A post participation review of the University of Virginia's on-line graduate credit physics course for teachers *PHY 605: How Things Work I*

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The University of Virginia (UVa) Physics Department offers a series of on-line graduate credit courses intended for physics teachers who are pursuing their master's degree, or who want to expand their physics content knowledge as part of their professional development. Here I present a post participation review of PHY 605: How Things Work I, which I took in Fall 2005 for credit toward my M.S.Ed. (Physics) degree from Buffalo State College. I found PHY 605 very worthwhile in both increasing my Physics content knowledge and teaching me simple and relevant demonstrations and concepts that I could directly use in my own high school physics classroom.

In Fall 2005, I was teaching both High School Regents and General Physics classes in Rochester, New York, and working toward obtaining my M.S.Ed. (physics) from SUNY- Buffalo State College [Ref 1], that satisfies the masters' degree requirement for my NY professional teacher certification. The ninety-minute commute from Rochester to Buffalo for evening classes was fairly discouraging during the school year (particularly in winter), so I chose to take PHY 605 from the University of Virginia (UVa) on-line offerings.

I had a couple of courses to choose from and I chose *PHY 605: How Things Work I* for a variety of reasons. In my General Physics course I felt that it was particularly important to connect what the students do in class to real life experiences and I thought that this course would help me make more of those connections. I also chose this course because I had heard of the text *How Things Work* before. This was a very popular book and I figured that something this popular was probably worthwhile.

The University of Virginia Department of Physics course *PHY 605: How Things Work I* was described in the department online literature [Ref 2] as:

". . . a practical introduction to physics and science in everyday life. The course considers objects from our daily environment (baseballs, frisbees, roller coasters, vacuum cleaners, rockets, clocks and much more!) and focuses on their principles of operation, histories, and relationships to one another. This course emphasizes motion, mechanics, liquids, heat, gases, and sound. The demonstrator and lecturer is professor Lou Bloomfield, who has originated and developed the courses *How Things Work I and II* at UVa." [Ref 2]

Half of all students taking these online UVa graduate physics courses for teachers [Ref 2] find out about them by searching online; courses with similar intentions are also offered through the NTEN network [Ref 3]. At the UVa web site there are pages offering detailed information about each course that UVa offers, as well as links to each course's home page, and explanation for how to register for courses. Course prerequisites are a four-year degree and a teaching license; however this information is not verified when registering for the course. [Ref 2]

My total cost for the three credit PHY 605 as an out of state student in Fall 2005 was just over $900. In state students received a price break of $300. In addition, the textbook *How Things Work: the Physics of Everyday Life [Ref 4]* by Louis Bloomfield of UVa physics costs about $80. After registration, I received access to the UVa *Blackboard Learning System, WebAssign* (an online homework system)*, the Horizon Wimba Audio Chat Room* (hereafter referred to as chat room), and a UVa e-mail address. [REF 5,6,7] Students also received by mail ten CDs of videotaped lectures by Professor Louis Bloomfield teaching his undergraduate "How Things Work I" course. These were shipped upon registration for the course and reached most students in two weeks, however some students received their CDs late because they registered late for the course.

To succeed in this course a student needed a fairly modern computer with Internet access, an e-mail account, Acrobat Reader, and RealPlayer (to watch the CD lectures). It was also helpful to have a DSL, cable modem or other fast internet connection (dialup is too slow), computer speakers and a computer microphone for the chat room. The instructions to get to everything else needed for the course was available on the course web page and the instructor e-mailed separate, more detailed, access instructions to each student.

There were several components to the course including bi-weekly reading and homework assignments, the ten discs worth of lectures to watch, and thee exams plus a final. The first two exams were multiple choice and the final was multiple-choice, however the third exam was different. Instead of answering multiple choice questions, students were asked to write multiple choice questions that were then graded on a rubric. As an option students could also participate in an asynchronous online *BlackBoard* [Ref 5]

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forum which students could post questions or ask other students questions about the course. Once a week there was also audio/internet help sessions led by the instructor using *Horizon Wimba Chat Room* [Ref 7].

My instructor of record for the course was Dr. Richard Lindgren, (not Prof. Bloomfield the CD lecturer). The instructor wrote the homework work assignments, tests, and led the on-line chat room. There were on average three hours worth of CD lectures to watch each week, plus about fifty pages of textbook reading. A typical homework assignment consisted of three demanding conceptual questions with six parts each such as the following question:

"Two identical toboggans leave the top of a steep hill at the same time. Imagine that you are in one of them, by yourself. The other is occupied by six people.

a. Neglecting the effects of air resistance and friction, which toboggan will reach the bottom of the hill first? Defend your answer.
b. During the descent, your toboggan brushes up against the six-person toboggan. Which toboggan will experience the largest change in velocity as the result of the impact? Defend your answer.
c. You decide to take a steeper route down the hill. How will your speed at the bottom of the hill be affected?
d. Before each downhill run, you must pull the toboggan back to the top of the hill. Explain how the toboggan's gravitational potential energy changes on the way up the hill and on the way down.
e. When are you doing (positive) work on the toboggan?
f. When is gravity doing (positive) work on the toboggan?" [ref 8]

Each part of the question required a couple of sentences for an answer. On *BlackBoard* there was a space to discuss each part of the question with your peers taking the course. The instructor would also answer questions, but more often it was students answering other students questions.

Although this course was very similar to PHY 105, taught by Professor Louis Bloomfield, there were some key differences that made this course appropriate for an upper level physics course. Many beginning physics teachers have difficulty conceptually understanding physics, and the homework sets in the PHY 605 course were designed to challenge students' conceptual knowledge. These questions were more difficult than those questions asked of the PHY 105 students. Another key difference between the two courses is that PHY 605 had the students write their own conceptual questions, this is something that teachers would be doing in their own courses. Blackboard also allowed some collegiality between new teachers. Lesson plans, good books, and other ideas were exchanged through this forum. I must admit that some of the homework questions stumped me and I had to post messages to *BlackBoard*.

BlackBoard was organized particularly well. The instructor created a separate spot for discourse upon each homework questions, so students could immediately find the information they were searching for. It was very helpful to be able to read and reread responses from both the instructor for the course and the other students. The downside was that sometimes it took a day or two to get a response. This meant that completing homework at the last minute sometimes left me with little or no help. A procrastinator's only hope was that someone more responsible asked the same questions and that a discussion of the homework question he or she was struggling with had already ensued.

Besides posting to blackboard, struggling students could get help with homework assignments and test material in the audio chat room every Wednesday. The chat room was not required for the course, but it was helpful to get to have verbal conversations with classmates and the professor. In order to be able to properly use this technology a student needed speakers and a microphone for their computer. Although it was possible to participate in the chat room without a microphone (by listening to the voice chat through the computer speaker and typing in a response), the instructor suggested he would require students to have a microphone and audio in order to participate in the chat room for future course offerings. Dr. Lindgren strongly felt that students without these tools could "not put enough information down fast enough" by typing. [Ref 9]

Chat room sessions were held every Wednesday at eight in the evening and lasted about an hour. I found the on-line audio chat to be extremely helpful, and the software very ingenious. A student could have a conversation on the computer like talking on the phone. Students took turns to speak by raising their hand (pressing a button), and the teacher could ask open-ended questions in which all students could write a response and anonymously post it to open up the question for class discussion. Teachers could also post pictures and diagrams for students to look at. However, the chat rooms were poorly attended with at most seven people showing up out of sixty-seven students. The instructor did not make attendance to the chat room mandatory, preferring that only students who really needed help attend the chat room session. The instructor also commented that the chat room sessions were more popular in his spring 2006 semester classes. Lindgren intends to keep chat room sessions on a voluntary basis. [Ref 9]

Three of the four exams, including the final were multiple-choice format consisting of approximately fifty questions. Each three hour exam had to be taken without notes or other resources, and students had to nominate a proctor for each exam. The instructor of record took considerable pains ensuring the security of the exam taking process. The exams were very different from the homework, and extended beyond homework topics -- on several occasions topics or ideas that weren't discussed in the homework appeared on exams. It was important that a student read the text, watched all the lectures, and memorized the formulas from the book. Students were expected to memorize formulas for exams, and had to be particularly careful when reading exam questions.

One word may make a difference between a correct answer and an incorrect one.

I really enjoyed the third exam, in which students were asked to write an exam with fifteen multiple-choice questions. The grading rubric was very well defined and I learned a lot trying to make up interesting and conceptually challenging questions. I felt this assignment really tested my understanding of the material and not just trivial facts that I may or may not have learned. It was also directly relevant to my profession as a teacher.

The material in the course was difficult for students who did not have a physics background, and relatively simple for those students such as myself who did have a physics background. I was able to do the first assignment without reading the book or watching the videos. However, I had had relatively little experience in the later topics of Fluid Mechanics and Heat, and I found that I learned a great deal conceptually from these classes. This course definitely is not for those who are computer neophytes or phobic; however, I consider myself functional in being able to use the computer and I only had one minor difficulty with the technology.

The class also helped to build my conceptual knowledge quite a bit. This was a physics course, not an education course. The classes on the CDs were at a college freshman physics class level, so I was able to do other things like laundry, dishes, grading papers, etc. while I watched the videos. The videos were worth watching however as Professor Bloomfield had several creative and entertaining ways of explaining concepts along with many intriguing demonstrations that I have since been using in my classroom. One such example was a demonstration of tying a banana to a string and hanging it from the ceiling. The banana can be cut with a knife even though the banana is not pressed against another object, like a cutting board. Bloomfield used Newton's first law to explain this concept. My students really enjoyed this demonstration and it helped engage them. I am also planning on using some of Professor Bloomfield's lectures on fluids in my General Physics class. Any graduate class that I can turn around and use in my classroom later that week was well worth the time spent taking it. I recommend this course to teachers even those not interested in graduate credit for this very reason.

References:

Ref 1:

MacIsaac, D.L., Henry, D., Zawicki, J.L. Beery, D. & Falconer, K. (2004). A new model alternative certification program for high school physics teachers: New pathways to physics teacher certification at SUNY-Buffalo State College. *Journal of Physics Teacher Education Online, 2*(2), 10-16.

Ref 2:

PHY 605: How Things Work I course web page http://galileo.phys.virginia.edu/classes/605.ral5q.fall05/ see also: University of Virginia's MAPE program information http://galileo.phys.virginia.edu/classes/605.ral5q.fall05/regist.html PHY 605: How Things Work I information on how to register http://galileo.phys.virginia.edu/classes/605.ral5q.fall05/regist.html

Ref 3:

National Teacher Enhancement Network (NTEN) courses are listed at: http://www.scienceteacher.org/courses.htm and one NTEN course is discussed at length in Keller, J.M. & Slater, T.F. (2003) The Invisible Universe Online: Design of a distance learning astronomy course for secondary science teachers. Astronomy Education review 2: http://aer.noao.edu/cgi-bin/article.pl?id=42.

Ref 4:

Bloomfield, Louis A. *How Things Work: The Physics of Everyday Life,* second edition. John Wiley & Sons, Inc: Hoboken, NJ, 2001.

Ref 5:

More information on Blackboard can be found at: http://www.blackboard.com/us/index.aspx Blackboard is a registered trademark of Blackboard Inc., © 1997-2006

Ref 6:

More information on WebAssign can be found at: http://www.webassign.net/. WebAssign is a registered trademark of North Carolina State University under license to Advanced Instructional Systems Inc. © 1997-2003 North Carolina State University © 2003-2006 Advanced Instructional Systems Inc.

Ref 7:

More information about Horizon Wimba Audio Chat Room can be found at: http://www.horizonwimba.com/ Horizon Wimba Audio Chat Room is a registered trade mark of Horizon Wimba, Inc. © 2005

Ref 8:

E-mail correspondence from Richard A. Lindgren to Kelly Pearson. Tuesday May 16, 2006 at 11:01 am.

Ref 9:

Private correspondence and interview with Dr. Richard Lindgren by Kelly Pearson on May 12, 2006 at 3:30 pm

