hare, W. C. *Respiratory System*. In The Anatomy of the Domestic Animals. 5th ed. Vol. 1, 2. ed. By R. Getty, W. B. Saunders Company, Pp: 511-514, 518-523, 926-933, 1290-1294, 1567-1572., (1975).

16. Nickel, R., Schummer, A., Seiferle, E. and Sack, W. O. *The viscera of the domestic mammals* (Vol. 2). P. Parey., (1979)

17. König, H. E., Bragulla, H. and Hans-Georg, H. G. *Veterinary anatomy of domestic mammals: textbook and colour atlas*. Schattauer Verlag., (2007).

18. Nakakuki, S. The bronchial tree and lobular division of the horse lung. *Journal of Veterinary Medical Science*, **55**(3), 435-438 (1993).

19. Smith, B. L., Aguilera- Tejero, E., Tyler, W. S., Jones, J. H., Hornof, W. J. and Pascoe, J. R. Endoscopie anatomy and map of the equine bronchial tree. *Equine Veterinary Journal*, **26**(4), 283-290 (1994).

20. Dong, C. S. *Anatomy of Domestic Animals*. Fourth edition. Beijing: China Agricultural Publishing House (2009).

21. Budras, K. D., Sack, W. O., Rock, S., Horowitz, A. and Berg, R. *Anatomy of the horse*. Schlütersche (2012).

22. Al-Abasi, R. J. and Mirhish, M. *Anatomical and Histological Study on the Trachea and Lung of One-Humped Camel in Middle of Iraq* (Doctoral dissertation, M. Sc. thesis, Veterinary Medicine Collage, University of Baghdad) (2001).

23. He, W., Zhang, W., Cheng, C., Li, J., Wu, X., Li, M., and Wang, W. The distributive and structural characteristics of bronchus-associated lymphoid tissue (BALT) in Bactrian camels (Camelus bactrianus). *Peer Journal*, **7**, e6571 (2019).

24. Barone, R. Les images radiologiques normales des poumans et de leur arbre broncho-vasculaire chez le chien. *Revue de Medicine Veterinaire*, **121**, 1-22 (1970).

25. Menaka, R. Tracheo bronchial tree and its morphological pattern of corrosion cast model. *International Journal of Agricultural Sciences and Veterinary Medicine,* **3**(3), 64-66 (2015).

26. Swielim, G.E.A. *Anatomical studies on the lung of the goat*. Thesis Ph.D. in Anatomy and Embryology, Faculty of Veterinary Medicine, Cairo University (1981)

27. Hagrass, M.S. *Some anatomical studies on the lung of the buffalo in Egypt (Bos bubalis)*. Thesis Ph. D. in anatomy and embryology, Faculty of Veterinary Medicine Cairo University (1982)

28. Tyler, W. S. Comparative subgross anatomy of lungs: Pleuras, interlobular septa, and distal airways. *American Review of Respiratory Disease*, **128**(2P2), S32-S36 (1983).

29. Singh, A., Singh, G. and Nagpal, S.K. Broncho-pulmonary tree and segments of the lungs of buffalo calves. *Haryana Veterinarian,* **45,** 29-34 (2006)

30. Rajesh, R., Payal, J. and Mansi, S. Exploratory anatomy of the tracheo-bronchial tree of goat using corrosion cast technique. *Haryana Veterinarian*, **59**(1), 80-83 (2020).

31. Yousif, N. H. and Dawood, M. S. Morphometric Comparative Anatomical Study of Lower Respiratory Tract between Sheep (Ovis aris) And Goat (Caprus hircus) in Baghdad province. *Kufa Journal for Veterinary Medical Sciences*, **10**(2), 26-36 (2019).

32. Larson, M. M. *Normal Radiographic Anatomy*. *Feline Diagnostic Imaging*, 151-160 (2020).

33. Ishaq, M. A morphological study of the lungs and bronchial tree of the dog: with a suggested system of nomenclature for bronchi. *Journal of Anatomy,* **131**(4), 589-610 (1980).

34. Pasquini, C., Spurgoen, T. and Pasquini. *Anatomy of the Domestic Animals, Systemic and Regional Approach*. 5th ed. SUDZ Publishing. Pp: 322-324., (1997).

35. Robinson, N. E. and Sorenson. P. R. Collateral flow resistance and time constants in dog and horse lungs. *Journal of Applied Physiology,* **44**, 63–68 (1978).

36. Robinson, N. E. Some functional consequences of species differences in lung anatomy. *Advances in Veterinary Science and Comparative Medicine,* **26**, 1–33 (1982).

37. Alfonso, L. and Shannon, A. M. *Respiratory System, Mediastinum, and Pleurae*. In Pathologic Basis of Veterinary Disease (Sixth Edition) (2017).

38. Prohl, A., Ostermann, C., Lohr, M. and Reinhold, P. The bovine lung in biomedical research: visually guided bronchoscopy, intrabronchial inoculation and in vivo sampling techniques. *Journal of Visualized Experiments*, **89**, e51557 (2014).

39. Osman, F. A. *Some anatomical studies on the bronchial tree and pulmonary vessels of the dromedary camel (Camelus dromedarius)*. Thesis M.V. Sc., Cairo Univ., Fac. Vet. Med. (1974).

40. Gerald, R. B., Joerg, K., Saeed, T. and Ulrich, W. The Pleural Curtain of the Camel (Camelus dromedarius). *Anatomical Record*, **293**(10), 1776-1786 (2010).

41. Markus, B. Thinking about e-Learning. In *Proceedings FIG International Workshop. Sharing Good Practices: E-learning in Surveying, Geo-information Sciences and Land Administration* (pp. 11-13), (2008).

42. Dakroury, Y. H. Egyptian E-Learning University: Case Study. *International Journal of Internet Education*. http://ijie.journals.ekb.eg/, (2021).

43. Singh, A. K. Blended Learning Vs. Traditional Learning: A Detailed Overview of the Two Approaches**.** (2023). *https://elearningindustry.com/blended-learning-vs-traditional-learning-a-detailed-overview-of-the-two-approaches#:~:text=Traditional%20learning%2C%20often,*

44. Allison, L. 4 tips for making your e-learning course content mobile friendly.; getting started with multi-device e-learning.; why rise 360 is a kick-butt multiservice authoring app. *Learning Heroes,* (2016).

45. Gupta, M., Marsden, S., Oluka, T. and Sharma, R. Lessons learned from implementing e-learning for the education of health professionals in resource-constrained countries. *Electronic Journal of e-Learning*, **15**(2), 144-155 (2017).

46. Radović-Marković, M. Advantages and disadvantages of e-learning in comparison to traditional forms of learning. *Annals of the University of Petroşani, Economics*, **10**(2), 289-298 (2010).

47. Eastmond, D. Educational technology research and development, realizing the promise of distance. *Education in Low Technology Countries*, **48**(2), 100–111 (2000).

48. Sehrt, M. E-learning in the developing countries – digital divide into digital opportunities. *UN Chronicle Online*, **4**(3),45 (2003). [Online], Available at: http://www.un.org/Pubs/ chronicle/2003/issue4/0403p45.asp (Accessed: 22 January, 2013).,

49. Evans, R. Explaining Low Learner Participation during Interactive Television Instruction in a Developing Country Context, PhD Dissertation, University of Pretoria [Online], Available at: http://upetd.up.ac.za/thesis/submitted/etd-02282005-081708/ unrestricted/00front.pdf (Accessed: 18 January, 2013), (2005).

50. El Gamal, S. and Abd El Aziz, R. Improving higher education in Egypt through e-learning programs: HE students and senior academics perspective. *International Journal of Innovation in Education*, **1**(4), 335-361 (2012)

51. Callum, R. Hybrid and blended learning in higher education. *https://elearningindustry.com/blended-learning-ultimately-best-corporate-training,* (2021).

52. McCoy, L. P. Internet Web Quest: A context for mathematics process skills. *Technology-Supported Mathematics Learning Environments:* **67th** Yearbook, 189-201 (2005).

53. Salsovic, A. Integrating Technology into the Developmental Mathematics Classroom: A Web Quest. *NADE Digest.*, **3**(1), 21-25 (2007).

54. Calder, N. *Processing mathematics through digital technologies*. Rotterdam, The Netherlands: Sense., (2011).

دراسات تشريحية مقارنة على رئتي الحيوانات المستأنسة (أسس لإعداد وحدة تعلم الكتروني)

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الملخص

تواجه العديد من البلدان، بما في ذلك مصر، تحديات عديدة في مجالات التعليم العالي، لا سيما في أوقات الأزمات. وقد ساد التوجه عالميا باعتماد التعلم الإلكتروني كحل فعال للتغلب على هذه التحديات. في هذهالدراسة، تم تطوير وحدة التعلم الإلكتروني بناء على تشريح الرئتين في السلالات المحلية للحيوانات المستأنسة ، مثل الحمير والجاموس والماعز والجمال والكلاب، باستخدام تقنيات مختلفة مثل التشريح العياني والتصوير الاشعاعي وإعداد عينات متحفية بتقنيات مختلفة. وقد كشفت الدراسة أن هناك علاقة بين نمط الشعب الهوائية الفصية وعدد فصوص الرئتين في مختلف الفصائل الحيوانية. تضمن إعداد وحدة التعلم الإلكتروني استخدام وسائط إلكترونية متعددة ، ونظام إدارة التعلم (LMS) ، ومنصة استضافة (http://vetmed-academy.com) ، واستراتيجيات تعلم مختلفة ، أظهر استطلاع شمل 45 طالبا جامعيا ردود فعل إيجابية فيما يتعلق بتوقعات الوحدة ، والهيكل ، والمحتوى ، والاختبار ، والتوقيت ، ووتيرة التعلم الإلكتروني ، والتنقل ، والوسائط المتعددة ، والتفاعل. ومع ذلك، كانت الردود المتعلقة بتكنولوجيا المعلومات والاتصالات (ICT) وقضايا خدمات الإنترنت أقل مواتاة. ووفقا للدراسة، تلعب التقنيات الرقمية دورا حاسما في تسهيل التعلم الإلكتروني الفعال من خلال توفير البنية التحتية والأجهزة والموارد والمحتوى والخدمات ذات الصلة. بالإضافة إلى ذلك ، أصبحت تكنولوجيا المعلومات والاتصالات (ICT) أداة لا غنى عنها لتقديم المناهج الدراسية للمتعلمين في جميع أنحاء العالم.

الكلمات الدالة: التشريح المرئي- الرئة- الحيوانات المستأنسه – نموذج التعليم الالكترونى.