UNIVERSITY OF WATERLOO

LITE SEED GRANT PROPOSAL

a) Project Title

Integrating 3D Digital Multimedia into Anatomical Education

b) Project summary

Students in Kinesiology require an understanding of surface anatomy (external features of the human body) in relation to the internal structures, such as muscles or nerves. However, students have difficulty linking what they palpate or see superficially to the anatomy below the skin. Instructors have indicated that this is due to both a knowledge gap and limited useful resources available to review and practice

This proposal aims to fill this knowledge gap. The primary objectives are 1) to provide 3D anatomical modelling software (AMS) on wireless devices used in lab and 2) create related video content from the software. Videos will be made available within LEARN for unlimited access. These resources will contribute to a blended learning model that will facilitate student understanding between external features and internal structures, and improve hands-on skills resulting from deeper anatomical understanding. Student learning outcomes and resource use will be assessed.

c) Project goals/outcomes and, where applicable, research question(s) to be investigated:

1. Create video content from 3D AMS for dissemination to undergraduate and graduate Kinesiology students.
2. Provide 3D AMS on lab wireless devices. This will have cross-curricular impact, providing students access to digital anatomy content and tools throughout the four years of undergraduate kinesiology labs, in addition to students in experiential graduate courses will also utilize the resources.
3. Bridge students' nascent understanding of internal anatomy to external features that they feel or see. This will translate to better preparedness and superior hands-on skills for activities including movement analysis, injury assessment, exercise assessment and training, and biological signal measurement.
4. Equip instructors with both 3D AMS and new videos to enhance student learning. Integration of these tools into the lab experience will elevate skill-based learning outcomes**.**

d) Project rationale and description, including review of relevant literature (where applicable) and contextual information:

Anatomical education is evolving and students are increasingly looking to digital tools for learning. An educational framework on how digital technology should be implemented is yet to be determined, however, several use cases have demonstrated the positive application of such technology in higher education (Pringle & Rea, 2018). Holographic models have been shown to improve understanding of gross anatomy as evaluated by higher test scores (Miller, 2016). Moreover, integration of mobile technology into higher education anatomy classrooms appear to have positive results on learning outcomes and engagement (Wilkinson & Barter, 2016). Further, when used in conjunction with traditional methods of lecture and dissection methodologies, 3D digital technology improved student learning outcomes, particularly in spatial awareness and identification of anatomical parts (Peterson & Mlynarczyk, 2016). Currently, the majority of studies have examined the effects of 3D digital technology on test scores but the impact on clinical skills remains unknown (Azer & Azer, 2016).

Currently there are limited resources for teaching surface anatomy within the Kinesiology program. The chronology of the Kinesiology program also requires students to understand surface anatomy in 1A which precedes KIN 100L (Human Anatomy Lab), which is not presented until 1B. This can be problematic as 1A students would be expected to learn anatomy through lectures and textbooks (2D resources) and apply that understanding in 3D. Further, in KIN 100L the cadavers are pre-dissected, skin removed, and embalmed which alters tissue texture and look. Providing video content based on 3D modelling and the 3D AMS, will help students better understand the spatial relationship between internal structures and external. This approach of using digital content and modeling is novel for our department. As a result, there is neither manpower nor any resources dedicated to exploring how 3D AMS could fill the knowledge gap and implemented into our anatomical education.

3D AMS would provide a much-needed resource in anatomical education that could positively impact learning. Compared to other digital tools, the 3D AMS provides view of a full realistic anatomical model based on a living human and an ability to model several anatomical systems (e.g. multiple layers of muscle, nervous system, cardiovascular system, etc.), Previously used tools rely on 3D radiological imaging (CT or MRI scans) and models showcasing isolated systems (e.g. specific muscles). A more realistic and fulsome model should not only improve knowledge construction of surface anatomy for students, but ultimately it should strengthen core skills that are requisite for students including kinesiology concepts, analysis or problem solving, and professional

skills. The Kinesiology program at Waterloo prides itself on providing a first-class lab experience that is second to none. We focus on expanding the depth and breadth of knowledge, and improving upon practical skills (i.e. knowledge application, communication with clients, and professional conduct as health providers). These directly impact the UDLEs outlined within the Kinesiology program. Ultimately, our students develop excellent hands-on skills that can be immediately applied throughout experiential learning opportunities and upon graduation.

The first step in our project will be to create videos combining lab demonstrations alongside surface anatomy recordings from the 3D AMS. These will be stored on LEARN and made available to both current students, and instructors within Kinesiology. Once the videos have been created, the 3D AMS will be included on our mobile teaching lab devices for student use. A qualitative analysis will be conducted to examine if the digital resources improves aggregate grades from previous cohorts for 1) practical skills in KIN 104L and KIN 204L, and 2) KIN 100/100L. Additionally, preparedness of students assessed by self-reflection and by instructors will be examined to elucidate utility of these new tools. Lastly, we will examine the viewing statistics of newly created content on LEARN in comparison to traditional content (i.e. PDFs, lecture slides).

This project will have cross-curricular impact affecting approximately 1100 undergraduate and 110 graduate students in the kinesiology program.

e) Plan/methods/procedures for carrying out and assessing the project:

Intended outcomes, including project outcomes, student learning outcomes, and/or teaching enhancement outcomes	Sources of evidence and how evidence will be collected related to project, student learning, and/or teaching enhancement outcomes	Plan for analyzing evidence to assess the project, student learning, and/or teaching enhancement outcomes
Improved student knowledge and hands-on skills	Examine if aggregate grades for exams/courses related to anatomical understanding, are higher for incoming students compared to previous cohort	Compare incoming student's KIN 104L practical exam marks to previous cohort. Compare incoming student's KIN 100/100L final marks to previous cohort
Greater access of newly created multimedia from 3D AMS for incoming students, relative to traditional resources	Examine access of new multimedia relative to traditional multimedia for incoming students	On LEARN, compare viewing statistics (e.g. number, length) of new content created from 3D AMS to traditional content (e.g. PDFs).
Greater perceived benefits of new tools by students	Examine student preference of multimedia created from 3D AMS to traditional content	Assess using student surveys which will be distributed by Undergrad Program Assistant at end of 1A
Greater perceived satisfaction and usage of 3D AMS by instructors	Examine instructor's perception of student preparedness as well as their own usage of the 3D AMS to teach	Assess using surveys at the end of 1A. Instructors will compare experience to previous year. Solicit feedback on benefits, barriers, implementation, and adoption of 3D AMS.

We are currently in discussion with ORE regarding research on the efficacy of using 3D AMS in our kinesiology teaching labs and how best to assess it.

If learning outcomes are improved and student/instructor software usage and satisfaction are assessed to be high, then 3D AMS will be further promoted in KIN courses beyond first year and additional multimedia will be created. The cost of creating videos would be low with the availability of ITMS and a strong case that will be made by asking for Departmental funding to maintain or increase software licenses and cover remaining costs of multimedia production.

f) Statement regarding areas of expertise of project applicant(s):

The applicants are subject experts in anatomy and palpation, and have software expertise to assist with multimedia production. We will be receiving support from ITMS in video design. Further, the applicants of this proposal have experience in statistical analysis and qualitative research. Any additional support may be sought through colleagues within the Department of Kinesiology and Faculty of Applied Health Sciences.

g) Outline of project's impact -- contribution to UWaterloo community:

The use of 3D AMS will demonstrate how digital technology can be used to enhance lab experiences focused on developing hands-on skills and understanding of the human body. Outside of our department, the School of Optometry and Biomedical Engineering could also have their student learning experience enhanced with the addition of 3D AMS as a resource. Students from those programs often have classes in our School of Anatomy so 3D AMS would also allow them to extend their anatomical education beyond the lab.

h) Plan for dissemination:

Once this project is complete, the results will be first showcased within the Department of Kinesiology to encourage adoption of this resource into future course offerings or current courses may elect to adapt their material to include this resource.

The results from this project, on whether integrating 3D AMS into anatomical education enhances learning, could be shared with the School of Optometry and Biomedical Engineering departments, who regularly have classes within our School of Anatomy. These programs may also elect to include 3D AMS as a way to augment their student's education.

Lastly, the results from this project will also be shared at the Teaching and Learning Conference held in May on campus and at AHS Teaching Fair in December.

i) Budget:

Item (e.g., Research Assistant(s))	Rate	# hours	Amount	Justification
2 x Complete Anatomy Educator Licenses	$66 + tax CAD/License		$149 CAD	Essential to create 3D multimedia content and access to additional resources within software
3 x Complete Anatomy Individual Licenses	$59 + tax CAD/Platform		$200 CAD	Essential for student learning; not otherwise available freely
Graduate Research Assistant	$41.96/hr (incl. 4% vacation pay)	70	$2937	Assist with analysis of data in Section E
Undergraduate Anatomy Teaching Assistant(s)	$21/hr (incl 4% vacation pay)	200	$4200	Record content from software under direction from course instructors; TA knowledge expertise will make recording more efficient
Total			$7486	

j) Sustainability

We have been in communication with ITMS and any additional multimedia would be created in collaboration with them. Video production through ITMS is a service provided to our department so the costs associated with this activity would be minimal. Any additional costs (e.g. video graphics) would be supported by the department. If our project successfully demonstrates the value of retaining the 3D AMS licenses for anatomical education, departmental funding would be requested for annual license renewals.

k) Timeline

Activities and Milestones	2019-2020												
	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Install software on devices	x												
Train instructors on software use	x	x	x	x									
Create videos with TAs, ITMS, and instructors	x	x	x										
Upload videos to LEARN				x									
Ethics Approved			x										
Data collection					x	x	x	x	x			x	
Data analysis									x	x	x	x	
Submit final report													x

References

Azer, S. A., & Azer, S. (2016). *3D anatomy models and impact on learning: A review of the quality of the literature* Elsevier BV. doi:10.1016/j.hpe.2016.05.002

Miller, M. (2016). Use of computer-aided holographic models improves performance in a cadaver dissection-based course in gross anatomy. *Clinical Anatomy, 29*(7), 917-924. doi:10.1002/ca.22766

Peterson, D. C., & Mlynarczyk, G. S. A. (2016). Analysis of traditional versus three-dimensional augmented curriculum on anatomical learning outcome measures. *Anatomical Sciences Education, 9*(6), 529-536. doi:10.1002/ase.1612

Pringle, Z., & Rea, P. (2018). *Do digital technologies enhance anatomical education?* Retrieved from https://www.openaire.eu/search/publication?articleId=core_ac_uk__::ab946b08a3667a2729bd15e9b50eea16

Wilkinson, K., & Barter, P. (2016). Do mobile learning devices enhance learning in higher education anatomy classrooms? Retrieved from http://eprints.mdx.ac.uk/17589