BIOLOGY, MEDICINE, & NATURAL PRODUCT CHEMISTRY ISSN 2089-6514 (paper)
Volume 14, Number 2, October 2025 | Pages: 1625-1628 | DOI: 10.14421/biomedich.2025.142.1625-1628 ISSN 2540-9328 (online)

Designing Interactive Online Atlas of Mammalian Anatomy (*Cavia cobaya*)

Muhammad Jafar Luthfi[1]*, Riyanto[2]
[1]Biologal Education Department, Faculty of Tarbiyah and Education, UIN Sunan Kalijaga Yogyakarta.
[2]Faculty of Science and Technology, UIN Sunan Kalijaga Yogyakarta
Jl. Marsda Adisucipto 55281 Yogyakarta, Telp. +62-274-540971, Indonesia.

Corresponding author*
jafarluthfi@yahoo.com

Manuscript received: 26 October, 2025. Revision accepted: 07 March, 2026. Published: 15 March, 2026.

Abstract

This research is an integration between fields of Biology, Photography, Design, and Informatics Engineering. The study aimed to develop an interactive online atlas of mammalian anatomy to improve the accessibility and data sharing (free access) of mammalian anatomy. Website was developed using SDLC (System Development Life Cycle) which consists of five steps as follows: website's strategic planning, determine the scope of website, website's requirements analysis, design and implementations of website, and testing. Based on the results of testing and system implementation, it can be concluded that online interactive atlas (AtlasAnatomy.org) had been successfully built as anatomical educational media of mammal.

Keywords: AtlasAnatomy.org; Online anatomy atlas; Vertebrates; Reptile; Interactive atlas.

INTRODUCTION

Vertebrates include all animals that have backbone. Some of the characteristics possessed by vertebrate animals are having a closed circulatory system, having a backbone in their body, having a complete digestive system, and having a bilateral symmetry body. Vertebrates consist of 5 (Five) classes, namely Pisces, Amphibians, Reptiles, Aves, and Mammal.

Vertebrate dissection is one of the most important subject in life science including biology, medicine, and veterinary. This course is usually carried out in a standard lab work performing animal dissection attended by students and guided by tutor/assistants. This subject, however, is categorized as difficult enough by many students, revealed by lower mark in the subject. In addition, performing real class vertebrate dissection is costly, time and labor consuming.

Advances in information technology are increasingly made information exchange easier. Facility from information technology becomes important for supporting research and scientific activities. One of the advances in information technology is the rapid development of the Internet. Data show that internet users are increase from year to year, either globally or in Indonesia (APJII, 2014). The data are shown in figure 1.

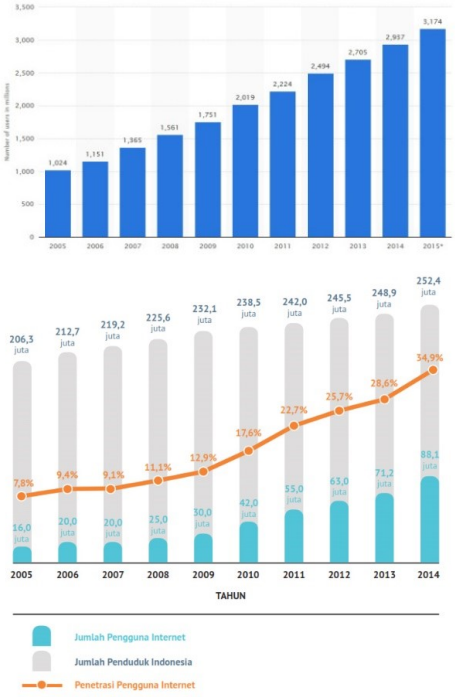


Figure 1. (A) World Internet users (Source: APJII); (B) Internet users in Indonesia (Source: **statista**.com).

From the development of information technology, internet, and growing number of domains (detik.com), a new perspective begins in the development and distribution of science. Information technology can help

studying anatomy much more easier, cheaper and practical. Real class vertebrate dissection could be done alongside complementary online learning source of vertebrate dissection. This online course could help students learning the material before the real class, or they can re-check the material after the class to master the course. To some degree, this online atlas could potentially be used as teaching material for life science students.

In 2011, research on digital atlas has been done by Jones, Stone & Karten, entitled "High-resolution digital brain atlases: a Hubble telescope for the brain". This research explains the application method for digitalize microscopic part of the brain network containing normal and experimental data and to make the content easily accessible online. The results of this study can be accessed at URL www.BrainMaps.org. The predecessor study related to BrainMaps.org was in 2008 entitled "BrainMaps.org - Interactive High-Resolution Digital Brain Atlases and Virtual Microscopy" (Mikula S, et.al, 2008). Other online atlases avalaible are anatomyatlases.org, innerbody.com, instantanatomy.net, and Biodigital.com. All the atlases are human anatomy.

We used *Cavia cobaya* as a representation of Mammalian Class. This study used guinea pig as objects in the preparation of interactive online atlas as a reference for learning source.

MATERIALS AND METHODS

Animal

Five guinea pigs (*Cavia cobaya*) were used in this study. The guinea pigs were sacrificed, dissected and photographed using Canon EOS 60D camera.

Online atlas design

For design online atlas we used computer with Intel @ 3.40GHz processor i7-4770 CPU (C) i7-4770 equipped with Microsoft Windows 8.1 Operating system software, PHP 5.3.0 programming language, Apache local web server version 2.0, MySQL Client Database Server version 5.1.37, Mozilla Firefox Web Browser version 56.0.2, Text Editor Sublime Text 3, Adobe Photoshop CS4 Extented, CorelDRAW X6; HTML, PHP, Javascript, and Image Map programming languages; Servers for data processing and storage; AtlasAnatomy.org domain name.

This research was conducted at Integrated Laboratory of UIN Sunan Kalijaga Yogyakarta. Dissection and photographing were done as per standard method. Development and manufacture of interactive online atlas system using insoursing method (Mulyanto, A., 2008) SDLC (System Development Life Cycle) covering stages of planning, needs analysis, design, manufacture, and testing. Working procedures used in this study include Literature Studies, Data Collection & Processing, Website Design, System Testing, and System Implementation Analysis.

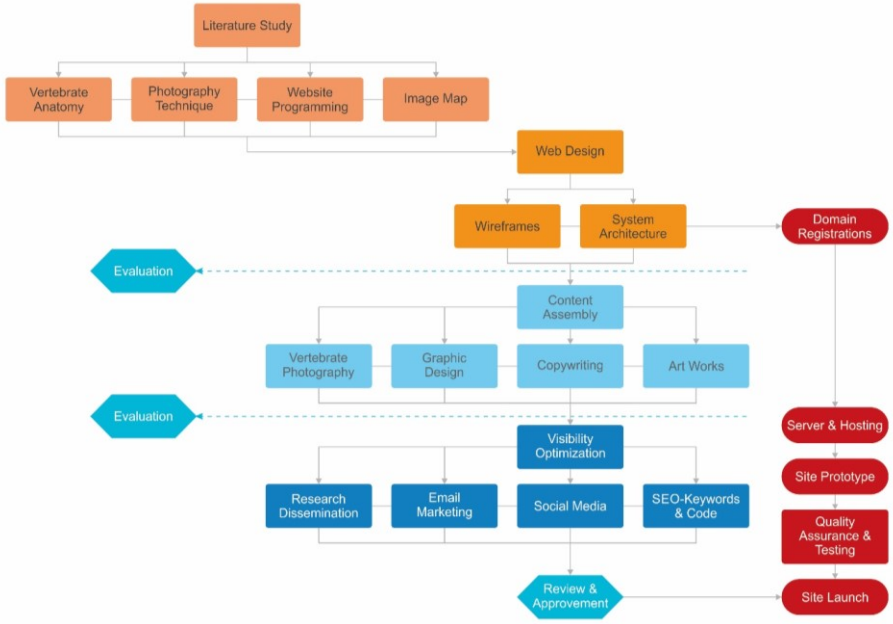


Figure 2. *AtlasAnatomy.org* drafting scheme.

The steps of this research were:

- The first step was literature study; namely the study of theories related to animal anatomy, photography techniques, as well as the theory of website making and programming languages.
- The second step was Data collection & Processing; i.e, performing standard dissection, taking

pictures/images on the dissected reptile object and processing the image using software to get the image data. Organs were identified, described, and named.

- The third step was website making by way of insoursing; there are 5 (Five) stages that need to be done namely planning, needs analysis, design, manufacture, and testing.
- The fourth step was system testing; there are 2 (two) tests conducted, namely alpha testing conducted directly by the research team about the functional website and beta testing conducted by the general public with a focus on the functionality and interface website. The results of this test are used as material improvement and website development.
- The fifth step was system implementation; namely implementation of the website system to obtained evidence or comprehensive facts about animal anatomy website.

RESULT AND DISCUSSION

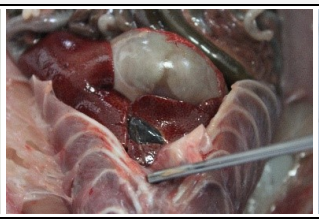
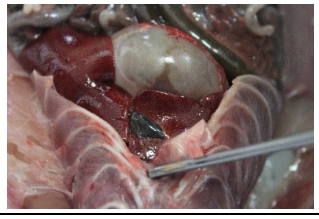
Determination of Mapping area objects

Guinea pig morphology consisted of external morphology, anterior extremities, posterior extremities, organ topography, respiratory system, male reproductive system, female reproductive system, and digestorium system. Table 1, table 2, table 3, and table 4 show the segmentation of each section to create Image Map.

Table 1. Division of guinea pig Image Map area.

No	Anatomy System	Area Mapping Objects		
1	External Morphology	- Nares Anteriores - Timpani membrane - Trucus - Front limb	- Rima oris - Caput - Posterior Ekstremetas	- Orgamon visus - Cervix
2	Anterior extremities	- Bracium - Digit	- Antebracium - Falcuna	- Manus
3	Posterior extremities	- Femur - Digit	- Crus - Falcuna	- Pes
4	Organ Topography	- Trachea - Hepar	- Jantung - Vesica fellea	- Pulmo - Duadenoum
5	Respiration system	- Pulmo	–	- Trachea
6	Male Reproductive System	- penis - Epididimis	- Ren - Testis	- Vas deferent
8	Digestorium	- Hepar - Vesica fellea	- Lien - Rectum	- Small intestine

Table 2. Image Map outside morphology guinea pig on the website system.

No	Origin Image		
1			
2			
3			

Preparation and writing of syntax to create mapping in the Truncus section are as follows:

- Image Dimensions: 950 x 364 pixels
- Syntax determination of Truncus part coordianate region:

<area name="truncus" alt="" title="" href="#" shape="poly" coords="268,57,274,57,279,57,287,58,297,58,308,59,322,59,329,59,336,59,344,59,356,59,367,59,375,59,389,59,404,60,416,60,430,61,446,61,462,63,478,64,492,66,508,69,521,69,535,71,549,73,562,74,578,77,590,79,602,83,611,85,612,89,611,96,611,100,611,110,608,118,608,125,608,133,607,140,608,146,608,152,599,151,592,151,581,151,579,145,583,142,584,136,584,131,582,125,576,120,570,117,564,116,559,114,554,114,548,114,542,115,534,119,529,130,530,139,535,148,536,152,522,150,501,150,479,150,457,150,429,151,410,150,389,151,373,151,353,152,348,141,342,130,335,119,329,112,320,112,311,112,298,115,285,121,276,126,274,132,276,138,281,144,287,147,294,149,299,149,306,146,314,144,324,154,313,157,302,156,291,156,281,156,274,154,267,154,255,151,248,150,242,149,240,147,245,135,249,126,253,116,257,107,262,98,265,87,268,77" />

The anatomical photograph of mammal in this study had successfully arranged for online access. Goubran & Vinjamury (2007) stated that the online atlas is the effective for student learning source.

We had succesfully developed interactive online atlas of Cavia cobaya as complementary learning source in the field of vertebrate anatomy.

CONCLUSION

Based on the results of the study we concluded that this research has succeeded in establishing an interactive anatomy of mammalian anatomy available online (AtlasAnatomy.org.)

Acknowledgements: This research is supported and funded by Institute for Research and Community Service (LP2M) UIN Sunan Kalijaga fiscal year 2022.

Conflicts of Interest: MJL is on the editorial board of the *Biology, Medicine, & Natural Product Chemistry*, and was recused from this article's review and decision. The authors declare that there are no conflicts of interest.

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