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## Influences on Technology Use in High School Anatomy and Physiology Instruction

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**INFLUENCES ON TECHNOLOGY USE IN HIGH SCHOOL ANATOMY AND  
PHYSIOLOGY INSTRUCTION**

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HONORS SENIOR RESEARCH PROJECT**

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## INTRODUCTION

What do you think of when you hear the words: *Anatomy lectures*? I imagine a large room with many students and a single instructor who is *conveying scientific facts* that most of us could read out of the textbook. The typical Anatomy and Physiology classroom that I think most people have experienced is just that: a lecturer delivering information to a large audience that generally remains silent. Teaching methods employed in the typical Anatomy and Physiology classroom at the high school and collegiate level have revolved around *instructor directed lectures for a very long time* and because of that I have experienced this traditional lecture-based style too frequently.

Typically instructors provide a number of PowerPoint slides as a guide; whether the guide is complete or not is up to the instructor's discretion. The instructor decides if the students will have to complete the note outline themselves, which gives them a little more independence than the alternative of having everything provided to them by the instructor. This "traditional style" is *subject to many criticisms* such as having a lack of *engagement*, a lack of *excitement*, and a lack of student-teacher/student-student *interactions* (Oliver-Hoyo & Allen, 2005). However, traditional classrooms still use a variety of technology in the form of textbooks and certain pieces of hardware as mentioned in (Mischra & Koehler, 2006; Waight et al., 2014), but these have become so common that they no longer are regarded as "technology" (Mischra & Koehler, 2006). While this style has been prevalent for some time now, a new classroom is emerging that incorporates technology and addresses all of these criticisms.

With new technology becoming available to instructors and students, the "old" classroom is disappearing. The new Anatomy and Physiology classrooms are more *interactive*, more *student-centered*, more *discussion based*, and overall *more appealing to the general student* (Pereira et al., 2007; Waight et al., 2014). Instructors can still deliver content in the traditional way, but by *incorporating technology as an aid to instruction* it allows for the creation of a multi-dimensional strategy that stimulates *active learning* (Brenton et al., 2005; Nat. Research Council, 2000). *Hands-on learning, group learning and discussion*, as well as, unique and *innovative activities* are all made possible by the use of technology.

The technology available for teaching and learning Anatomy and Physiology is *abundant and it is advanced*. Anyone can log onto the Apple Store on any iPod/iMac device or the Android Market on any Android powered device and find hundreds of apps dealing with Anatomy and Physiology. Apps that are available range from *free trials to full paid versions*, specific body systems to *fully comprehensive models*, as well as, *kids(novices) to adults(experts)*. Web resources are equally important to these computer applications because they are able to provide instructors and students with lesson plans and create an access to knowledge within seconds. That means questions that challenge the instructor can be answered on the spot and within a reasonable amount of time. Students may even research their own questions and improve discussions with their interests and knowledge. All of the hardware such as projector screen, microscope, dissecting tools, and other devices are all forms of technology that stimulate learning in the classroom (Waight et al., 2014). For that reason, Anatomy and Physiology is now *more exciting* for the science enthusiasts and general students alike.

## Purpose of Study

The purpose of this study was to understand technology application in high school Anatomy and Physiology classrooms surrounding the Grand Valley State University area. In this study, technology is most often referred to as digital computers and computer software as described in (Mishra & Koehler, 2006). I used this information to recognize weaknesses in today's teaching method, and I developed a report of technology use in the classroom. This project allowed me to explore the strategy instructors use to evaluate forms of technology, employ these various forms, and finally how they acquire their knowledge of technology resources. I found that technology use is a result of a few key factors: budget, school-adopted resources, the instructor's content knowledge, and the instructor's interest in technology. The form of technology that is used in the classroom is a result of the instructor's goals for the students, the time allotted for the goals, and the student's ability to use the technology required for the learning goal.

## **METHODS**

### Participation

I examined course catalogs for schools surrounding Grand Valley State University in order to identify availability of Anatomy and Physiology courses. I found a list of approximately ten schools and contacted the majority asking for their participation. More instructors were contacted than I could interview. This study was conducted in college prep level Anatomy and Physiology high school courses. The selected schools were based on demographics and the selection was intentional. The four schools are a sample of location (urban/rural), size, student numbers, budget, and coincidentally, instructors' experience. I looked at differences in course difficulty, types and numbers of dissections, and the content covered throughout each course. These criteria were thought to be some of the key factors that influence the availability and use of technology in a school district.

I contacted the instructors at each desired school and confirmed participation via email. The selected instructors were provided with background information of the study, a confirmation letter, and a letter informing them of the Human Subjects Review Board's approval and further contact information. They were informed that all records would be stored on the research computer and the audio recording device locked in the research file cabinet when not in use. No specific names or locations were used in order to keep the participation anonymous.

### Selected Schools/Instructors

#### *Interview 1 – High School A – Instructor 1*

- Teaching science for years
- Lots of experience in science classroom
- Technology resources readily available
- Enrollment of approximately 1400 students in grades 9-12.
- Suburban community

*Interview 2 – High School B – Instructor 2*

- Teaching science for 1 year
- Little experience in the science classroom. Lots of experience in foreign language classroom.
- Technology resources are limited
- Transition from a rural to urban area. Socio-economic status averages slightly above surrounding areas.
- Enrollment at approximately 2200 students K-12

*Interview 3 – High School C – Instructor 3*

- Teaching science for years at the high school and collegiate level
- Lots of experience
- Technology resources readily available
- Suburb of large city
- Enrollment is approximately 4,500 students for the district.

*Interview 4 – High School D – Instructor 4*

- Teaching science for years
- Lots of experience
- Technology resources readily available
- Enrollment of approximately 2,600 students K-12
- One-to-one student technology initiative for students in grades 6-12.

Procedure

I provided my research summary, research proposal, and a sample of interview questions to each participant prior to the scheduled interview sessions. This gave the instructors an idea of what to expect during the data collection period. It also gave them the opportunity to prepare some answers prior to the semi-structured interviews that took place. I conducted three semi-structured interviews and one questionnaire through email. The semi-structured interviews were no more than an hour in length. Due to scheduling complications, interview 3 had to be conducted through email as a questionnaire. The same interview outline as the face-to-face meetings was emailed to Instructor 3 for them to fill out. Because the email questionnaire did not provide the detailed responses that were received during the interview process, it is used as a supplemental resource to support the themes developed from the semi-structured interviews.

The first three interviews were conducted during the first semester of classes and covered basics of technology use and current teaching methods in the high school Anatomy and Physiology courses. The fourth interview was conducted during the second semester and dealt with deeper understanding of the themes that emerged from the first part of the study. (Script in Appendix A; Transcripts in Appendix B)

During the first semester I followed up the interviews with a classroom observation. Observations were made at High School A and High School B. The intentions of the classroom observations were to observe the classroom environment and set-up, as well as, how the instructor enacted what they described during their interview. Supplemental material collected during the meetings included lesson plan examples, activity examples, and syllabi. These materials aided in the overall qualitative analysis of the interview transcripts.

## Analysis

The interview recordings were personally transcribed and transferred to the research computer into the program Atlas.ti. Atlas.ti is a qualitative analysis research tool that allows for documents such as interview transcripts to be coded throughout a four-step process: open coding, code-family creation, theme construction, and model development. I used the process of grounded theory as defined in (Johnson & Christensen, 2012). Each day was recorded in a detailed lab notebook. The notebook explains the process of coding and the use of the program Atlas.ti. In the notebook, any and all insights that I had throughout the data collection and data analysis process are noted. To conclude the analysis portion of this study, participants were emailed the results in order to confirm the conclusions I made were accurate and correct. (Codes used in Appendix C).

## Rest of Paper

The rest of this paper includes the analysis of the interview transcripts, a discussion of the common themes and model development, and a connection to the larger literature base. The results, which include an overall summary of each interview, are broken down by instructor and supplemented by direct quotes. The direct quotes are included to illustrate the full transcripts in Appendix B. Common themes are explained through two theoretical models and definitions of the elements are provided. The final section describes some limitations and suggestions for future work.

## **RESULTS**

### Instructor 1

They have a unique style that focuses on student independence and classroom discussions. In short, the instructor's goals are directed toward the "independent learner". The key to success in the Anatomy and Physiology classroom is practice and repetition. The instructor mediates through the overwhelming technological resources. Because of their use of technology, it allows for constant formative assessment to monitor student progression toward the learning goals. Their style of "Initial learning at home and practice in class" is essentially only useful with the help of technology. Thus, the Internet gives students complete access to knowledge that the instructor takes advantage of by creating unique research activities.

This class is fortunate to experience a relatively high number of dissections. The instructor is dependent on technology for this style to be effective. The science department has in its possession 90 computers so technology is always available. However, it is preferred that the students handle models rather than iPad applications. iPad applications become useful when looking at composite imagery.

*"I think that is great when we have studied three or four systems and they have the ability to go and look at how they all fit together."*

Overall, this instructor relies heavily on technology for this teaching method to be successful. Coordinates the use of technology to target basic understanding, repetition of information, and emotion of students.

#### Instructor 2

They have a style that puts lecture as a secondary option. Similar to Instructor 1, the goals are directed toward the “independent learner”. The goals for students in this class revolve around them making their own conclusions about the material and then shaping those conclusions through classroom discussions. Past experience plays a major influence on the teaching method for this new subject. At the moment, until science content becomes more comfortable, the instructor’s goal is to develop learning skills in students before the content. Teaching them to ask questions and teaching them how to find those answers are priority. This teaching method will be redefined based on the students’ needs throughout the years.

*“I try not to shoot students down because if I show interest in what they are interested in, there will be further discussions, participation, and overall excitement in the classroom.”*

This class lacks a lab classroom and has to sign up/share lab time with other classes. The lab technology is not readily available. The instructor relies on other means to engage students rather than the flashy technology available to other schools. These include humor and excitement, as well as, any other manipulative that supplements the traditional lecture style. To them it was not only about computer-based resources; the instructor referred to any tool used in the classroom as technology more often than the others did.

Overall, this instructor believes that technology is great as a communication tool and as a compliment rather than a substitution to hands-on material. With a lack of computer-based technology, the method of instruction is different. The instructor uses other sources of engagement; the use of humor and personal interaction, hands-on manipulatives, and textbook activities allow for learning skills to be developed. Because the content seems to be more unfamiliar, the ability to learn is more important until Anatomy and Physiology instruction becomes comfortable.

#### Instructor 4

They have a student-directed and instructor guided teaching method that has minimal focus on the independent learner; thus, not an open-ended learning environment. The teaching strategy employed depends on the difficulty of the material presented in class. Criteria crucial for learning in their class are repetition, emotion, and student-teacher interactions. By sparking an emotion in the students and facilitating classroom interaction/discussion, students trust the instructor more than the Internet resources.

The most useful technological advancement for the classroom is the projector. The technology and dissections that make this class successful are readily available any day, essentially a “blank check”. Technology gives the students the access to knowledge that has created a “new” classroom completely different than 10-15 years ago. However, the access to knowledge cannot replace the personal interactions and hands on learning required for Anatomy and Physiology. “There’s a reason doctors are taught with cadavers and not computers”. They

believe there is a cost-benefit analysis of time, effort, and knowledge that influences technology use. The technology use is also dependent on self-interest, knowledge of technology, and school adopted resources. One way that all this available technology can be a deterrent to learning is that it allows students to only recognize information and answers rather than understand and communicate the content.

Overall, this is a “cutting edge” instructor who knows the ins and outs of many technological resources. Not as dependent on technology for their teaching method as the others. Students respond to review, emotion, and stories shared in class; all of which are just as effective as technology in the class. What technology gives us in the classroom is access to knowledge and a simpler way to conduct learning.

*“Its all the information the world knows on it. I think that is the number one benefit of technology as far as computers go. Access to knowledge. Flat out”*

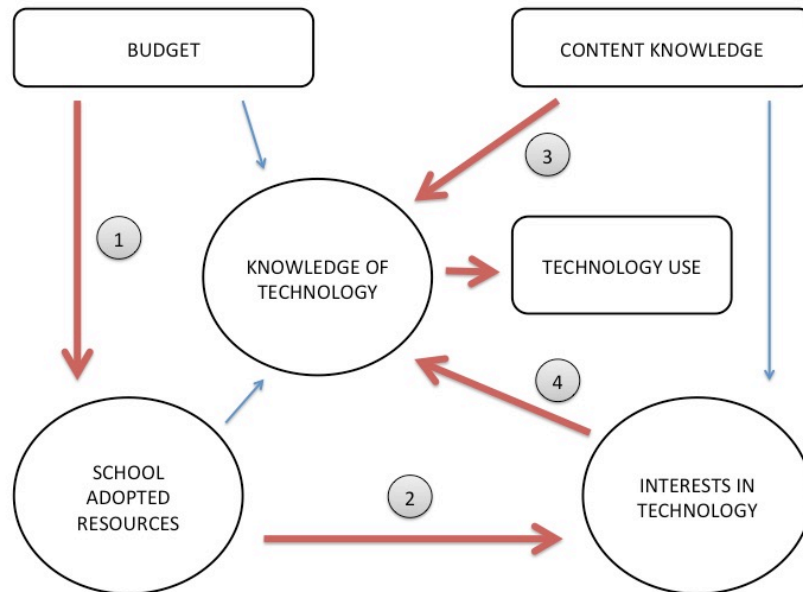
## **DISCUSSION**

Overall, the four teaching methods were similar in that the instructors all focused on similar goals for the students. All the instructors were influenced by the same independent factors, budget and content knowledge. The use of dissections, web resources, and simple computer programs were common as a supplement to lecture. The differences among schools and instructors were made apparent through the type of and number of dissections, type of technology available, and how often the technology was utilized. Each of the instructors are supportive and appreciative of technology, but may not get access to technology they think would be beneficial. Therefore, the technology such as manipulatives, labs, and dissections are a must and virtual technology, such as computer-based programs, are complimentary not a substitution to hands on demonstrations like dissections.

Two models were developed to summarize the findings of the interviews and observations conducted during this study. These findings are supplemented by direct quotes from the interview sessions (Appendix B), examples of lesson plans, and examples of activities and syllabi.



Figure 1: Amount of Technology Used



Definitions:

**Budget** – Reflects the school’s budget that in turn has an effect on the instructor’s classroom budget.

**Content Knowledge** – The amount of experience and also the comfort level the instructor has in teaching the subject of interest, in this case, Anatomy and Physiology.

**School Adopted Resources** – The resources available to the instructor through the school district such as the one-to-one technology initiative of High School D.

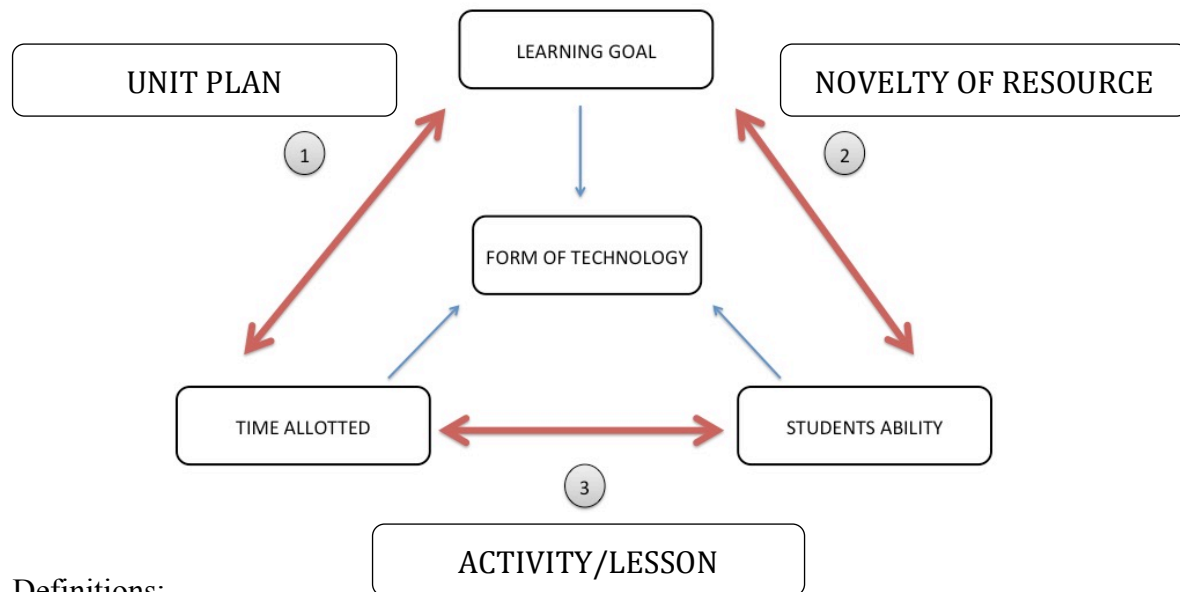
**Interests in Technology** – Reflects the instructor’s interest in the use of technology as well as their interest and willingness to learn about new resources.

**Knowledge of Technology** – Reflects the instructor’s knowledge of what is available to them in their school district as well as in their budget. Also is determined by the knowledge that the instructor has of using the technology and implementing it into the classroom in an effective manner.

Budget and content knowledge are independent factors that influence school adopted resources, knowledge of technology resources, and the interest in technology use in the classroom. The result of this interaction is the different amount of technology use that I observed in the classroom. The information from the school demographics and the majority of interviews 1 and 2 support this model.

1. School budget has a great influence on school-adopted resources, more than any other factor. The teacher will adopt the resources that are available to them in the school district. A major difference among the participating schools was the one-to-one technology initiative found in High School D.
2. School adoption has the most impact on the instructor's interest of technology. The more technology that the school has available, the more the instructor's want to use it, or will take the time to appreciate it as a resource. (Interview 4 in Appendix B)
3. Instructor's content knowledge has a great influence on the instructor's knowledge of technology. The more experience the instructor has of teaching the content, the more they will want to know what is available with regards to new technology. They will then be more adventurous as to how they use new technology in an effective manner. (Interview 2 in Appendix B)
4. The instructor's interest of technology has the most impact on the knowledge of technology that the instructor has. Having a desire to learn and use new technology will increase their knowledge of what is available to them and how they can benefit from using the new technology as an aid to instruction.

Figure 2: Form of Technology Used



Definitions:

Unit Plan – The set of lessons, learning goals, assignments, and assessments that the instructor organizes for each unit.

Novelty of resource – Reflects how new the resource is to the student. A resource can be novel or can be something that the students are familiar with and accustomed to using.

Activity or Lesson – The exercise used as part of the unit plan that has a specific learning goal and a specific amount of time that is needed to complete it.

Learning goal – The objective the instructor has for their students that is derived from the standards set forth by the school district/state requirements.

Student’s ability – A measure of how well the students can complete the task at hand, as well as, how efficient and successful they are at mastering the new resource.

Time allotted – The amount of time set aside for each assignment that is completed during the unit plan. This includes the time needed for students to learn how to use a novel resource also.

Activities and lessons, the unit plans, and the novelty of a resource are independent factors that influence the learning goals, time allotted for each goal, and the students' ability to learn and use the technology. The result of this interaction is the various forms of technology that I observed being used in the classroom. The arrows are all double-headed to signify the cyclical relationship that all the factors have on one another. Similar to Figure 1, the factors described work synergistically to influence the instructors' choice as to the amount and form of technology that is used as an aid to instruction. This model was developed from the combined evaluation of Interviews 1 and 2 with major influence coming from the responses of Interview 4. (Appendix B)

1. The learning goals and time allotted per learning goal/activity are dependent on the unit plan that is constructed by the instructor. More time will be dedicated to newer and more difficult content. If the instructor decides to use higher-level learning goals, more time will have to be set aside for group projects or independent research projects. Both examples most often are accompanied with some form of technology. (Interview 1 & 4 in Appendix B)
2. Novelty of the resource that the instructor intends to use has an influence on the learning goals and the students' ability. A newer and more complicated technology will have to be accompanied with a higher-level learning goal, and will increase the demand for students' abilities. More time will have to be spent teaching the student the content required for the learning goal because of the additional time required to learn the process of how to use the new technology. (Interview 4 in Appendix B)
3. The activity/lesson that the instructor is using for the unit plan has a direct impact on the amount of time that the lesson takes and the student's ability to complete the task. Choosing unique activities will push students to learn new things, allowing for new technology to be used as an aid to instruction. If the teacher chooses an old activity that the students do often, time allotted can be shorter and the students' abilities will not be challenged. (Interview 2 in Appendix B)

## CONNECTION TO LITERATURE

The models developed from the process of grounded theory mirrors that of pedagogical content knowledge, or PCK. PCK is the combination of content knowledge and pedagogy and is now recognized as a useful representation of how instructors handle their subject matter and application in a classroom setting (Mishra & Koehler, 2006). Our findings suggest that technology and the instructor's knowledge of technology are affected by both content and pedagogy. This is in line with Mishra & Koehler's view that the

*[TPCK] framework emphasizes the connections, interactions, affordances, and constraints between and among content, pedagogy, and technology. In this model (TPCK), knowledge about content, pedagogy, and technology is central for developing good teaching. However, rather than treating these as separate bodies of knowledge, this model additionally emphasizes the complex interplay of these three bodies of knowledge. (Pg 1025)*

Looking at the two models developed in this study, it is apparent that there must be some interaction among the content experience and the teaching methods of the instructors that elicit

the use of technology and the form of technology in the classroom. This study is a direct representation of the seven elements defined in the TPACK framework (Mishra & Koehler, 2006).

*1. Content Knowledge – knowledge of the subject that is taught or learned. (pg 1026)*

In Figure 1, I defined content knowledge as an independent factor that instructors bring to the classroom. In this study, it is referred to as the experience and comfort level that the instructor has in their subject area. Instructors 1, 3, and 4 exhibited high levels of content knowledge while Instructor 2 had high content knowledge in foreign language, but relatively low content knowledge in the subject area of interest.

*2. Pedagogical Knowledge – deep knowledge about the processes and methods of teaching (pg 1026)*

In my models, pedagogical knowledge is included in the independent factors affecting the form of technology. Constructing unit plans, developing learning goals, and creating assignments are all parts of pedagogical knowledge. Instructor 2, because of the lack of content knowledge in my assumption, exhibited deep understanding of pedagogical knowledge by knowing how to teach, knowing how to interest the students, and knowing how to develop learning skills in the students.

*3. Pedagogical Content Knowledge – teaching of specific content, knowing what teaching approaches fit the content, and how elements should be arranged. (pg 1027)*

All instructors demonstrated pedagogical content knowledge and majority of their responses referenced PCK indirectly. The teaching methods described by the participants show understanding of how students learn and knowledge of what works the best in their classrooms. (Appendix B).

*4. Technology Knowledge – knowledge of standard and advanced technologies. (pg 1027)*

The participants in this study varied in the amount of technology knowledge that they brought to the classroom. In this study, this idea is described by knowledge of technology that is influenced by budget and content knowledge. Instructors 1 and 4 exhibited more knowledge of advanced technology than Instructors 2 and 3. Yet, Instructor 2 for example, expressed interest in advanced technology but was restrained by other factors.

*5. Technological Content Knowledge – knowledge about the manner in which technology and content are reciprocally related. (pg 1028)*

Instructor 1 displayed a tremendous amount of technological content knowledge. Their style of teaching was unique relative to the other participants in this study. The content matter was taught and learned with aid of a computer everyday. It is a slight representation of a “flipped” classroom where the initial learning takes place at home and the in-class time is used for questions and discussion. (Interview 1 in Appendix B)

*6. Technological Pedagogical Knowledge – knowledge of the existence, components, and capabilities of various technologies. (pg 1028)*

This idea is clearly illustrated throughout Interview 4. The “cutting-edge” instructor knows all about what is available to their classroom and how to use the resources effectively. They also understand how the classroom has changed because of the advancements in technology use by more and more instructors. This supports the idea that the “new” classroom is very different than the Anatomy and Physiology lectures from decades ago. (Interview 4 in Appendix B)

*7. Technological Pedagogical Content Knowledge – knowledge that goes beyond all three components, and is the basis of good teaching with technology. (pg 1029)*

TPCK is the most accurate description of this study’s central idea: what influences the use of technology in high school classrooms. Instructors must have deep understanding of all three components (content, pedagogy, and technology) in order to be as successful as they can be in creating the “new” style of classroom. This study supports Mishra and Koehler’s TPCK framework by developing similar models from real classroom interviews and observations.

## **LIMITATIONS and FUTURE WORK**

The limitations of this study included time constraints and sample size. It was difficult to schedule meetings during the school year that worked well for all the participants and myself. This was an attempt at a representative sample of demographics and teaching experience, it was not large enough to be sure that the models are completely accurate. Further studies can be done to evaluate the technology use in high school classrooms specifically Anatomy and Physiology. It is necessary that these models be tested and evaluated by applying them to new classrooms in order to solidify the relationship with the TPCK framework.

## **ACKNOWLEDGMENTS**

I would like to thank all the schools and participants for their time during this study. I would also like to thank my advisor Thomas C. Pentecost, and Dr. J from the Grand Valley State University Honor’s College for giving me this opportunity.

This EXEMPT research protocol has been reviewed/approved by the Human Research Review Committee at Grand Valley State University. File No. 15-041-H.

## APPENDIX A: INTERVIEW SCRIPTS

### *Interview 1-3*

- Q: What can I expect from a typical day in your classroom?
- Q: Describe your teaching method?
- Q: How did you develop your teaching strategies?
- Q: What influences your choice of teaching strategies?
- Q: What aspects of the classroom are essential for maximum learning?
- Q: Describe some ways you have engaged students in anatomy?
- Q: Strengths and weaknesses of the classroom?
- Q: Is technology available to students in the anatomy classrooms?
- Q: How many dissections take place?
- Q: If yes, do you think technology in the classroom is beneficial?
- Q: How do you use computers in your classroom?
- Q: Are you familiar with website design and if so, have you created a website for the class?
- Q: If no, how would you introduce technology into the classroom?
- Q: Do you believe it would be beneficial to do so?

### *Interview 4*

- Q: What can I expect from a typical day in your classroom?
- Q: Describe your teaching method?
- Q: How did you develop your teaching strategies?
- Q: What influences your choice of teaching strategies?
- Q: What aspects of the classroom are essential for maximum learning?
- Q: Describe some ways you have engaged students in anatomy?
- Q: Strengths and weaknesses of the classroom?
- Q: What technology is used in your classroom? And why do you use it?
- Q: What technology is available to students that you don't use in the classroom? What computer programs are you familiar with?
- Q: Does class size determine the type of and number of dissections?
- Q: How often do you use technology of any kind?
- Q: What are some of the student's responses to the use of technology in the classroom?
- Q: In your opinion, what are some specific benefits of technology use?
- Q: What does this statement, "computer-based technology is complimentary not a substitution" mean to you and do you agree or disagree?
- Q: How would the anatomy classroom be different without technology?
- Q: How do you decide what resources to use in the classroom and how do you evaluate whether a resource is beneficial, accurate, or useful?
- Q: Would you be willing to learn about the available technology or about web-design to enhance the new style of classroom that is emerging? How did you learn about the technology you are familiar with and when do you decide to use it?
- Q: Do you think the amount of information available through technology is a setback to students learning due to them being overwhelmed, or lacking the knowledge to use the technology in the correct manner?

## APPENDIX B: INTERVIEW TRANSCRIPTS

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### *Interview 1*

*Instructor 1* - I teach a college prep level anatomy and physiology course. It's not an AP course, but it's a little bit higher level than some other intro level biology class, 10<sup>th</sup> through 12<sup>th</sup> grade.

*INTERVIEWER* – What can I expect from a typical day in your classroom?

*Instructor 1* – It mainly depends on the lesson. Today what you are going to see and this is most of the time, each chapter they have a couple sets of sections that they have read ahead of time. The sets of sections are read before even coming to class. And then what we will do is open up the computers and they will go to our website. Within this website, there's a bunch of folders and within that folder there will be a keynote or slide show presentation for each day. Mostly around 15-17 slides and each of the slides will have questions they have to answer that show them diagrams and/or illustrations. Depending on what diagrams are shown or how many questions there are, they have to write down their answers and the key will be provided at the end. Or it will be more of a check-as-you-go to make sure they understand the material. This makes sure they don't get to the end and say wait a minute, I don't understand any of that. So it depends really on what the lesson is. That is what you will see today because we are finishing the last section of chapter four notes.

*INTERVIEWER* – Are you presenting that presentation?

*Instructor 1* – No, they do it all themselves in pairs so they can go back and forth and quiz each other. That whole time I am walking around the room and that gives me the chance for one-on-one discussions. If I know there's a particular topic that they have troubles with, I will stop everyone and instruct them to go to the slide together but this way it's not a big large lecture class. That's what we do on a day-to-day basis.

*INTERVIEWER* – So your teaching method is different than the usual lecture based method?

*Instructor 1* – Yes it is, I don't lecture. I mean it depends. When we did cells I did lecture a little bit because we had a lot of videos. I think there has been two days where I have lectured at all in this quarter. Even then I only lectured to get them started and then okay now you can go back and practice it. Even when I do that like when we get to bones, I'll use my iPad and show them three dimensional views such as Anatomy 3D or medical program that I bought for seventy something bucks. But we can't put those on all the individual iPads. The kids though when we do that, they will see it and I tell them that it might be something worth investing in before you get to the college level. So I will let them experiment with mine and some will order the free-version. But the problem with the free version is that it only comes with one or two body systems. It is pretty pricey for them to just play around with. At our level, some of those programs are just too in depth. It is almost overwhelming.



*INTERVIEWER* – Most of the time, college books come with a keycard that lets you purchase online portions of the book also.

*Instructor 1* - I have anatomy revealed and I like certain parts of it and I will show it on the main screen but like I said there's a lot of information that for an intro class they don't need to know. The kids will get overwhelmed if they are seeing fifteen anatomical structures but they only need to know three of those fifteen. It's like "woah" which ones do I have to learn. Now they are studying 300 but at our level only need fifty of them. So most of the software are geared to the college level. Ill cover up a lot of those extra terms when showing a slide, I'll use arrows to point to stuff they need to be focusing on. A lot of times I will leave those terms but tell them where to focus because it is good for them to be introduced to it.

*INTERVIEWER* – How did you develop this strategy of teaching or what influences these choices?

*Instructor 1* – I think that, actually a lot of things, first that I don't want them to tune out when I am just up at the front lecturing about it. You only have small fractions of the kids that can really learn that way. Number two as far as data and understanding who is able to, I can't go from each student and listen to their conversation because they aren't making any conversations, but in this setting I can do that and I can hear their conversations and get a better idea about how their brains are working. As opposed to me saying something out loud and they processing it the same way as I said it.

*INTERVIEWER* - So a means of formative assessment?

*Instructor 1* – I would say definitely a formative assessment. It is more interesting because I can show seventeen slides and on one slide I will have five different pictures, cadaver pictures, it is just their engagement, their interest in it. Because again, it's not just one slide we will spend an hour talking about. I can show them a lot of slides and a lot of views of something. Like right now we are studying, they just finished doing body landmarks, they are standing up, pointing at things, and like this is lateral and this medial. I can actually be a part of that. That is a big part of it. We really didn't have a textbook that was printed in the last twenty years so I started with just rewriting notes for them. I used to have an abridged version of a textbook, so a one semester course book. That was really helpful but now it is a college level textbook, totally outdated, not that a lot has changed but the problem was that the previous anatomy teacher only got through four or five chapters. It's just too much. I wanted them to have a full body picture by the time we were done at the end of the year. We do every system, we do biochemistry, granted its at a basic level. It is pretty impressive in that they do a histology unit. They will take pictures using their phones through the microscopes. They had twenty four different types of tissues they had to know all the parts of tissues, what they did, and took a seventy-three question exam on it. Some were using scopes and taking it to the next generation by taking pictures, blowing those up on the computer, studying them, printing them out and labeling them, creating flashcards. It was really cool to see what we can do with that technology. It gave them a foundation where they could study at home, practice with friends, and label. We had a lot of websites to help with their learning. Same thing when we go do the bones. Students will lay them out and take pictures

from different angles and print those off and make numbered lists and label. They have to know bones, plus the bone landmarks. They are so lucky compared to when I was in high school anatomy because if you didn't get in class you didn't get it at all.

*INTERVIEWER* – Is the practical the same three dimensional models, or pictures?

*Instructor 1* – We will rotate around the lab tables, and there will be a bone at each station with questions like “what is number 1?” or “what view is this?”. They can pick some up and look as much as they want.

*INTERVIEWER* – That's really similar to the college identification tests.

*Instructor 1* – That's what I tell them, these lab practicals are the chance for you to practice. If you wait until college... then uh oh.

*INTERVIEWER* – What aspects of the classroom are essential for maximum learning? You have already touched on discussions and engagement is there anything else?

*Instructor 1* – I do think too that at the beginning of the year, like at this point in the year I can take a step back a little bit and they can run themselves. I mean I literally can be gone for a half hour and they know to go back over the slides and I don't have to put a note on the board. Like today is a review for 4.4 and 4.5, but in the beginning I have to watch them intently and every second. Otherwise, they will be off task and/or socializing. In the first couple chapters they really experience this is how you practice it and this is when you get to ask questions. There is no review day later, like “oh the test is tomorrow I better learn this now”.

*INTERVIEWER* – What about classroom organization?

*Instructor 1* – Most of the time we are back here at the dissection tables. 4<sup>th</sup> hour is a little bit big so some might want to push some desks together, but I prefer they don't because it is usually those students who want to socialize about homecoming or whatever. Really the slides I make them so they run right up to the end of the hour or have to take some home and do them if they want that extra practice. A lot of the slides are repetitive because the sections themselves aren't that big. So they'll think they got it down and then they get asked more questions. There's repetition, you don't learn something by doing it once. You learn something by looking at it in multiple views. Again this is one of the reasons that I use the slides. If I stood up there and lectured this information, the kids that could move at a faster pace would be stuck at my pace which would always be the slowest pace. While the kids that need to move slower can then go home and they know they can pull up these slides and finish them on their own. They won't have me there to ask questions though.

*INTERVIEWER* – So the slides are the homework also?

*Instructor 1* – Well there really isn't any homework. But the thing about it is that it allows them to move at whatever pace they are most comfortable at. Most of the time, 95% of the time, the students get it done in the hour. Or they feel good about the material and they jump ahead a couple slides and see that it is just review, “so I am good”. I don't grade the slides, every once in

a while I just might hold them accountable by making sure they write down the answers. I don't grade them, it is their practice and if they don't value their practice their scores are going to be low, and they know that. As far as what they get graded on, I can get you some chapter stuff and show you. This is what they will get from me at the beginning of the chapter. It is all their notes for the entire chapter. On the first day of the chapter, I assign 4-1 and 4-2. So their job is to go home and, we call it close-reading it, but really just read it for understanding and trying to know the facts. Start memorizing the terms but they know that they get time in class to practice it. I get kids that just come in and highlight notes and I know that they aren't ready. It's not close reading. I have other students who have taken notes, labeled figures, trying to understand facts, and when they come into class I try to identify and put two people who didn't come prepared together. Because now they kind of have to struggle together rather than putting them with someone who came prepared because the person who does get it just gives all the answers. It's not even about getting the right answers but they fake themselves out that they know the information. They cheat themselves. All the work is due the day of the test, sometimes they have to do research, like this question for example says "research primary peritoneal cancer". This one is a diagram with nothing labeled on it and they had to use the terms to prep the patient for surgery. This is just basic fill in the blank questions. So they have a variety of questions to practice and it is part of their grade and it is about 15-20% of the chapter. Each chapter test is about 60 questions. Those questions add up to be about 15 points, I don't grade them all, I grade certain ones. But they are still held accountable for all of them. That they do on their own so if there was any homework that would be their homework. Sometimes they go through them fairly quick, something like this would take them a little bit longer because it has a research component. Before they take the test, they get a practice test called a workbook, which I give to them in advance. But I usually tell them to hold off on it until we learned it, so they can test themselves and see how I did. So those are the handouts I give them. A lot of people equate it to the flipped learning or blended learning because they can go home and learn all this stuff on their own, they can do the reading, all the notes is all what I would have said, so now they have an in-class opportunity to practice rather than practice at home. They do the initial learning at home, and practice in class. This will be what they get for answers and I give that to them at the beginning. Most of the time they are pretty good at "I want to know this so I'll peek every once and a while, like I number 11 wrong". I tell them make sure you get the first couple right, so you don't get to number 18 and realize they are all wrong and you don't understand serous membranes at all. I give them checkpoints like check at question 4 or check at question 8. They aren't cheating me; they are cheating themselves if they just copy down the answers.

*INTERVIEWER* – What are strengths and weaknesses of this classroom, with regards to set-up not students?

*Instructor 1* – The textbook that's why I don't use it and I include a lot of research based questions.

*INTERVIEWER* – If you had a updated textbook, would you use it?

*Instructor 1* – If it was an abridged version then I might. Like if it was an essential version then yeah because at the high school level, you can't depend on learning all the information plus the readability is not for high-schoolers. Like this is the textbook we have and it is what 1000 pages.

I will set these out and if they need extra resources they can use them but most students prefer going to internet because all the information is out there if they know how to research and access it. I would rather, I guess it is a strength of this class, is that they have to do a lot of research on the internet for answers to like research questions or think of someone they know who has cancer and find out what cancer they have and do research on it. If I limited myself to the textbook, they could read about cancer but a little paragraph and wouldn't have a connection with someone they know and the current statistics on the specific cancer. Another question they had was stem cells and what impact they have on cancer research. They wouldn't have all the current information that is changing all the time. I probably wouldn't waste the money on a textbook honestly. We are going to be limited to the less expensive books. If you look at some of the questions I use the same kind of idea for the end of the sections. But really, like my students are going to do 33 questions. It's there if you want to but I limit it to four or five reasonable questions for the students who do extracurricular activities. Again this is high school, most of the students are top performers but they are also the most involved. I guess as far as advantages go it is a college level prep, not a lot of homework, but it gets sensitive to the amount they have to do and the expectations I have of them.

*INTERVIEWER* – Have you ever had a student who didn't want to be here even though this is an upper level elective?

*Instructor 1* – No but I have had students come in and think this would be easier than what it actually is or up until this point that they are inheritably gifted, so now “I have to work harder at learning this information”. Some of them come into this class with the idea that they don't have to work as hard that they will just know the information if they wake up the next morning. I think that it's like that for some because they are seniors and they have chosen easy electives and don't want to work hard, so they won't sign up for something like anatomy. Occasionally I get those students that do because they friend is in it and for two weeks they are like maybe I shouldn't have taken this class.

*INTERVIEWER* – Now do they change their opinion at the end?

*Instructor 1* – It depends. Seniors no. Sophomores yes. All the students who take it, sophomores have 98% or higher, it is not ability. If you had them raise their hand if they were sophomores those ones will be the ones who are scoring the highest. It's not about a thing they can't do. But it is definitely something to do with motivation, end of senior year, I am always like why did you want to take this class. “Because I want to be a doctor.” But do you really want to be a doctor, because someone who really wants to plan on learning this high level of information, you need more motivation than what you are showing. I try to show them that it takes effort. Don't kid yourself that you are going into an easy field because it's not. And it is a good eye-opener for them. If they want to do well they have to have their own set of passion for it. Also, there is no screening process for this class, if you have haven't scored over a 60 in any other science class you can still take it. It is likely they won't take it again next semester because it is a two-semester course. I will say though that even if you want to be a mom or dad and not go to college, it is still relevant information to real-life. Our intellect is just as important.

*INTERVIEWER* – That being said, the in-class dissections include a cat is that correct?

*Instructor 1* – We dissect the cat from pretty much January to June. We will dissect on and off. We do a sheep brain dissection, cow eye dissection, a larynx, kidney dissection, and a bunch of large organ dissections. Other technology we use that's beneficial to this classroom is other website resources.

*INTERVIEWER* - And there is a class website and that is used every day?

*Instructor 1* – Yes there is, every day. When they took the histology exam, they all had laptops out in front of them. When I took it, we always moved microscope to microscope but then there's always the worry that somebody bumps it, or is my slide moved, or the stage dropped. So that has always been a worry when I used to do it like that. At the end of the exam, I would go back and make sure nothing moved but you can never tell when it actually moved. A lot of times I was throwing out questions for fairness. I now have sat down and taken pictures of each slide, with the pointer pointing at different things. So they use the laptops and open up a slide, or slideshow, and answer the questions off of that. It makes it easier for me also because I don't have to spend time setting up twenty to thirty microscopes beforehand. I used to spend 4 or 5 hours the night before.

*INTERVIEWER* – So what exactly was the app that you use in class?

*Instructor 1* – Occasionally I will use anatomy revealed and show some examples. When I get to the endocrine system for example if I haven't found a ton of pictures for glandular secretions, I will maybe jump to that and watch some videos on that. I will show it to them quickly, I don't really use the program as much as like videos of YouTube. I will put those videos right into the presentations. The problem with that is that a lot of those times the videos are playing but all the students are on different parts of the video. I try to play the most important videos in front of class before we break apart.

*INTERVIEWER* – Does every student have his or her own laptop?

*Instructor 1* – No, my biggest class size is 22, so I get 11 laptops. We have a laptop cart that we share among the four teachers. So on any given day I have 8 computers available. Usually, the cart is being used among the four of us teachers, but it's not all thirty of them being used. For example if the teacher next door isn't using all of his, I will end up borrowing some of them. If on a day all of the teachers are using laptops, there's another cart down the hall that we could possibly use. In total for the department we have 3 carts, or 90 computers. I really don't want them doing their own work, because it's the back and forth communication that really is helpful. I also don't like groups of three and four, because it ends up one or two students dominating the conversation.

*INTERVIEWER* – If there were iPads available to all students, would it be beneficial for each student to have the app mentioned before and be able to manipulate an image in 3 dimensions? Also would it be beneficial for students to have access to such information 24/7?

*Instructor 1* – I definitely think that that is valuable. Although to me if I have the model in class, they can pick up the bone in class and manipulate it. Same thing with the full skeleton I have.

When we study the bones, they will use these. I would prefer them actually handling the models than looking at a program. To me when the iPad app becomes valuable is when you get the composites where you look at how the muscles are attached to bone, or how the tendons are attached. I can't get that from all of the models in the class. With the iPad program you are able to remove a layer and see what is underneath. I think that is great when we have studied three or four systems and they have the ability to go and look at how they all fit together. Sometimes we study it so separately that we forget to think about that. I think at this level also, that if they were given the ability to manipulate an image, they would lose some of the experience by not knowing whether it is anterior or posterior. Sometimes we just need to provide the minimum that when they get to the point where more is available, they really understand the material and what they are doing.

*INTERVIEWER* – So in your opinion, using an iPad program skips steps in between the basics and in depth understanding?

*Instructor 1* – I definitely think so. If we could at the end of three chapters just play around with it, yet I don't know if it is worth the money just to "play around with it". I feel like when my students go to that next level, they will have seen so many of those images that when they do get their hands on those programs they will understand what they are doing.

*INTERVIEWER* – As for a comparative aspect to this course, do you directly compare the cat anatomy to human anatomy?

*Instructor 1* – Yes we do. They will do a chapter on the human, so everything will be related to the human. Then we will go dissect the cat and they will get a list of cat muscles. A couple of those muscles will be marked as "not in human" or "also in human". So we go through the cat information and compare that to the human anatomy.

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## *Interview 2*

*INTERVIEWER* – What can I expect from a typical day in your classroom?

*Instructor 2* – Similar to what you observed. They usually do independent reading. I choose their readings. We do have lab days where we find time to get into the lab between the three of us teachers. That's the biggest challenge we have. I do allow them to do more study time. This is actually the very first time I have lectured of a PowerPoint. In the past, I have made notes for them so they use the book and other resources to fill them out. I spend part of my time answering individual questions, or group questions, and then spend time at the end of the chapter discussing, openly with the class, the information. I want them to study and complete the process first and then I want to lecture/discuss. Typically I let them do all the work first and then lecture rather than lecture first like I did today. This makes them come to their own conclusions. I can then notice where they are mistaking information or if there are grey areas. This clears up any misconceptions they might have.

*INTERVIEWER* – How did you develop this method, and/or what influences your choices?

*Instructor 2* – My zoology professors influence the method; one at grand valley and one at GRCC. The one at GRCC, emphasized so much that I want students to know the information and not recognize the information. I want them to always process the information, and ask questions. I have shared that every one of their tests they are required to ask a question not answered or highlighted in the book. I will give them points based on their question abilities whether it is a basic simple question or a question that is more hypothetical where they can do a minor amount of research to answer and one that would require a full research plan. I always try to get them to ask and want more information. Additionally, I incorporate reading into the grading, which is like two points a week. I make them find an article online, the subject can be anything, it can be anatomy related, health related, history of a disease in their family, so all they have to do is read it, write a summary about it, and a reaction to it. The reaction can be questions that they further have; it can be something that they thought was novel that they learned. I just want them to be excited about science. They wanted more direction on it but I told them it has to be anything they want. And that is a simple thing that I do each week. Probably the way that I developed this program is that I first went through the chapters and what are all the underlying themes so that I could make sure that they were hitting up every potential them. And obviously in anatomy and physiology there are homeostatic mechanisms, root words, and others I see. What do I want students to be solid on? Then they recognize obviously that all the subjects are intertwined. Eventually they will realize that not everything is exclusive of one system to another.

*INTERVIEWER* – What aspects of the classroom are essential to maximum learning? You have touched on discussion and engagement already.

*Instructor 2* – I feel like because this is the first year teaching this subject and my first ten years have been focused on teaching Spanish, which in its own is its own beast because it is so elementary and we don't have it at the middle school level, it has its own pedagogy, I am only just learning what works and what doesn't work. I know what worked for me but I don't presently know what works for all my students. I am going with what works for me right now. But I know I will have to modify this for an individual student after I realize when they give me answers, because majority of my questions asked are open ended questions. Sometimes they get very frustrated with those tests because they want one concrete answer to the questions. I am not going to give them easy questions like that. I want you to show me that you can draw conclusions from information. It is a learning curve for me right now. Basically I just want them excited about learning. I want them to be passionate about learning and I want them to come away with pushing themselves, working harder, designing their own strategies, because this is a college prep class and I am going to push all of them in their own unique way so they can be successful.

*INTERVIEWER* – Can you describe some ways you have engaged students in anatomy? These include homework, activities, in class discussions, or labs.

*Instructor 2* - I freely and openly let them share with me or the class things that excite them. If the student tells me privately and I think it is worth sharing in class I will share with the entire class. I just show them my general excitement for what they have to say. I try not to shoot

students down because if I show interest in what they are interested in there will be further discussions, classroom participation, and overall excitement in the classroom. Some students may perceive teachers overly excited about their subject areas and that may or may not be relevant to them personally at that time.

*INTERVIEWER* – Along with the different aspects you have mentioned, what are some strengths and weaknesses of this particular classroom set-up.

*Instructor 2* – The weakness is that this is not a lab classroom. 100%. An additional weakness is that we lack sufficient laboratory materials for all science students. Not just anatomy and physiology. Access is another weakness. I have to talk to other teachers if I want to use the lab because we all share one lab. I requested at the beginning of the year \$2500 worth of materials for the class, and I am only being promised to spend \$400. That might get sheep parts. I think that's going to get me sheep parts and scalpels. Those are limited to brain kidney eye and heart. I want pigs, and I would like brand new microscopes. Some are in desperate need of repair or replacement.

*INTERVIEWER* – The student body in your classroom is diverse with regards to wanting to learn anatomy. There are some students who don't want to be here/care about anatomy, and others are willing to work hard and learn. Granted this is your first year at teaching anatomy, but have you had a student who has changed their mind about learning anatomy?

*Instructor 2* – A present example would be something like students who are just in here for a science credit. I do need to work harder on this. There is a student who is basing all her articles on cats. It is interesting. If I know their interests, I can try to target them and say "hey I saw that you are talking about this this and this, how can we apply it to what we are learning now?". If I show general interest in what they are doing, it will take time, because I do have students that school is just not their thing. But they will get their wake up call soon. They will then think "I should have tried harder, or studied harder". I hope I can be successful and change their opinion right now. I have a number of siblings and they fall over the same spectrum and because of my situation with my siblings I can also relate to the apathy of the students. I use a lot of humor in my class to reach to them too.

*INTERVIEWER* – For my research, technology includes any supplementary tool used to increase student learning/engagement other than the typical lecture based PowerPoint. However for this classroom in particular it seems technology with regards to computer technology is not readily available. Is that correct?

*Instructor 2* – No just this year, even though not employed yet, we did purchase for each department, 30 chrome books. I have not presently employed them. As for manipulatives, I will definitely be using them. The first chapters are primarily body directions and landmarks. There is a chapter of chemistry, which covers so much information in a couple paragraphs, and my students are mixed with regards to chemistry backgrounds, so the test was open book/note because of those different chemistry levels. Chemistry will be touched upon in each system. For my chemistry class we did pH lab where we used cabbage indicators and dropping chemicals into them. It is surprisingly cheap and awesome. They realize impacts chemicals have on



biological processes immediately. So that was exciting. We learn how to associate that information to our own body in this class.

*INTERVIEWER* – Do the student ever use the computers in this classroom?

*Instructor 2* – Not yet but they will. Actually they have to email me their weekly article that they have found online. They can watch videos rather than articles and email the url link. Their response would be a summary of the video and what they got from the information. There are a lot of videos online such as TEDtalks.

*INTERVIEWER* – Is there a class website?

*Instructor 2* – Not presently, but as soon as I get the curriculum down, its happening.

*INTERVIEWER* – Are you familiar with website design?

*Instructor 2* – I know that if I go to Squarespace, I can drop and drag and make it happen. Right now my students will let me know that they lost their notes or they like a particular lesson's PowerPoint and I keep in touch with them through email. I enjoy the communication.

*INTERVIEWER* – Would you introduce an iPad program into an anatomy class for high school?

*Instructor 2* – I would absolutely love that.

*INTERVIEWER* – They would be able to use an app like Anatomy Revealed instead of having a lack of dissection they could have it on a handheld device where they can access it at home, 24/7.

*Instructor 2* - I would like them to have both, I think they need to have both, unless a parent or student had severe reservations against opening up an animal. I would want that to be a compliment not a substitution. All things are compliments; I would not want everything to be exclusively lecture or exclusively taking notes. I wouldn't want there to be just one activity taking place the entire time. Right now because they are upper level students, I can get away with four activities per hour and they won't burn me to the stake. Obviously with freshmen, I double that because their focus time is limited.

Are there any other questions that you have for me, ones that I may not have answered exactly how you intended?

*INTERVIEWER* – What are some activities that you anticipate doing in future lessons covering the body systems?

*Instructor 2* – I have a list of them written down on my computer. I made a document of resources, syllabus, themes of chapters, and I wrote a two-page list of activities for every system. They are what I remember doing and what I enjoyed such as making a life size skeleton, measuring pupil dilation, or heart rates. I also record the technology resources, I am exceptionally organized, and I will come back to these documents in years to come.

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*Interview 3 – (email questionnaire)*

*INTERVIEWER* - What can I expect from a typical day in your classroom?

*Instructor 3* - teacher explanations, student inquiry, individual work, small group work

*INTERVIEWER* - Describe your teaching method?

*Instructor 3* - students working and facilitated by teacher

*INTERVIEWER* - How did you develop your teaching strategies?

*Instructor 3* - trial and error, professional development, observing other teachers

*INTERVIEWER* - What influences your choice of teaching strategies?

*Instructor 3* - trial and error, sharing teaching strategies

*INTERVIEWER* - What aspects of the classroom are essential for maximum learning?

*Instructor 3* - student participation and organization

*INTERVIEWER* - Describe some ways you have engaged students in anatomy?

*Instructor 3* - class discussions, dissections, small group activities, reading/writing, labeling diagrams, student projects

*INTERVIEWER* - Strengths and weaknesses of the classroom?

*Instructor 3* - strength: student interest, participation, building relationships with students  
Weakness: cell phones and attendance

*INTERVIEWER* - Is technology available to students in the anatomy classrooms?

*Instructor 3* – yes

*INTERVIEWER* - If yes, do you think technology in the classroom is beneficial?

*Instructor 3* - Yes

*INTERVIEWER* - How many dissections take place?

*Instructor 3* - 2-3 – sheep brain, cat, sometimes heart (sheep)

*INTERVIEWER* - How do you use computers in your classroom?

*Instructor 3* - Webquests, student presentations, PowerPoint presentations, research projects

*INTERVIEWER* - Are you familiar with website design and if so, have you created a website for the class?

*Instructor 3* - not familiar with website design

*INTERVIEWER* - If no, how would you introduce technology into the classroom?

*Instructor 3* - GOOGLE classroom, research projects

*INTERVIEWER* - Do you believe it would be beneficial to do so?

*Instructor 3* - yes, but must be facilitated and organized

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#### *Interview 4*

*INTERVIEWER* - What can I expect from a typical day in your classroom?

*INSTRUCTOR 4* - We usually have a quiz. A review of yesterdays material. It depends on the day generally. I do a few minutes lecture, sometimes its online and they have to do it the night before for homework and that's what the quiz is over. Then we do a lab of some sort. Like right now we are doing dissections of the cat. Along with respiratory physiology labs. Some kids are working on this and some on that and they rotate because I don't have enough equipment. The general day is that, a quiz, a lecture of some kind, and lab.

*INTERVIEWER* - Describe your teaching method

*INSTRUCTOR 4* - I would say I try to make it 25-40% teacher directed lecture notes and something like that. The rest student-directed with my guidance. Not really open ended, most of it is that I know the result that they should get; lets talk about the reasons why we aren't getting that. For example lets say we are doing blood pressure and some have blood pressure readings off the board. Its generally user error and I try to guide them back.

*INTERVIEWER* - How did you develop those methods?

*INSTRUCTOR 4* - Trial and error. Yeah I used to be a lecturer with a little hands on. Now I moved to more hands on.

*INTERVIEWER* - What influences your choice of teaching strategy?

*INSTRUCTOR 4* - If the material is easy I have the students do it on their own. So for example we are doing parts of the heart and blood flow direction was the lecture for today, they are doing that for homework. Online they watch it and take notes, its just wrote memorization. If it talks about heart attacks, or concepts that are really question generating ill do that in class.

*INTERVIEWER* - What aspects of the classroom are essential for maximum learning?

*INSTRUCTOR 4* - Review, our quiz sometimes we do them sometimes we don't but I think they are essential because it brings us back to what we did last time. Emotion: I try to make every time I talk or lecture that they get an emotion out of it. Whether its happiness sadness empathy because I think it helps you remember things. And hands on materials.

*INTERVIEWER* - Describe some ways you have engaged students in anatomy?

*INSTRUCTOR 4* - Stories activities cat dissections are always engaging sometimes for the worse. Some kids do not want to do it but end up liking it a lot.

*INTERVIEWER* - What are some strengths and weakness of your classroom?

*INSTRUCTOR 4* - Strengths would be students like coming there because they do not know what we are doing every day. Weakness I would say that sometimes doing labs to them cannot be connected back to what we are doing. Most things I try to do data collection and they get lost in the data other than in the results.

*INTERVIEWER* - What technology is used in your classroom and why do you use it?

*INSTRUCTOR 4* - Smart board, projector, students have their own computers we are a one-to-one school, I use dissecting equipment, blood pressure, all kinds of scientific equipment, we have all kinds of things. I think the most essential tool for the teacher to teach and learn is the projector. We can do so many things. Project microscope images, put the cat under and throw it up on the board.

*INTERVIEWER* - And when you say one-to-one they have their own computers and take them home?

*INSTRUCTOR 4* - Yep they have it for the year.

*INTERVIEWER* - It is a laptop?

*INSTRUCTOR 4* - Yeah it is a chrome book.

*INTERVIEWER* - What technology is available that you don't use in your class?

*INSTRUCTOR 4* - I try to use it all. I don't think there is anything. We have some vernier probes that I don't use. Mostly because I haven't taken the time to learn. That's probably it.

*INTERVIEWER* - Does class size determine the type and number of dissections that you do in a year?

*INSTRUCTOR 4* - No.

*INTERVIEWER* - Is it something else financially, or budget?

*INSTRUCTOR 4* - I would say that it is more likely. Lately I have had a blank check for dissections. We have slaughterhouses in town so I can get hearts, eyeballs, kidneys, for basically nothing. The cats are expensive and it is the big expense for our science department.

*INTERVIEWER* - So if you have a large class how do you manage?

*INSTRUCTOR 4* - Just pair up or group them bigger.

*INTERVIEWER* - How often do you use technology of any kind?

*INSTRUCTOR 4* - Everyday

*INTERVIEWER* - What are some of the student's responses to the use of technology?

*INSTRUCTOR 4* - I think the one to one thing was at first, they hardly use it but now they use it all the time. I've really toned back on the use of things like the computer to get more social interaction.

*INTERVIEWER* - What are some specific benefits of technology use?

*INSTRUCTOR 4* - Knowledge. You can find out somebody in the world is an expert and you can find out the information. So if a kid asked me about neurofibromatosis it's a few keystrokes away. It's all the information the world knows on it. I think that is the number one benefit of technology as far as computers go.

*INTERVIEWER* - So in short ease of access?

*INSTRUCTOR 4* - Access to knowledge. Flat out.

*INTERVIEWER* - What does the statement computer based technology is complimentary and not a substitution mean to you and do you agree?

*INSTRUCTOR 4* - Totally, most of my students would rather me tell them about the heart. Especially the stories about the heart rather than a video of a dude from Montana tell them about the heart. Like they would rather have the social interaction than they tell me about it and I'll write it down.

*INTERVIEWER* - Does the same go for the activities that they do?

*INSTRUCTOR 4* - No. I think when they start doing activities, it switches a little bit too, because that's a social interaction also. When I'm breathing into a ... and my friend does the same. He gets 2.8 and I only get 2.7, and in this setting it becomes a social thing. Learning is a social skill; it is social. You wouldn't know anything if you didn't have someone help you learn it. You would know some things but not as much as you do.

*INTERVIEWER* - What is your take on computer based dissection compared to the real thing?

*INSTRUCTOR 4* - I have kids that try it. They would rather say "I'm not going to do the cat today so I'm going to learn online. They find out real quick that 3D is very different than 2D. I mean you don't really know about a skunk until you smell one. You can look at all the pictures of a skunk hear descriptions of what a skunk is like, and then you are around one and you get too close and it sets off, now I know what a skunk is. There is nothing like, there is a reason they don't teach doctors online labs. They get a cadaver and digging into it because that's where you really learn.

*INTERVIEWER* - How would the anatomy classroom be different without the use of technology?

*INSTRUCTOR 4* - Boring. If you mean technology in all forms, I can't imagine. I think it would be more like a college classroom, that is just lecture and you go to the lab separately. I think it would be very much less popular with students than it is now.

*INTERVIEWER* - Let's say just with computer technology? If you get rid of web resources and all of that.

*INSTRUCTOR 4* - I don't use many online programs, but I do use Moodle. Like blackboard. I use it as a warehouse for stuff. It would be like my teaching fifteen years ago. Where you came in and wrote notes for a lab, went home studied, came back and did the same thing. I think now, access of knowledge, like if a kid asked about neurofibromatosis, I don't have to go home and look it up and come back the next day. I can put it on the screen, what does it look like, what's the description of the disease, here's the gene group it's from, now it's right there.

*INTERVIEWER* - How do you decide what resources to use in the classroom and how do you evaluate the resources as beneficial, useful, or accurate?

*INSTRUCTOR 4* - I start with time. Is the time invested going to be worth what we get out of it. So if I have a new program, is it worth me having a kid do something on that because they have to learn how to do it, and then do it. Is it really worth all the time? If not I don't do it. Number two is the amount they are going to learn worth the time. So I have a kid describe how a nerve works by typing in some people talking to each other. Is there a better way. If so I use it. Can they draw a model of it quicker? Probably. Can they make a vine? Show action potential? Probably and they learn just as much, probably for sure. They all know how to use vine so I don't have to teach them anything. That is where I start; time and cost benefit analysis without writing it all out. Is the amount we put in worth what you are going to get out? Sometimes I've tried things and I'm like that was not worth it. Sometimes I try things and get rid of them and try something else.

*INTERVIEWER* - Are you familiar with Webquests?

*INSTRUCTOR 4* - Yeah

*INTERVIEWER* - Have you used them?

*INSTRUCTOR 4* - No, well I have used other peoples' Webquests. This is what the others did, what do you think, and you can use it as a resource. I have never made my student do them.

*INTERVIEWER* - How do you evaluate the accuracy of those?

*INSTRUCTOR 4* - I personally look at it first. If it is accurate, I go with it. I tell my students all the time when they are researching something, if your source is anything with ASK in the title, you better question it. It could have been anyone writing about that you don't know if its right. I try to review it first. If they are doing the research, it is always a good teaching point; how do

you know what your reading is accurate and where did you get it from.

*INTERVIEWER* - Are you familiar with web design?

*INSTRUCTOR 4* - As far as web pages?

*INTERVIEWER* - Yes and do you have a class website?

*INSTRUCTOR 4* - I do not. Well I have one but its predesigned it's like a blackboard page. I have the Moodle portal thing. I did design my class website at one time before we had Moodle, but it became too much. There's only so many hours I have in the day and I could keep it up. It's a lot of work.

*INTERVIEWER* - Did you find it helpful when you did have the website?

*INSTRUCTOR 4* - Oh it's very helpful if a student's gone. They know where to find the information. I have everything posted. If I'm not sure what I did last weekend, because snow day snow day snow day. I can go on and look here's what he posted that we did and I can look it up.

*INTERVIEWER* - Would you be willing to learn about new technology that is available to enhance the new style of classroom?

*INSTRUCTOR 4* - Yeah I would consider myself on the cutting-edge.

*INTERVIEWER* - How did you learn about the technology that you are familiar with now?

*INSTRUCTOR 4* - Word of mouth. School adopted. Google we use google drive, I taught myself how to use google docs. I taught my students. I taught other teachers how to use it. Moodle self-taught. With some help. Any other web based stuff I use, I learned from chat boards, friends, twitter.

*INTERVIEWER* - When you say cutting-edge you mean your self-interest?

*INSTRUCTOR 4* - Yeah, there are other teachers that are. The guy that teachers chem, Ryan, he is right there with me. When you are a one to one school, teachers have to be more cutting edge than if they are not.

*INTERVIEWER* - Do you believe that the amount of information available to students through the use of technology is a setback to their learning due to the overwhelming amounts of information or using the technology in the correct way?

*INSTRUCTOR 4* - Yes I think technology can be a very big deterrent to learning because they don't take the time to figure it out. They think they can google every answer. And it is a distraction. Having a computer in the classroom if they are allowed to have it open, typing notes on it, when really they are checking their email or Facebook. It can be a problem.

*INTERVIEWER* - What about with regards to anatomy iPad apps? The use of that as a study tool, is that overwhelming because you can take layers off, manipulate the image, is it medial/lateral or anterior/posterior, do you think that is overwhelming?

*INSTRUCTOR 4* - I think it can be. That's where I come in. I would go through the program, see what it's about. I say use this slide or use this cut, this is what you need to know. Here is what you don't need to know. If you see these words ignore them. I think it is the teacher's responsibility to help them with that. The farther they progress on to college the easier it will get.

Off script:

*INTERVIEWER* - What I am going to look for is how the schools differ in terms of technology available, what the teacher is actually making use of,

*INSTRUCTOR 4* - The number one use that I use them for is for kids to submit work. If they write a paper on red blood cells, like a creative writing on red blood cells that's how they submit it. They don't write it on a piece of paper.

*INTERVIEWER* - Then I use Atlas.ti the qualitative analysis tool. Then overlap the coding involved.

*INSTRUCTOR 4* - I would be interested in the final report if you would be willing to share it with me. It would be really interesting.

*INTERVIEWER* - The first round I did, I did some classroom observations to see what they were saying and how it relates to the running of the classroom.

*INSTRUCTOR 4* - I bet this has been interesting.

*INTERVIEWER* - I didn't expect it to be much. But after we sat down and interviewed three different schools and they all say something kind of different. There's something here with regards to technology use. It is just around the grand valley area so it might not be applicable across the board but that's that.

*INSTRUCTOR 4* - I mean classes are pretty much the same everywhere. It depends on who is in charge of it and what they use and what they have as infrastructure.

*INTERVIEWER* - Yeah the new classroom is emerging with technology at the forefront. And the teachers that been in the classroom for fifteen years they might not be tech savvy. Students' progress past the teachers at that point and know more about technology.

*INSTRUCTOR 4* - I will say they know more about twitter I'll tell you that. I think I've caught up now. Twitter is a very good learning tool. If you follow the right people you really learn a lot. Anything that you want to know you can find it. And you're right somebody's already learned it and they put it out.



## APPENDIX C: ATLAS.TI CODING RESULTS

### CODES-PRIMARY-DOCUMENTS-TABLE (CELL=Q-FREQ)

Code-Filter: All

PD-Filter: All

Quotation-Filter: All

CODES	PRIMARY DOCS				Totals
	1	2	3	4	
advantages of technology	3	3	1	6	13
class website	2	1	1	2	6
classroom advantage	0	0	0	2	2
classroom disadvantage	2	1	1	0	4
classroom discussion	0	2	1	2	5
classroom dissection	1	1	1	1	4
classroom strengths	0	0	1	1	2
college prep level	3	2	0	0	5
comparative dissection	1	0	1	0	2
Course level	3	1	0	0	4
determining dissections	0	0	0	1	1
essentials for learning	0	0	0	3	3
formative assessment	2	1	0	1	4
group learning	3	1	2	0	6
knowledge application	0	1	0	0	1
materials evaluation	0	0	0	2	2
method development	0	0	0	3	3
motivation	1	1	0	0	2
setbacks of technology	4	1	1	3	9
student-teacher interactions	1	2	1	2	6
student engagement	1	5	1	1	8
student independence	3	3	1	0	7
student inquiry	0	0	1	0	1
student participation	1	0	1	1	3
student preparation	1	0	1	0	2
teaching method	10	4	2	2	18
technology appreciation	5	2	1	4	12
technology use	13	4	2	3	22
twitter as a tool	0	0	0	1	1
unique student activities	1	2	1	0	4

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