

# Interactive Teaching Aids Design for Essentials of Anatomy and Physiology—Using Bones and Muscles as Example

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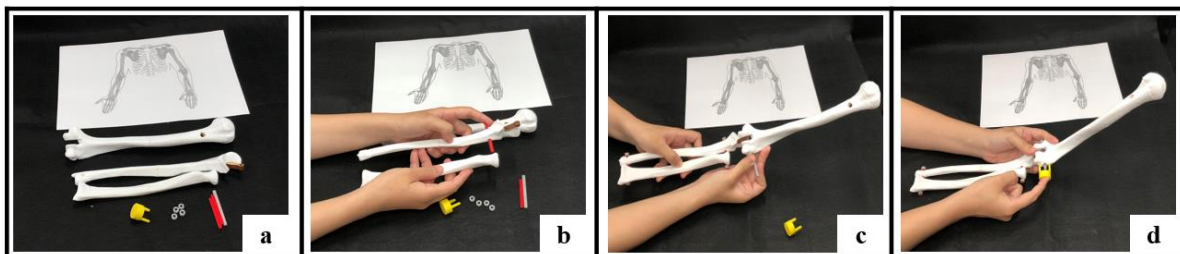


Figure 1: Assembled manuals for arm. (a) Part of the model; (b) Assembling the radius and ulna; (c) Inserting LEGO connectors to assemble the humerus; (d) Finished assembly.

## CCS CONCEPTS

•Human-centered computing → Human computer interaction (HCI) → HCI theory, concepts and models

## KEYWORDS

Interactive Teaching Aids Design, Anatomy, human, bones

## ACM Reference formal:

Hui- Ju Chen, Zi-Xin You, Yun-Ho Yu, Jen-Ming Chen, Chia-Chun Chang and Chien-Hsing Chou. 2018 Interactive Teaching Aids Design for Essentials of Anatomy and Physiology—Using Bones and Muscles as Example. In *Proceedings of SIGGRAPH '18 Posters, Vancouver, BC, Canada, August 12-16, 2018*, 2 pages. <http://doi.org/10.1145/3230744.3230808>

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SIGGRAPH '18 Posters, August 12-16, 2018, Vancouver, BC, Canada

ACM 978-1-4503-5817-0/18/08.

10.1145/3230744.3230808

## 1 INTRODUCTION

Learning essentials of anatomy and physiology [R. Richardson et al. 2018] can make students knowing more about the connection between bones and muscles of human bodies. In the past, we can only use books, pictures, videos or fixed bone model to teach. This kind of teaching may suit for student over 15. But, for student under 15, it's hard to increase their interest or studying time for learning. If there are some models that can be assembled during the class, as Alison James [A. James et al. 2014] said, building LEGO helps us to think more about the 3D shape of the object. Can also increase student's interest of learning.

In this study, we design a set of interactive teaching aids for essentials of anatomy and physiology to student under 15. The aids include two parts, assembled real working model and interactive augment reality.

In assembled model part, student can assembled 3D-printed bones and muscle-like plastic bag with syringe and rubber bands. By assembled them, students can learn more about how bones are connected with muscles. The other part, the interactive augment reality is design for the assembled working model. Showing how muscles really works on the screen of device. In this way, student can memorize it easier and deeper.

## 2 REAL WORKING ASSEMBLED MODEL OF BONES AND MUSCLES

To make learning easier, we use 3D printer to make human bones model as shown in Fig. 1 with LEGO structure, student can think then assembled the model after browsing pictures. After assembled bones model theirs, student may know more about the position of the bones structures inside human body.

As beginning, we choose two parts of our body, arms and knees. As shown in Fig. 2, arms is a simple structure part of our body which is good for beginner. In Fig. 2(b), knees is a part that very unique, including meniscus and patella which is good for student to learn deeper.

In traditional teaching method of essentials of anatomy and physiology, we use books, pictures or fixed-structure model. It's not a interesting and long term study way for student. To increase the efficiency, we use the way like playing games that makes student would like to do it again and again. For example, the arms in Fig. 1, we let student look at the anatomical map theirs to figure out where the bones belongs. And assembled the 3D-printed bones model. Not only to learn the location of the bones, but also to observe the shape when bones are working.

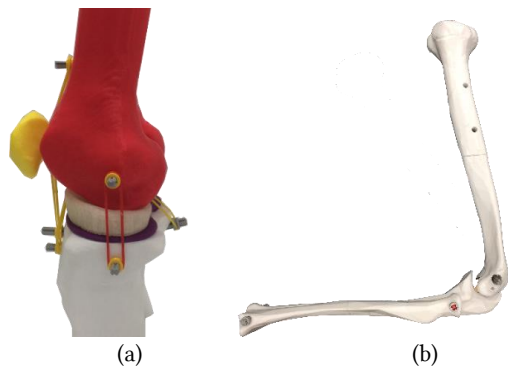


Figure 2 : (a) 3D-printed arms bones (b) 3D-printed knee bones.

### 2.1 The Demonstration of How Muscles and Tendon Works in Motion.

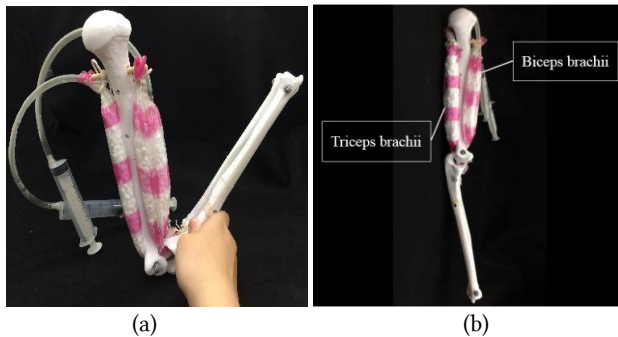


Figure 3: Simulate the shrink and diastolic of biceps and triceps when your arms are bending and straighten.

In essentials of anatomy and physiology, not only the position, but also the connection between bones and muscles are very important. So we also design a simulate demonstration of muscles and tendons. As Fig. 3, we shape the plastic bag like human muscles. Fix it at the right position on the 3D-printed bone. Using syringe to simulate the motion of muscles. For example, when we bending the arms, as Fig. 3(a), the syringe fill the air into plastic bag (biceps shrink). As Fig. 3(b), the syringe drain out the air (biceps diastolic). So we can simulate the straighten of arms. We can also simulate the tendon's location by striping the rubber band as Fig. 4.

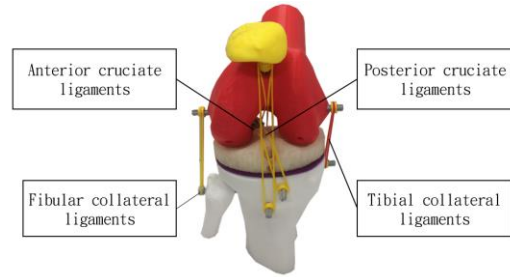


Figure 4: Rubber bands simulate the connection of knee tendons

## 3 THE INTERACTIVE AUGMENT REALITY SYSTEM OF ESSENTIALS OF ANATOMY AND PHYSIOLOGY

To show the original shape of our bones and muscles, we also designed an AR system for the bones model. As shown in Fig. 5, student can place the bone model which they just assembled under the lens of cellphone or tablet. By using the App we designed, we can take a look at what bones and muscles really looks like. And can also observed the motion such as bending and straighten from different angles. By this device, we believe we can left a deep memory on student's studying process.



Figure 5 : Augment reality shows what bones and muscles really looks like.

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R. Richardson, The Making of Mr. Gray's Anatomy. Publish by Oxford University Press, 2008.  
 A. James, "Learning in Three Dimensions: Using Lego Serious Play for Creative and Critical Reflection across Time and Space," Global Innovation of Teaching and Learning in Higher Education, 2014, pp 275-294.