



Virtual Immunology

Needs Analysis

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October 17, 2000



Problem Statement

The Immunology Course in the Physician Assistant (PA) Program in the School of Science and Health at Philadelphia University has no lab facility to provide students with hands on experience with microbial interactions.

The professor has observed that students have particular difficulty grasping direct/indirect immunofluorescence, viral-induced hemagglutination, complement fixation, and double diffusion precipitation reactions.

The media Dr. Cundell has at her disposal to present the material cannot visually depict the concepts and chemical reactions she needs to teach. She only has two dimensional, static media (blackboard and overheads) to graphically depict the chemical reactions she needs to teach. These chemical interactions occur in motion between three-dimensional molecules in the physical world.

Audience Analysis

The students taking the immunology course are predominately those in the Physician Assistant Program in the School of Science and Health at Philadelphia University. This highly competitive graduate program is comprised of motivated learners required to maintain a B average. Experience with computers varies widely among students. The majority of these students live on campus. The learners tended to be interested in rich visual presentation of chemical reactions and text explanations.

Instructional Environment

Learners will be using this program on their own time. They will be required to complete the instruction and assessment individually. Once in class, the professor will debrief the students and discuss the material that was presented. At this point, if any of the students are missing any knowledge, they will have the ability to revisit the program and fill in those gaps.

Technical Environment

The following information about the environment in which the Instructional Multimedia (IMA) will be used is based on an interview with members of the Office of Information Technology staff, directed by Rob Weiss. This information is critical to the design and delivery of the final instructional product.

- There are 4 student labs in Search Hall
- All computers are PC platform with CD-rom and IE 5.0
- Network connection is a shared T-1
- Private network folders or web pages can be created for specific user groups
- The network is capable of handling simple 3D animations
- The OIT staff would allow testing of the program during development



Sources and Types of Information

The following resources will be utilized throughout the project. Additional sources will be added as used.

- Subject Matter Expert (SME) and Client Diana Cundell - Dr. Cundell's expertise was utilized to develop the vision, content, learning objectives, entry-level skills, exit skills, student profile and the instructional problem for this Instructional Multimedia Application.
- Former students – Former students were surveyed to gain an understanding of the strengths and weaknesses of the presentation modalities, and the specific instructional needs for this course.
- Prospective students - Prospective students were surveyed to assess learning styles, technological background, attitudes towards computer based supplemental materials, and delivery mode of the program.
- Rob Weiss – Rob Weiss was interviewed to gain an understanding of the technical parameters of the Philadelphia University network.
- Mary Malinconico – Mary is the Internet SME for the program and will be consulted for web development concerns.
- Phil Charron and Russ Starke– Phil is a technical subject matter expert for Macromedia Authorware and instructional design. Russ is instructional design and information architecture subject matter expert. Both will be utilized for clarification and guidance throughout the design and development process.
- Internet sites – Design sites and content sites that will be utilized in the development of this project are:
 - <http://medtech.cls.msu.edu/ISL/immunology/immune.htm>
 - <http://www.mdli.com/support/chime/default.html>
 - <http://www.bio.davidson.edu/Biology/Courses/RasMol.html>
 - <http://www.egroups.com/group/mc82vil>
 - <http://mime1.marc.gatech.edu/MM Tools/NQ.html>
 - <http://mime1.marc.gatech.edu/MM Tools/NIP.html>
 - <http://mime1.marc.gatech.edu/MM Tools/MMDM.html>
 - <http://mime1.marc.gatech.edu/MM Tools/NADA.html>
- Immunology Course Material – Material provided by Dr. Cundell and other material such as Foundations to Microbiology and the supplemental CD-rom.
- Instructional Design Course Material from prior Instructional Design courses.
- Technology Resources and Resource Material – Alex Kerr; 3D artist at NYU design student; Andy Jenkins, Lightwave subject matter expert.



Tools and Techniques

The tools and techniques utilized to gather information for this project include interviews and surveys of past and prospective students.

Interviews were conducted with Dr. Diana Cundell, Ph. D. Dr. Cundell is the client and SME of this project. As our client, an interview provided an opportunity to learn the scope of the project, her expectations and the perceived problem. As SME, we have regular meetings with her to learn the material.

Surveys with former and prospective students were conducted. This was the best instrument to reach the maximum number of students within the time constraints presented. Observation of class was not an option because the class is not currently being offered.

An e-mail interview with Rob Weiss, Head of the Office of Information Technology (OIT) at Philadelphia University (PU) was conducted to learn the parameters of the Philadelphia University network and to learn the hardware specifications in the campus computer labs.

Data Collection Procedures

(See Appendix A for original surveys and interview questions)

General information for the project was collected by means of an interview with Dr. Diana Cundell. At a scheduled meeting, we discussed many aspects of the project and asked for her opinions and input. Her responses to our questions were then summarized and sent to Dr. Cundell for her approval.

Our technical data was collected by means of an e-mail interview sent to Rob Weiss.

For the students' technical knowledge and learning preferences, we designed two surveys, one for graduates of Dr. Cundell's class and one for students who will be taking this class in the Spring Semester, 2001. These surveys were e-mailed to Dr. Cundell and then forwarded to the appropriate students. The students, in turn, completed the surveys and returned them to our project manager, Jesse Berg.



Summary and Interpretation of Data

(See Appendices B and C for interview, summaries, and raw data)

Prospective Students

The following list represents a summary of the data collected from the student questionnaires.

Computer Experience

- 20% have less than one year of computer experience
- 40% have 2-4 years of computer experience
- 40% have 4+ years of computer experience
- 60% are very comfortable using a CD-rom
- 40% are somewhat comfortable using a CD-rom
- 20% are very comfortable using the internet
- 80% are somewhat comfortable using the internet
- 60% have access to a computer at home
- 1 respondent knew the specifications of their home computer
- 100% have logged onto the PU network
- 100% would be willing to use campus labs for supplemental material outside of class

These data suggest that the audience for the instructional multimedia application is relatively inexperienced with technology. Sixty percent (60%) have less than four years experience using computers and only one (1) respondent knew basic information about his/her computer, such as processor speed and browser type.

Of the surveys returned, the students revealed a slightly greater comfort using a CD-rom than the Internet. Additionally, all of the students polled have logged onto the Philadelphia University Network, and therefore have some experience with certain characteristics of computing systems.

Preferences for Instructional Delivery

- 67% would have preferred supplemental materials in print
- 0% would have preferred supplemental materials in on-line text format
- 20% would have preferred supplemental materials in an online tutorial

These results do not have to add up to 100% because ranked preferences allowed multiple answers in any given category. The data shows that printed materials are comfortable to students. These results are discussed in more detail in the following section entitled "Preference of Delivery of Supplemental Material."



Perceived Value of 3D Animated Models versus Current Visual Aids

- 33% strongly agree that 3D animated models would have made it easier to understand the concepts of Immunology than the overheads and diagrams presently used.
- 67% somewhat agree that 3D models would have made the concepts easier to understand than the visual aids presently used.
- 0% responded that 3D animated graphics would have made the concepts more difficult to understand than the presently used models.

All respondents stated that to some degree, 3dimensional models would have made the concepts easier to understand than the overheads and diagrams presently used.

Thirty-three (33%) percent of students strongly agreed that 3dimensional diagrams would make the concepts easier to understand than traditional classroom overheads and sixty-seven (67%) somewhat agreed with this assertion. Additionally, in open-ended question number 11, 40% specifically identified the quality of visual aids as a factor.

Student Descriptions of Preferred Classroom Learning Conditions

- Visual aids
- Interactive teaching
- Interesting presentation
- Review of case studies
- Research projects
- Diverse presentation techniques (such as video and audio) to supplement lecture

The student response to open ended question number 11, identified that future Immunology students have preferred classes with strong visual aids, multiple styles of delivering materials and clear presentation to enhance knowledge acquisition. Additionally, higher order cognitive activities, such as those demanding analysis, synthesis and evaluation were specified as valuable qualities in the preferred classroom.

Former Students

The following list represents a summary of the data collected from the student questionnaires.

Best Aspects of Immunology Training

- Content of class (i.e. causes and treatments of diseases, forms of immunity)
- Written assignments (i.e. mock patient histories, research)
- Group debates
- Breakdown of material into instructional packets
- Professor's notes
- Accessible professor, receptive to questions



Students overall, identified the greatest strengths of the class the conscientious, thoughtful and attentive leadership of Dr. Cundell. Her supplemental notes, group debates and discovery-learning based research projects were all identified as positive attributes of the class. These activities fall into higher order categories of Bloom's Taxonomy, such as application, analysis, synthesis and evaluation.

Worst Aspects of Immunology Training

- Lack of visual aids to learn about reactions
- Better visuals would have helped clarify and differentiate the processes
- Found it hard to visualize the reactions
- Lack of a laboratory to go along with the class

All former students identified either the lack of visual aids or the absence of a laboratory experience as weaknesses in the class that limited the ability of the students to grasp the concepts to the fullest. In examining question 2 of the graduate questionnaire, students gave the following comments:

- "The worst aspects were not having much visual aid to learn about antigen/antibody interactions . . ."
- "Occasionally, all the different information began to get mixed up. Better visuals would have helped me keep the different processes straight."
- "I found it hard to visualize the reactions of immune responses. I would have liked to see more pictures or videos."
- "If there was one thing I would change, is to apply a Lab with the course."

Clearly, the theme in these responses is that there is a desire for better visuals in the course, because they would help illustrate the processes.

Preferences for Instructional Delivery

- 67% would have preferred supplemental materials in print
- 50% would have preferred supplemental materials in on-line text format
- 33% would have preferred supplemental materials in an online tutorial

These results are discussed in more detail in the following section entitled "Preference of Delivery of Supplemental Material."

Perceived Value of 3D Animated Models versus Current Visual Aids

- 50% strongly agree that 3D animated models would have made it easier to understand the concepts of Immunology than the overheads and diagrams presently used.
- 50% somewhat agree that 3D models would have made the concepts easier to understand than the visual aids presently used.
- 0% responded that 3D animated graphics would have made the concepts more difficult to understand than the presently used models.

All respondents stated that to some degree, 3 dimensional models would have made the concepts easier to understand than the overheads and diagrams presently used.



Preference of Delivery of Supplemental Material

Prospective Students

In question 9 of the prospective student survey, results were inconsistent with other data collected, and warrant careful interpretation.

This question asked future students of Immunology how they would prefer receiving supplemental material for the course. In questions 10 and 11, students described that they would like clear and rich visual aids. However, in question 9, students requested printed materials as first choice, then text-based materials, then on-line tutorials as a last choice. They responded with the following numbers:

| | Printed Materials | On-Line Text | On-Line Tutorials | Other |
|--------------------|-------------------|--------------|-------------------|-------|
| Most Preferred | 3 | 0 | 1 | 0 |
| Somewhat Preferred | 1 | 2 | 0 | 0 |
| Preferred Less | 0 | 2 | 3 | 0 |
| Least Preferred | 1 | 0 | 0 | 0 |

It can be seen that print materials are the most preferred and on-line tutorials are least preferred. They are even less desired than on-line text. These results raised the following questions: Do the students understand what an on-line tutorial is? Do the students have an idea of the visual potential of the on-line environment? Were our directions clear? Was this question ambiguous or misleading? Do students understand that three-dimensional figures are possible in a computer-based tutorial? The results of this question contradict to questions 10 and 11, which are simply stated questions that reveal interest in rich visuals.

Due to the limited computer experience of the students, it is possible that students were confused by question 9. The more clearly written questions 10 and 11 revealed deep interest in rich visuals.

Former Students

The results of question 3 of the former student survey yielded similar results to that of the prospective students survey question 9. A similar interpretation is warranted.

Unexpected Meaning

The results of this question demonstrated that the wording of the question, as intended, was misleading. However, the results seem to reveal an unintended facet of the prospective students' attitude towards on-line learning. These students responded that their least preferred method to receive supplemental training was in the form of on-line tutorial. They also described the virtue of and desire for 3D animation to depict the chemical processes. One student specified video as an effective manner to study scientific processes. These same students reported a relatively low degree of computer experience. It is plausible that these students neither know the potential for multimedia



to depict processes in three-dimensional animations through video. It is also possible that these students, who in general are not advanced with technology, may have an attitudinal aversion to an on-line tutorial. Familiarity with the text-based format may have led these students to select printed materials, and secondly on-line text as preferred method of receiving supplemental materials. Lack of familiarity or understanding with on-line tutorials may have induced these learners to select on-line tutorials as last choice, despite the fact that an on-line tutorial is capable of meeting the other demands of these learners.

Subject Matter Expert

Dr. Cundell is open to any suggestions that will enhance her students' knowledge of immunology. She described that her current method of presentation, two-dimensional overheads does not accurately convey the information to her students. She would like to see the development of a multimedia program that would provide her students with a more realistic view of some important concepts in her course.

She sees the product as a standalone program that will teach the students about topics in immunology. The students will have a chance to interact with the program in what would be a virtual laboratory, where they will make predictions, record observations, and draw conclusions. She would like the students to complete this program individually, outside of class, and then discuss their findings as a group. She is concerned with security and academic honesty issues concerned with such a program, and insuring that students do their own work in an electronic environment.

The required topics have been prioritized in case time dictates a smaller scope than anticipated. Each module should be 15-20 minutes in length. She has also provided us with a wealth of other resources including textbooks, former students, prospective students, and her expertise. She does not know of any other professors that teach a similar course.

She describes the students that this will be designed for as intelligent and highly motivated, adding that they will use campus equipment if required.

Implications for Instruction

The former and prospective students in the Immunology class responded to questions designed to illuminate their experience with different forms of computer technology and their learning style preferences. The results of these surveys are intended to help determine how to deliver the IMA (web or CD-rom), the level of complexity and nature of the interaction within the program, how to present the material in accordance with the learning styles of the audience, and how to determine the location where students can be expected to do the Instructional Multimedia Application.



Delivery Method

One conclusion that can be drawn of the data regarding delivery mode is that the IMA cannot be hosted on the Internet. There would be highly challenging bandwidth restraints caused by trying to deliver the type of instruction that the students requested over a dial-up modem connection. Additionally, an Internet hosted program would complicate the security concerns that the client has.

A network hosted IMA is a viable delivery method. Technically, the IT Department of Philadelphia University has the capability of hosting a private folder, accessible only to group members on the Philadelphia University Network. This has been done for professors in the past.

The results of our survey do not clearly dictate whether the IMA that we produce should be hosted on the PU Network or on a CD-rom. Most respondents were comfortable with CD-rom and web-based delivery, as all students reported being at least somewhat comfortable with navigating the Internet and only one respondent stated that they were uncomfortable with using a CD-rom. All students reported that they were willing to use campus labs to do additional work, and know how to log onto the PU network.

Based on the survey results, upcoming Philadelphia University Immunology students would be receptive to a CD-rom or locally hosted Philadelphia University network based IMA. The client does not have a preference between these options. The final decision will be made after testing the graphics on the Philadelphia University Intranet and on a CD-rom. Ease of development and quality of the animations in both CD-rom and Intranet format will steer the final decision of how to deliver the product.

Level of Complexity

Since the students are not highly advanced with the use of computers, the IMA should be very intuitive and assume very little experience with computers. Simplicity of operation should be complimented by simple instructions, limited use of technical terms, and a glossary. Help and glossary functions should be clear and easy to use. The interface should be intuitive, building more on understanding of science than familiarity with computer interfaces.

If the unintended results of student questionnaire number 9 are true, then the program has to be so intuitive and motivating that it overcomes the attitudinal aversion to on-line tutorials that the students brought to light. Perhaps the instructor will also need to prepare and orient the students to the program before asking the students to simply attempt it on their own.



Learning Style

To most effectively teach immunology to the students in the PA program, the combination of text and visually presented material will be utilized. This decision is required because students reported a comfort and preference for printed materials, yet relate a clear desire for visual representation of chemical processes. One student stated “visual aids such as 3D movies or short clips on DVDs (like we had in General Biology) might help students to learn the mechanisms by seeing them in motion.” Many students echoed this sentiment, which dictates that material be depicted in 3D animated fashion when possible. Learners also specified that experimentation would have enhanced the learning experience, therefore, manipulation of molecules should be built into the IMA that is developed, in order for students to learn from experimentation. Material presented with text explanation and 3D diagrams should assist in knowledge acquisition. Prediction, observation, analysis and experimentation with the subject matter should address the higher order cognitive functions that the students outlined as preferences in the ideal classes.

Location

The IMA will be accessible in Campus Computer labs, whether it is network hosted or whether it is delivered on a CD-rom. All prospective students expressed willingness to spend extra time outside of class on campus on this supplemental material, and the campus labs have the necessary hardware to host such a program.

Instructional goal

Students will learn the tests routinely used by immunologists by making predictions based on instructional situations, observing interactions and interpreting the resulting data.

Learning outcomes

For each segment of the IMA, there are specific learning outcomes that students will be responsible for.

- Students will demonstrate the differences between a species-specific antigen and a family specific antigen.
- Students will successfully predict the degree of infection on a patient based on the level of viral hemagglutination and the level of antibody in a specimen.
- Students will be able to determine the degree of bacterial infection in a patient by observing and analyzing the level of hemolysis seen in a sample.
- Students will demonstrate the steps in the Monoclonal antibody production test.



Content outline

The following topics in immunology will be instructed and tested in the IMA:

- Pretest of Immunology Terms
- Immunofluorescence Testing
- Hemagglutination reactions
- Complement fixation
- Techniques for producing monoclonal antibodies
- Final Test

Scope

The Virtual Immunology Project will provide a cyber-lab for the students of the Philadelphia University Immunology Classes. The project will be a standalone application that students will be required to individually complete before certain dates. Following their experience, the instructor will debrief the students in a classroom setting.

Since Philadelphia University has no immunology laboratory facilities available, the students are faced with learning three-dimensional interactions using static, two-dimensional graphics. This lab will provide the learners with an opportunity to observe a more realistic representation of four topics discussed in the course. These topics are Immunofluorescence Testing, Hemagglutination Reactions, Complement Fixation, and the Technique for Producing Monoclonal Antibodies. The virtual lab will begin with a pre-test and will then provide users with a choice of these four modules. One limitation is the amount of material and the allotted time to complete the project.

The results of the needs analysis show that the program could be effectively implemented on the Internet or on CD-rom. There are benefits and limitations to both forms. First, in order to accurately portray the required concepts, the use of three-dimensional modeling and animation software is required. This will produce larger file sizes possibly eliminating the Internet as a delivery medium. However, the idea of using the University network would still enable the development of a web-based product. On the other hand, a CD-rom will limit both the number of students that can complete the instruction at one time and the ability to send results to the instructor via e-mail.



Timeline

| | |
|-------------|--|
| October 16 | Meeting with SME |
| October 18 | Group Meeting |
| October 19 | Analysis Document Due |
| October 23 | Group Meeting with SME Initiate discussion of Prototype I |
| October 26 | Class |
| October 30 | Group Meeting with SME Rough Draft |
| November 2 | Sample Lightwave models saved in different formats Class Questions Due Conceptual Design Drafts |
| November 6 | Final Draft Prototype I |
| November 9 | Class Prototype I Conceptual Design Presentation |
| November 13 | Group Meeting Discuss Media Selection Initiate discussion of Prototype II |
| November 16 | Class |
| November 20 | Group Meeting Initiate discussion of Graphics |
| November 23 | THANKSGIVING |
| November 27 | Group Meeting |
| November 30 | Class |
| December 4 | Group Meeting Rough Draft of Prototype II |
| December 7 | Class Questions on Final Design Drafts |
| December 11 | Group Meeting Final Draft of Prototype II |
| December 14 | Class Prototype II, Final Design Presentation |
| March, 2001 | Alpha Version |
| April, 2001 | Beta Version |
| May, 2001 | Final Version |
| May, 2001 | Multimedia Expo 2001 |