

**A Three-School Comparative Analysis of
Student Usage Patterns and Attitudes Toward
PIVoT**

Alberta Lipson
Teaching & Learning Laboratory
Massachusetts Institute of Technology
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EXECUTIVE SUMMARY

PIVoT (Physics Interactive Video Tutor), a Web-based learning environment designed to be a multimedia educational supplement for Newtonian Mechanics, was used in entry-level physics classes at MIT, Rensselaer Polytechnic Institute (RPI), and Wellesley during the Fall 2000 semester. The Web site included video lectures, video help sessions, a physics textbook, frequently asked questions, practice problems, simulations, and a discussion board. Each school taught physics using a different educational format. MIT's entry-level physics class was taught in the traditional large lecture/recitation format; Wellesley's was taught in small lectures; and RPI's was taught using a studio physics format. MIT's entry-level physics class used PIVoT as a voluntary educational supplement, while RPI and Wellesley required students to access PIVoT for their problem set homework.

This study had two main goals: (1) to learn about Web site functionality, student usage patterns, and student attitudes toward PIVoT within differing educational contexts, and (2) to see whether the use of PIVoT enhanced conceptual learning. The first goal was accomplished by administering a student survey to registered PIVoT users at all three campuses. The second goal was accomplished through analysis of data collected at RPI where an educational experiment was conducted: four of the nine entry-level physics classes used PIVoT, while five did not.

Improvement in Conceptual Learning

RPI's entry-level physics students were given two pre- and post- diagnostic tests to assess their improvement in conceptual learning — the Force Concept Inventory (FCI) and the Force Motion Conceptual Examination (FMCE). The RPI experiment indicated that PIVoT users had significantly higher gain scores on the FCI than non-users. In regard to the FMCE gain scores, there were few differences between the two groups. The latter pattern may be explained by the fact that PIVoT covers topics that the FCI tests, but the FMCE does not.

Improvement in conceptual understanding was not uniform for all PIVoT users. Among students with stronger high school physics preparation, as measured by their FCI pre-test, PIVoT users improved their conceptual understanding significantly more than non-users. On the other hand, among those with weaker preparation, there were no differences between PIVoT users and non-users.

There was no relationship between PIVoT use and exam scores and final grades. Exams test conceptual understanding as well as algorithmic problem-solving ability. Thus, gains in conceptual understanding might not show up in exam scores. Similarly, final grade includes exam results as well as homework scores and in-class activities, so conceptual gains might not show up in this measure either. These results point to the importance of including pre- and post-tests into the curriculum wherever possible to better understand the benefits derived from educational innovations, such as the introduction of new educational technologies.

There was no relationship between the amount of time students spent using PIVoT and either their post-test scores or their final grades. Even when pre-test scores were held constant, no differences were seen. Time spent logged onto a Web site like PIVoT may not be a good indicator of engagement or involvement, since students can carry on other types of activities at the same time. This is particularly true when students access a Web site from their living group, the preferred locale for using PIVoT.

Web Site Functionality

Technical problems affected Wellesley students more than those at other schools since Wellesley's technology infrastructure was not consistently able to support the video streaming required for PIVoT. Survey results pointed to the importance of assessing the adequacy of the technical infrastructure to insure that it can meet new demands prior to introducing technology into the classroom.

A number of students had difficulties locating relevant content. Without further research, we do not know whether the problem resides with PIVoT or whether the students lack the motivation, time, and/or conceptual understanding to find the necessary information.

At a certain point in the semester, the organization of the Web site limited PIVoT's usefulness for RPI's physics students because the sequence of topics in RPI's entry-level physics curriculum did not match the sequence on the PIVoT Web site.

PIVoT Usage Patterns

Aggregate results from all three schools indicate that lecture and help session videos were used most frequently and found to be most helpful. Among MIT students, those who felt less well-prepared were more apt to access the lecture videos than those who felt better-prepared. Among RPI and Wellesley students, the pattern was reversed: those with stronger backgrounds were more apt to look at lecture videos than those with weaker backgrounds. Although the use of PIVoT was voluntary for MIT students, they accessed PIVoT more frequently than students at other schools to review for quizzes and exams and to better understand physics concepts. It is possible that RPI and Wellesley students had other types of resources available for quiz and exam review and for improving their conceptual understanding, resources that were less available for MIT students. A more detailed understanding of the educational context needs to take place to confirm this result. In general, this finding shows that educational technology does not have to be a required and structured part of the curriculum to benefit students. Findings also indicate that educational context has an impact on technology usage patterns and context needs to be taken into account when assessing the usefulness of educational technology.

Student Attitudes

In spite of the technical difficulties students may have encountered and the problems they may have had accessing relevant information, aggregate data from all three schools indicated that three-quarters or more of the students generally had positive attitudes towards PIVoT.

- Students found it helpful to have round-the-clock access
- PIVoT reinforced what students learned in class
- Students said they would recommend PIVoT to other entry level physics students
- PIVoT gave students access to a greater variety of learning materials
- Students wished other classes had Web sites like PIVoT

Help session videos, one of PIVoT's most frequently-used media types, focus on problem-solving skills. This aspect of the Web-based learning environment did not appear to offer students sufficient support since aggregate data from all three schools indicated that only one-third of the students said PIVoT helped them in this area.

Further Research

Since educational technology is used within a particular educational context, the specific context must be taken into account to better understand the impact of educational technology on student learning. This report described three different contexts (a large lecture/recitation format, a small lecture class, and a studio format) within which PIVoT was used, as well as two ways in which the technology was used — as a voluntary supplement and as a supplement linked to class assignments. Further research is needed to study the various combinations of usage models and educational contexts to discover which combinations contribute the most to student learning. This study raised a number of other important questions that require further study. Why do students with weaker backgrounds appear to benefit less from PIVoT than those with stronger backgrounds? How can PIVoT be utilized and/or changed to help students with weaker preparation? If students have difficulties locating relevant content, is this because they lack motivation to search for the information and want to be “spoon-fed” or because PIVoT’s search capability needs further refinement? Among those who use PIVoT while studying with others, does this enhance their conceptual understanding? Are students more motivated and engaged when they have access to a Web-based learning environment such as PIVoT?

This report was based entirely on quantitative results from survey data and from RPI's experiment. At this stage in our knowledge of how to most effectively utilize educational technology in the classroom, a mixture of qualitative and quantitative methods needs to be used to gain fuller understanding of the educational context, instructors' experiences, students' attitudes, and conceptual learning. Thus, survey and database results should be supplemented by focus groups, interviews, and observational research.

Introduction and Purpose of Study

This is a time of rapid change in the field of education. Educational technology is quickly changing the way instructional materials are being delivered to students. Since the amount and variety of educational materials that can be introduced on the Web are enormous, faculty are experimenting with the best ways to integrate computer-mediated materials into their classes, whether it's a face-to-face or a distance-learning class. They are asking a number of different questions such as: (1) Is it worthwhile to have Web-based voluntary educational supplements that students can access as they wish? (2) If students have access to a multi-media Web site with a rich array of materials, are they more apt to take advantage of it when there are structured Web-based homework assignments? (3) How do students experience educational technology? How do they use it? What are their attitudes? (4) Do these materials enhance student learning? This report will attempt to answer these questions by comparing the experiences of students on three college campuses who took entry-level college physics classes and had access to PIVoT (Physics Interactive Video Tutor), a Web-based learning environment designed to be a multi-media educational enhancement for Newtonian Mechanics. It will examine Web site functionality, student usage patterns, and student attitudes toward PIVoT, as well as assessing whether the use of PIVoT improved conceptual understanding.

PIVoT was designed and developed by the Center for Educational Computing Initiatives (CECI) and the Educational Media Creation Center (EMCC).¹ As described by Professor Richard C. Larson, the principal investigator, and Laura Koller, the multimedia producer,

“ The project's key research hypothesis was that the web, streaming video and other multimedia content, a relational database, and various digital storage and delivery mechanisms could be combined to provide a web-based virtual mentoring environment, simulating office hours' conversations between students and professors. If this was true, we expected students' use of such web-based tutors to result in measurable improvements in their mastery of course content. We viewed this type of tool not as a replacement for professors and courses, but rather as a rich, individualized ancillary environment designed to augment and reinforce learning experiences. ” (from a report submitted to Syllabus 2000 Boston for inclusion in their conference proceedings)

During the Fall 2000 semester, PIVoT was used concurrently at MIT, RPI, and Wellesley. PIVoT had been used by MIT students who took the entry-level physics class (8.01) during the Fall 1999 and Spring 2000 terms and by rising high school juniors who participated in MIT's MITES (Minority Introduction To Engineering and Science) Program during the summers of 1999 and 2000, but it was new to Wellesley and RPI. The PIVoT Web site includes the following:

- Fall 1999 Video Lectures given by MIT Professor Walter Lewin
- Professor Lewin's Video Help Sessions
- An online physics textbook, *Physics* by Hans Ohanian
- Frequently Asked Questions (FAQs)
- Practice Problems
- Simulations
- Discussion Board

¹ For more information about PIVoT and its development see <http://htf-puppy.mit.edu/research/pivot/index.html>.

PIVoT was used in different ways at each site. During Fall 2000, MIT's 8.01 class used PIVoT as a voluntary educational supplement. The class Web site contained course-relevant information and listed PIVoT as an educational resource that was available to students 24/7 on their desktop computers or at Athena clusters, MIT's campus-wide computing facilities. It was not mentioned in relation to specific homework assignments. 8.01 was taught with the traditional large lecture/recitation/ problem set format. Students attended lectures three times a week and recitations twice a week. Since the class enrollment was over 500, the lecture was given twice, and roughly half the students attended each time slot. Professor Edward Farhi was the lecturer, and the textbook was *Physics for Scientists and Engineers* by Douglas C. Giancoli.²

At Wellesley, PIVoT was used in Physics 107, Advanced Introductory Mechanics, which was taught in a small lecture format. There were two sections. The instructors, Drs. Yue Hu and Zhenya Zastavker, covered the same material and used PIVoT in similar ways. Each section met three times a week. The Ohanian physics textbook was used. Each weekly homework assignment contained ten problems and included three or four problems from the PIVoT Web site. The Wellesley experience was colored by the fact that Wellesley's technological infrastructure was inconsistent in its ability to handle the video streaming required for PIVoT. As a result, it was sometimes difficult for students to watch the Video Lectures and Help Sessions due to Wellesley's low bandwidth. In addition, software installation also presented some problems. These technical difficulties were not fully resolved by the end of the semester.

The RPI format differed from both Wellesley and MIT. RPI's Physics 1100 uses a "Studio Physics" format. As described by Cummings et al. in the paper "Innovations in Studio Physics at Rensselaer" (*Amer. J. of Physics*, Supplement to V. 67, No.7, 1999),

"The defining characteristics of Studio Physics are integrated lecture/laboratory sessions, small classes of 30 to 45 students, extensive use of computers, collaborative group work, and a high level of faculty-student interaction. Each section of the course is led by a professor or experienced instructor, with help from one or two teaching assistants...Classes meet twice a week for sessions lasting 110 minutes each. The studio model has reduced the number of contact hours—from 6.5 hours per week to less than 4 hours a week—without significantly reducing course contact. Hence an expectation of some independent learning on the part of students has become the norm."

During the Fall 2000 term, Professor Karen Cummings, the coordinator of the entry-level physics classes, initiated an experiment. The nine physics sections were divided into two groups, an experimental group that used PIVoT (4 sections) and a control group (5 sections) that did not. Students used PIVoT during the middle portion of the term — between the third and ninth weeks. Prior to the third week, students did not access PIVoT because the technology transfer necessitated some minor changes to the PIVoT code. After the ninth week, PIVoT was no longer used since instructors began covering electricity and magnetism, topics not included in the PIVoT Web site. All nine sections of students received homework assignments on the class Web site and submitted homework electronically. For the experimental group, four of the homework

² Although MIT's Fall 1999 and 2000 8.01 classes were similar in format and in their use of PIVoT as a voluntary supplement, other conditions differed. During Fall 1999, the lecturer was Professor Walter Lewin whose lectures and help session videos were on the PIVoT Web site. The hardcopy textbook was *Physics* by Hans Ohanian, the electronic text on the PIVoT Web site. Although PIVoT was not structured into any homework assignments, some online assignments referred students to selected PIVoT Help Session Videos. Students, were, however, free to decide whether to access PIVoT, and if they did, when and how to use it. Given these differences between the Fall 1999 and 2000 8.01 classes, the incentives for MIT students to access PIVoT differed in 1999 and 2000. For a full description about PIVoT's use and students' reactions during the Fall 1999 semester, see "An Examination of Student Usage Patterns and Attitudes Toward PIVoT: a Pilot Study," by A. Lipson, June 2000, Massachusetts Institute of Technology (internal report).

assignments given between the third and ninth weeks included a homework problem that was related to specific PIVoT Video Lectures and Help Sessions. An HTML link enabled students to easily access the referenced media. Wording within the homework assignments went something like this: “You will find the PIVoT material linked here to be very useful in solving this problem. However, you are encouraged to use any of the PIVoT materials you find useful. Please feel free to investigate the site.” (Cummings, personal communication) At least once during the term, there were additional links to PIVoT Lectures and Help Sessions. Although the PIVoT technology worked well, some pedagogical difficulties emerged because the sequence of topics in RPI’s physics curriculum differed from the sequence of topics on the PIVoT Web site. Cummings explained it this way,

“We have a strange schedule for covering topics which ..did not mesh so well with PIVoT. Specifically, we cover conservation of momentum before conservation of energy (very unusual). This is a problem because I could not assign PIVoT directly during this period because all the video PIVoT material on conservation of momentum made reference to conservation of energy (which we hadn’t done yet). After we had covered both, I directly referred students to the associated PIVoT materials.” (personal communication)

Methods

This report presents results from an educational experiment conducted at RPI and from a survey given to students at all three schools.

RPI’s Educational Experiment³

As discussed above, the nine entry-level physics sections were divided into two groups: (1) the PIVoT user group whose homework assignments included problems on the PIVoT Web site, and (2) the non-PIVoT group whose homework assignments contained no reference to PIVoT. At the beginning and end of the semester, both groups were given two conceptual diagnostic exams — the Force Concept Inventory (FCI) and the Force and Motion Conceptual Evaluation (FMCE) — to measure gains in conceptual understanding of Newtonian concepts. For a description and comparison of these tests see K. Cummings et al. “Comparing the Force Concept Inventory and the Force and Motion Conceptual Evaluation” (unpublished paper, 1999). RPI collected the following data: the amount of time users spent on the PIVoT Web site; scores from the FCI and FMCE pre- and post-tests; exams 1, 2, 3; the final exam; homework; class activity participation; and final grade. Individual student gains and average class gains for the PIVoT and non-PIVoT groups were calculated with results from the pre- and post-tests using the equation developed by Richard Hake (*Amer. J. of Physics*, 66, 1998). Gain scores are commonly used in physics education research to assess the effectiveness of course instruction and innovations. “This ratio of actual improvement to maximum possible improvement is taken to be a measure of how much of the material that was not understood at the start of the course was learned.” (Cummings, personal communication)

$$\text{Individual Student Gain} = \frac{\text{post test \%} - \text{pre-test \%}}{100 - \text{pre-test \%}}$$

³ RPI Physics Professor Karen Cummings shared her dataset with me. We communicated several times via email so that I could better understand the data. I also questioned her about some of the results since I am a social scientist and am unfamiliar with the pre- and post-diagnostic tests and their interpretations.

When applied to the class, the equation becomes:

$$\text{Average Class Gain} = \frac{\text{class post test average} - \text{class pre-test average}}{100\% - \text{class pre-test average}}$$

The post-diagnostic tests were given on the last day of class. Since a number of students were absent, T-tests were run to see if there were differences between the students who did or did not take the post-tests that might skew the results.⁴ The data indicated there were no statistically significant differences between these two groups of students.

Survey

Toward the end of the term, a Web questionnaire that was linked to the class Web site was administered to MIT students. A paper version was handed out to RPI and Wellesley students during class. Most questions on all three surveys were identical, although several were modified to reflect the different facilities in each environment. For example, the question “Where do you generally access PIVoT?” had different answer choices for each school. The questionnaire contained mainly structured questions, along with a few open-ended questions. (See Appendix A.) As an incentive to answer the survey, MIT respondents were automatically entered into a raffle to win a \$20 gift certificate to a local record store; 15 winners were randomly chosen. The response rates among registered PIVoT users at the three schools were:

MIT	31%	(103/337) ⁵
RPI	94%	(145/155)
Wellesley	60%	(37/62)

The survey included questions about:

(1) *Web site functionality*

- Ease of registration
- Ability to gain access to or use the Web site
- Ability to find relevant information

(2) *Student usage patterns*

- Time and place of use
- Reasons for use
- Most frequently used media types

(3) *Student attitudes toward PIVoT*

- Most and least helpful features
- Benefits and/or drawbacks of using PIVoT
- Endorsement (Would they recommend that PIVoT to future students?)

Results

RPI Educational Experiment

PIVoT users and non-users were compared on a variety of different measures. There were no statistically significant differences between these groups on the following: FCI and FMCE pre-

⁴ 211 out of 337 students took the diagnostic pre-tests and 138 took the post-tests.

⁵ 448 students were registered for mainstream 8.01.

instruction conceptual exams, exams 1 and 2⁶, homework, in-class activities, quizzes, final exam, and final grade. There were, however, statistically significant differences in the FCI post-test and in the various FCI-based measures that were used to assess gain: average class gain, average individual student gain, and average difference between post-pre scores. These measures are merely different ways of looking at the same data, and no matter which measure was used, all pointed to the same result, namely there were statistically significant differences between PIVoT users and non-users with PIVoT users showing greater conceptual gain in FCI-based measures than non-users. Although PIVoT users tended to have higher scores on the FMCE pre-post gain and difference measures, these results were not statistically significant. (See Table 1.)

Table 1. RPI Class Scores by PIVoT Use

	PIVoT Users	Non-Users	Total
	Means		
FCI Pre-Test	53	50	52
FMCE Pre-Test	42	43	42
FCI Post-Test	68 ***	56	63
FMCE Post-Test	71	67	70
FCI Post-Pre Difference	14 *	7	11
FMCE Post-Pre Difference	28	25	28
FCI Class Gain	31	13	23
FMCE Class Gain	50	43	48
FCI Individual Student Gain	33 *	-1	19
FMCE Individual Student Gain	49	42	46
Exam 1	80	79	79
Exam 2	75	74	75
Final Exam	76	73	75
Homework	84	84	84
In-Class Activities	96	97	96
Quizzes	95	92	93
Final Numerical Grade Score	83	82	83
	Percent Distribution		
A (91-100)	28%	33%	31%
B (81-90)	42%	36%	39%
C (71-80)	21%	17%	19%
D (61-70)	6%	9%	8%
F (60 or lower)	3%	4%	4%

T-test level of statistical significance *** p<.001, ** p<.01, * p<.05

⁶ Exam 3 results are not listed since it covered topics in electricity and magnetism.

Why did PIVoT users show greater improvement than non-users on the FCI test, while there was less difference between the two groups on the FMCE test? Cummings offers this explanation,

“Although both exams test basic mechanics concepts, the exact concepts they test are not identical. I am fairly confident that the difference in learning gains results from the PIVoT users having gotten help with a concept tested on the FCI that is not tested on the FMCE. For example, the FCI has questions on centripetal force and the trajectory of an object after it leaves a semi-circular track. PIVoT has a video demonstration of this. The FCI also has questions about projectile trajectories. I believe that PIVoT also has a video demonstration related to this. Also, keep in mind that the FCI has only 30 questions on it. The average RPI student gets about 15 of those correct to start with. This means that the difference between the control group and the PIVoT group is a couple of extra questions. These diagnostic exams are not great assessment tools, but they are reliable and valid. They are also all we have.” (personal communication)

Given that students who used PIVoT appeared to show greater improvement in conceptual understanding as seen in the FCI outcome measures, does PIVoT benefit all users equally or are there differential benefits depending upon whether students have stronger or weaker pre-college preparation? Using the pre-FCI and pre-FMCE scores as indicators of pre-college preparation, PIVoT users and non-users were divided into three groups on each diagnostic test based on whether their scores were in the lower, middle, or upper third. As Table 2 indicates, the scores of PIVoT users and non-users who were in the lowest third did not differ from each other. On the other hand, PIVoT users who were in the middle third of the range had higher scores than non-users on the FCI and FMCE post-test measures. And PIVoT users who were in the upper third of the range had higher scores than non-users on the FCI post-test, although the FMCE post-test scores of both groups were similar. Thus, in general, the use of PIVoT appeared to improve the conceptual learning of students with stronger pre-college preparation, while it did not appear to improve the conceptual learning of students who had the weakest pre-college preparation.

Table 2. Post-Test Scores and Final Grade by Level of Pre-Instruction Conceptual Score

		PIVoT Users			Non-Users		
		FCI Pre-Test Level					
		Low	Med	High	Low	Med	High
FCI Post-test	N	20	33	29	21	14	19
	Mean	49.2	64.7	84.3	49.7	48.3	70.9
	St. Dev.	21.1	15.3	12.6	21.2	20.7	26.3
Final Average	Mean	82.7	85.3	88.2	82.4	85.7	89.6
	St. Dev.	11.4	5.9	6.5	9.9	6.9	8.1
	FMCE Pre-Test Level						
		Low	Med	High	Low	Med	High
FMCE Post-test	N	24	29	29	22	10	22
	Mean	54.0	67.8	89.3	55.0	59.8	84.8
	St. Dev.	20.4	20.1	8.9	24.1	24.4	15.6
Final Average	Mean	82.8	85.7	88.6	81.9	85.8	89.7
	St. Dev.	9.7	6.7	6.7	9.5	8.1	7.3

To determine whether the differences seen above were statistically significant two 2 x 3 MANOVA tests (multivariate analysis of variance tests) were run — one examined the FCI pre- and post-tests and the other examined the FMCE pre- and post-tests.⁷ These tests crossed PIVoT use (2 categories) with pre-test level (3 categories). For both tests, PIVoT use and pre-test level were the independent variables (factors); final numeric grade and post-test scores were the dependent or outcome variables (both were continuous variables); and the combination of PIVoT use and pre-test level was the interaction term.

Prior to examining the inter-relationship of the two independent variables on the outcome variables, the analysis assessed the direct effects of each independent variable and the interaction term on the dependent variables. The results showed that PIVoT use ($F=8.19$, $p<.01$) and FCI pre-test level ($F=25.796$, $p<.001$) were significantly related to FCI post-test scores. PIVoT use was not related to final grade, although FCI pre-test level was related ($F=6.59$, $p<.01$). There was a marginally statistically significant relationship between the interaction term (PIVoT use and pre-test level) for the FCI post-test score ($F=2.282$, $p=.11$) but no relationship between the interaction term and final grade.

Table 3 presents data that answer the question posed above, namely whether there are statistically significant differential effects of PIVoT use depending upon pre-college academic preparation. This table examines final grade and FCI post-test means for each FCI pre-test level within the PIVoT user and non-user groups along with the lower and upper bound means of the 95% confidence interval.⁸ Among students in the pre-FCI lower third group, there were no

⁷ MANOVA, an extension of ANOVA (analysis of variance), is used when there are one or more categorical independent variables and two or more continuous dependent variables.

⁸ Statistical significance is determined by comparing relevant pairs of FCI pre-test scores with each other to see if they fall within or without the 95% confidence interval. If the score falls outside the 95% confidence interval, it is

statistically significant differences between the PIVoT user and non-user groups in their FCI post-test means. However, among the students in the FCI pre-test middle and upper groups, there were statistically significant differences in FCI post-test means between PIVoT users and non-users. Why do students with stronger backgrounds appear to benefit from PIVoT more than those with weaker backgrounds? One reason might be that PIVoT provides easily available student support materials that supplement instruction. Perhaps those with stronger backgrounds know best how to take advantage of these types of materials, while those with weaker backgrounds need more hands-on activities or individualized instruction that is tailored to their needs. Further research is needed to explore this issue in greater depth.

Table 3 also indicates that within all FCI pre-test levels there were no statistically significant differences between PIVoT use and final grade. As to a possible reason why PIVoT use might be unrelated to final grade, Cummings gives this explanation, “The grade is based on many things including a significant effort component (10% homework and 25% in class activities — do the work here and you get the credit...)”.(personal communication)

Table 3. Multiple Comparisons: Effect of PIVoT Use and FCI Pre-Test Level on Final Grade and FCI Post-Test Score

Outcome Variables	PIVoT Use	FCI Pre-Test Level	Mean	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
Final Grade	PIVoT User	low	82.76	1.81	79.18	86.35
		medium	85.83	1.41	83.04	88.62
		high	88.21	1.50	85.24	91.19
	Non-User	low	82.44	1.77	78.94	85.94
		medium	85.72	2.16	81.44	90.00
		high	89.63	1.86	85.95	93.31
FCI Post-test Score	PIVoT User	low	49.17	4.27	40.71	57.62
		medium	64.75	3.33	58.17	71.33
		high	84.25	3.55	77.23	91.27
	Non-User	low	49.68	4.17	41.43	57.93
		medium	48.33	5.11	38.23	58.44
		high	70.88	4.38	62.20	79.55

significant at the .05 level of significance. For example, the mean of the “used PIVoT/medium pre-test level” group falls outside the confidence interval of the “did not use PIVoT/ medium pre-test level” group, and vice-versa.

Figures 1 and 2 present these findings graphically.

Figure 1. Effect of PIVoT Use and FCI Pre-Test Level on FCI Post-Test

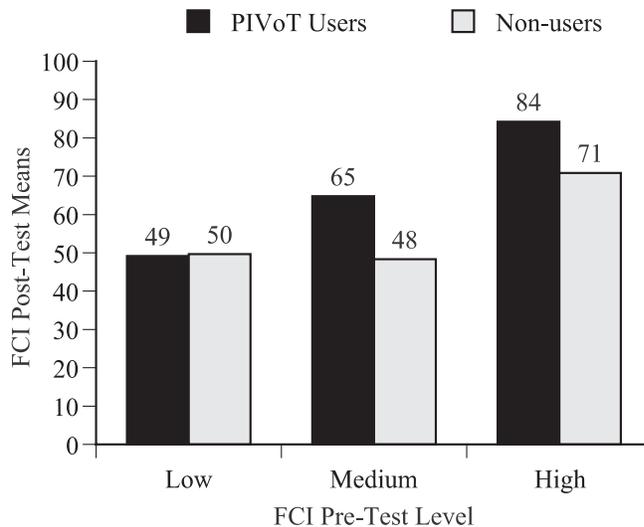
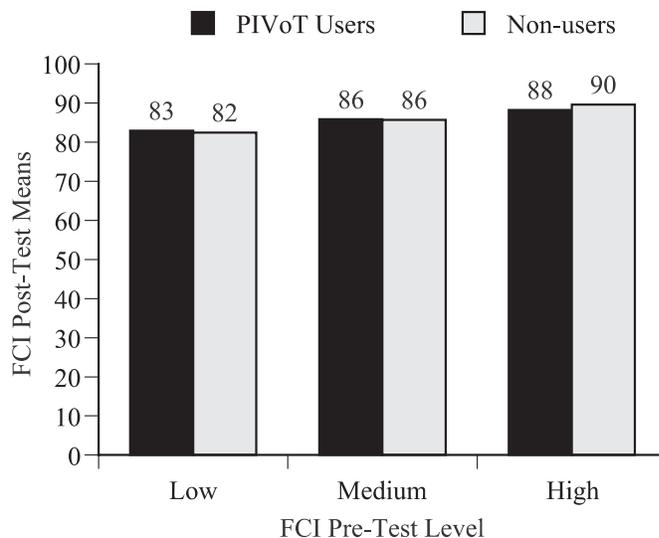


Figure 2. Effect of PIVoT Use and FCI Pre-Test Level on Final Grade



A second MANOVA test substituted FMCE pre- and post-test measures for the FCI pre- and post-test measures. There were statistically significant differences between the FMCE pre-test level and final grade ($F=8.523$, $p < .001$) and the FMCE pre-test level and the FMCE post-test ($F= 37.963$, $p < .001$). There were no statistically significant differences between PIVoT use and both the FMCE post-test and the final grade and between the interaction measure (FMCE pre-test level X PIVoT Use) and both final grade and the FMCE pre-test. When PIVoT users and non-users were examined within each FMCE pre-test level, there were no statistically significant differences between the groups, although the medium and high pre-test level PIVoT users had

slightly higher FMCE post-test scores than the medium and high pre-test level non-users. (See Figures 3 and 4.) In sum, although there were statistically significant differences in FCI post-test scores between PIVoT users and non-users when the pre-test was held constant, this same pattern was not reflected in the FMCE post-test scores.

Figure 3. Effect of PIVoT Use and FMCE Pre-Test Level on FMCE Post-Test

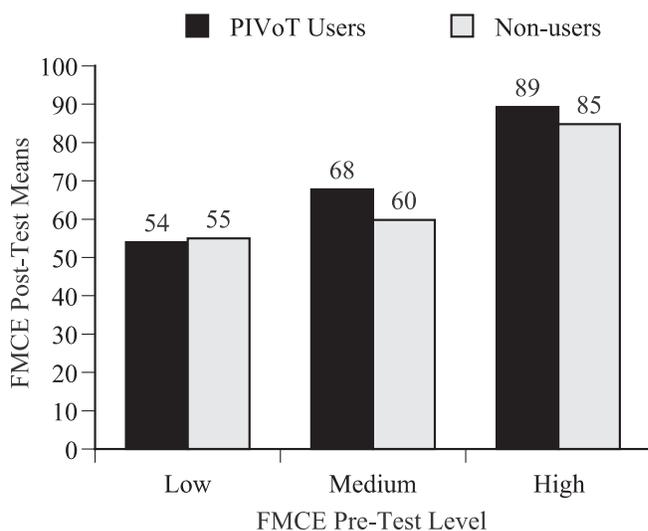
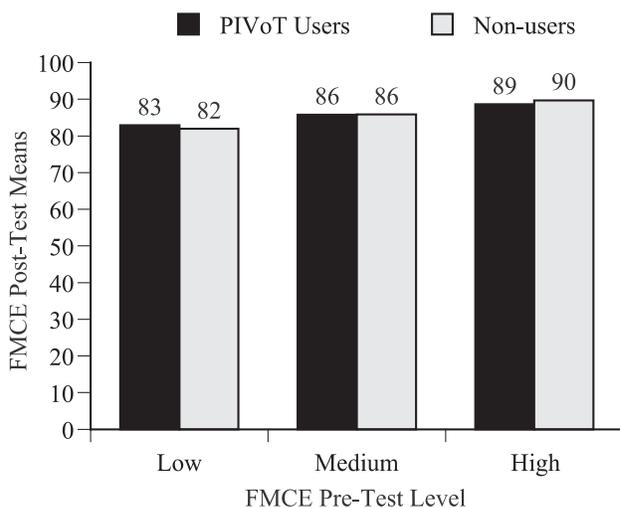


Figure 4. Effect of PIVoT Use and FMCE Pre-Test Level on Final Grade



How, if at all, does length of time spent using the PIVoT Web site impact outcome? Do students who use PIVoT for longer periods of time benefit more than those who use it for shorter periods? Within the group of students who had weaker academic preparation, did those who spent more time on PIVoT have higher post-test scores or higher grades than those who spent less time? To answer these questions, the number of times students were logged onto the PIVoT Web site was divided into thirds — lower third, middle third, and upper third — and a 3x3 MANOVA was

run.⁹ The independent variables were time and pre-test level; the dependent variables were final grade and post-test score; and interaction term was time X pre-test level. There were no statistically significant differences between the amount of time students spent using PIVoT and their post-test scores and grades. Within each pre-test level, there were no differences in outcome between students who used PIVoT for longer or shorter periods of time. Thus, for example, among students in the lowest pre-test group, there were no differences in outcome depending on the length of time they spent logged onto the PIVoT Web site. In considering these results, it is important to note that although logon time may be a valid indicator of involvement or engagement for some students, it may not be a valid indicator for others since it is possible for students to do other things while they are logged onto a Web site. Therefore, it is not surprising that there is no relationship between time and either outcome variable.

Survey Results (See Appendices B and C for the frequency distributions and open-ended comments.)

Web Site Functionality

Students at MIT experienced fewer technical problems than those at Wellesley or RPI. Two-fifths of the Wellesley students mentioned problems accessing the Web site and watching the videos, understandable in light of Wellesley's internet connectivity limitations. RPI's problems took place at the beginning of the term and were resolved after adjustments were made to the PIVoT code. Approximately one quarter of the MIT and RPI students said technical problems discouraged them from using PIVoT, while over half the Wellesley students said the same. Aside from the purely technical problems, a number of students at all three schools — nearly one-quarter to one-half — had difficulties finding the information they were looking for. Further research should examine whether the problems lie with PIVoT's search capabilities or whether students lack the time and interest to locate content on their own.

PIVoT Usage Patterns

Students were asked where and when they usually accessed PIVoT and what types of computer platforms were generally used. Almost three-quarters of the MIT and RPI students and three-fifths of the Wellesley students accessed PIVoT from their rooms. Two-fifths of the Wellesley students used PIVoT at their Computer Lab (E225). In contrast nine percent and six percent of MIT and RPI students accessed PIVoT from an on-campus computer facility. Nearly one-quarter of the Wellesley students "sometimes" or "often" used PIVoT while studying with others, while only twelve percent of MIT students and seven percent of RPI students said the same. Perhaps higher percentages of Wellesley students studied with others because they more frequently accessed PIVoT from an on-campus computer facility than students at other schools. Two-thirds of the MIT students and slightly less than one-half of the Wellesley students thought it was inconvenient to use PIVoT at an on-campus computer facility. This opinion came out clearly in the open-ended comments also. At Wellesley and RPI, the most popular computer platform was the PC. MIT students' responses to this question were not recorded due to a programming error. However, data from the fall 1999 MIT PIVoT survey indicate the PC was the most commonly used computer platform, and one can assume this has not changed.

⁹ MANOVA was run for both tests — FCI and the FMCE. These tests crossed time spent using PIVoT (3 categories) with pre-test levels (3 categories).

The questionnaire asked students to indicate their reasons for using PIVoT. Since Wellesley students had to access PIVoT to do their homework, fewer Wellesley students than one might have expected used PIVoT to help them with their problem set homework. Perhaps this was due to the technical problems mentioned earlier. While RPI and Wellesley students were required to use PIVoT for their homework problems, MIT students used PIVoT as a voluntary supplement. Thus, it is interesting to note that higher percentages of MIT students used PIVoT to review for tests and to help them better understand physics concepts. (See Table 4.)

Table 4. Reasons for Using PIVoT

	MIT	Wellesley	RPI	Total
Review for quizzes or exams	42%	14%	4%	19%
Help me better understand physics concepts	55%	41%	21%	36%
Help with problem set homework	23%	19%	59%	41%
Other	17%	8%	13%	14%

These patterns emphasize the importance of understanding both the educational and technological context when interpreting findings. That few Wellesley and RPI students used PIVoT for quiz and exam reviews compared to over two-fifths of MIT students may mean that RPI and Wellesley students had additional review opportunities available to them that were less available to MIT students. Similarly, the finding that only twenty-one percent of the RPI students said PIVoT helped them better understand physics concepts compared to fifty-five percent of MIT students and forty-one percent of Wellesley students may mean RPI's educational context offered other opportunities to improve conceptual understanding. This interpretation is strengthened by the following results. When reasons for using PIVoT were crosstabulated by whether students said their high school physics preparation was adequate,¹⁰ there was a relationship between preparation and the use of certain media types among MIT students, while there was no relationship among RPI and Wellesley students. Among MIT students, seventy-six percent who thought their preparation was inadequate used PIVoT to help their conceptual understanding compared to forty-five percent who thought it was adequate (Chi-square = 8.49, 1df, $p < .01$). Although not statistically significant, a similar pattern was seen for "Help with quiz and exam reviews;" fifty-one percent of the MIT students who said their background was inadequate used PIVoT for quiz and exam reviews compared to thirty-six percent who said it was adequate.¹¹ Therefore, to understand the usage patterns and value of a resource such as PIVoT, other classroom teaching modalities and support services for less-prepared students need to be examined.

¹⁰ Students were given a list of statements and asked whether they agreed or disagreed. One was: "My high school physics preparation was inadequate" (4-point scale from strongly disagree to strongly agree). Since the number of students in each cell was low, this statement was collapsed into 2 categories: disagree and agree. Sixty-four percent of MIT students 46 % of Wellesley students and 47% of RPI students agreed (thought their preparation was inadequate).

¹¹ The MIT report about Fall 1999 PIVoT ("An Examination of Student Usage Patterns and Attitudes Toward PIVoT: a Pilot Study," by A. Lipson, June 2000, Massachusetts Institute of Technology, p. 11) also notes that less-prepared students accessed lectures and help session videos more frequently than the better-prepared students.

Students were asked about the media types they used and which ones they found most helpful. The most frequently used media types were the Video Help Sessions and Lectures.¹² Since students at RPI and Wellesley were assigned homework problems on the PIVoT Web site, the percentage of students from these schools who accessed Practice Problems was much lower than expected. Perhaps the term used in the questionnaire, “Practice Problems,” was confusing. A higher percentage of Wellesley than MIT or RPI students accessed the electronic textbook which is understandable since it was their required text. (See Table 5.)

Table 5. Percent Who Used PIVoT Media Types

	MIT	Wellesley	RPI	TOTAL
Lewin help session videos	54%	52%	55%	54%
Lewin lectures	70%	55%	74%	70%
Electronic textbook (Ohanian)	37%	52%	12%	27%
Practice problems	26%	50%	23%	28%
Simulations	18%	32%	31%	26%
FAQ's	21%	45%	8%	18%

When each media type was crosstabulated by high school physics background, MIT students with weaker backgrounds were more likely to access Lewin Lectures than those with stronger backgrounds. In contrast, among students at both Wellesley and RPI, the opposite pattern was seen. Those with stronger backgrounds were more likely to access the Lectures than those with weaker backgrounds. Here again, this pattern points to the importance of examining technology usage patterns in the context of the individual classroom situation and the availability of resources. (See Table 6.)

Table 6. Percent Who Accessed Lewin Lectures by High School Background

	Adequate HS Physics	Inadequate HS Physics
MIT	61%	82%*
Wellesley	67%	36%
RPI	86%	69%*

Chi-square level of statistical significance * $p < .05$

MIT and RPI students rated Lewin Lectures and Help Session Videos as the most helpful media types. Although Wellesley students rated the Lewin Lectures highly, they did not give the Help Session Videos a comparable rating. Since Wellesley had technical problems with the videos, it is understandable that videos might not be seen as helpful, but why students might rate one type more highly than the other is unclear. Perhaps Wellesley instructors were more likely to refer students to the Lectures than the Help Sessions. Simulations and FAQs were not used as

¹² The 2000 MIT report about Fall 1999 PIVoT (“An Examination of Student Usage Patterns and Attitudes Toward PIVoT: a Pilot Study,” by A. Lipson, June 2000, Massachusetts Institute of Technology, p. 9) also indicates that Help Session Videos and Lectures were the most frequently used media types.

frequently as other media types, but responses suggest they can aid understanding and/ or problem-solving skills for some students. (See Table 7.)

Table 7. Percent Indicating Media Types Helped Their Understanding of Physics Concepts and/or Problem-Solving Skills

	Percent Who Said “Helpful/ Very Helpful”			
	MIT	Wellesley	RPI	TOTAL
Lewin Help Session Videos	60%	31%	73%	62%
Lewin Lectures	68%	53%	68%	66%
Electronic Textbook	38%	18%	36%	32%
Practice Problems	57%	47%	48%	51%
Simulations	53%	40%	56%	53%
FAQ’s	59%	43%	38%	49%

Attitudes Toward PIVoT¹³

Given the variation in class format and the different ways PIVoT was used in all three schools, student attitudes toward PIVoT were fairly consistent. Students at all three schools generally had positive attitudes. Seventy-five percent or more found it helpful to have 24 hour- a-day access. The same percentage thought PIVoT exposed them to a greater variety of learning materials. Eighty percent or more said PIVoT reinforced what they learned in class, and between seventy and eighty-five percent wished other classes had similar Web sites. Further, two-thirds or more would recommend PIVoT to others who take the same class next year. However, there were also some less positive results. Between sixty and sixty-eight percent thought it was time-consuming to find information, and only twenty-nine to forty percent said PIVoT helped them learn better problem-solving strategies.¹⁴ (See Table 8.)

¹³ These statements were derived from students' open-ended comments made in the Fall 1999 MIT PIVoT survey.

¹⁴ For a more in-depth examination of student attitudes towards PIVoT, see report about Fall 1999 PIVoT (“An Examination of Student Usage Patterns and Attitudes Toward PIVoT: a Pilot Study,” June 2000, Massachusetts Institute of Technology, pp 11-18).

Table 8. Student Attitudes Toward PIVoT: Percent Who “Agreed” or “Strongly Agreed” With These Statements

	MIT	Wellesley	RPI	TOTAL
It’s helpful to have access to PIVoT 24 hrs. a day	90%	85%	77%	83%
Using PIVoT has had a positive impact on my ability to keep up with this class.	64%	55%	66%	63%
PIVoT reinforces what I learn in class.	83%	80%	80%	81%
Sometimes it’s very time-consuming to find the information I’m looking for.	60%	68%	64%	63%
By using PIVoT I can learn at my own pace.	65%	61%	73%	68%
PIVoT lets me learn about a subject in depth.	63%	41%	66%	61%
PIVoT has helped me learn better problem-solving strategies.	36%	29%	40%	37%
I would recommend PIVoT to students who will be taking this class next year.	81%	67%	73%	75%
PIVoT helps me visualize and understand ideas that are difficult to learn from lectures, recitations, and textbook.	69%	59%	73%	70%
Because of PIVoT, I’ve had access to a greater variety of learning materials.	79%	82%	74%	77%
I wish other classes had Web sites like PIVoT.	85%	70%	70%	76%

When the above attitude statements are crosstabulated by high school preparation, there were some statistically significant differences, but not as many as one might have expected and not always in the expected direction. Table 9 reports on statements where there were statistically significant differences. MIT students with adequate high school preparation were more likely than those with inadequate preparation to say PIVoT helps them learn at their own pace. One might have anticipated that ability to control pace would be a more important factor for those with weaker than those with stronger preparation. Other findings were in the expected direction. MIT students with weaker preparation were more likely than those with stronger preparation to say PIVoT helped them learn better problem-solving strategies. The aggregate results from all three schools indicate that those with weaker preparation were more likely than those with stronger preparation to say:

- They wished other classes had similar Web sites
- It was helpful to have access to PIVoT 24 hours a day
- They would recommend PIVoT to others who will be taking the class next year

Table 9. Attitude Statements by High School Physics Background

	MIT		Wellesley		RPI		Total	
	Adeq.	Inadeq.	Adeq.	Inadeq.	Adeq.	Inadeq.	Adeq.	Inadeq.
It's helpful to have access to PIVoT 24 hrs. a day	86%	92%	78%	93%	70%	86%	76%**	90%
By using PIVoT I can learn at my own pace	81%*	58%	53%	77%	70%	76%	70%	68%
PIVoT has helped me learn better problem-solving strategies	19%*	45%	25%	36%	41%	38%	32%	41%
I wish other classes had Web sites like PIVoT	82%	86%	61%	79%	58%*	82%	66%**	83%
I would recommend PIVoT to students who will be taking this class next year	79%	83%	53%	81%	69%	79%	69%**	81%

Chi-square levels of statistical significance ** $p < .01$, * $p < .05$

Conclusion

This report began with four questions, and this section will try to answer them.

(1) Is it worthwhile to have Web-based voluntary educational supplements which are independent of homework assignments that students can access as they wish?

MIT, unlike the other two schools, used PIVoT as a voluntary supplement. PIVoT was available 24/7 either on their desktop computers or at an Athena cluster, and they could access it as they wished. PIVoT was not linked to their homework assignments. Data from the MIT survey indicate that it is worthwhile to have voluntary educational supplements. Among the MIT registered PIVoT users who answered the survey, slightly over one-half used it to help understand physics concepts; two-fifths used it to review for quizzes and exams; and almost one-quarter used it to help with their problem set homework. Students who perceived themselves as less adequately prepared were more apt to use PIVoT for these purposes. Over eighty percent of the MIT PIVoT users said: it was helpful to have 24 hour a day access to the PIVoT Web site; PIVoT reinforces what was learned in class; they would recommend PIVoT to others; and they wished other classes had a Web site like PIVoT.

(2) If students have access to a multi-media Web site with a rich array of materials, are they more apt to take advantage of it when it is linked to the class and there are structured Web-based assignments?

Survey results do not yield a clear-cut answer. This is somewhat surprising since my assumption was that class assignments should reference a Web site to insure adequate utilization. MIT students used PIVoT more than those in other schools to review for quizzes and exams and to help understand physics concepts. Wellesley students accessed FAQs more than other students. Both Wellesley and RPI students accessed simulations more than MIT students. And MIT and RPI students accessed Video Lectures more than

Wellesley students. These confusing results lead to the following conclusion, namely that educational technologies cannot be examined in isolation, but must be examined in relation to other classroom teaching modalities. For example, if Wellesley and RPI students did not use PIVoT to review for quizzes as frequently as MIT students, they may have had access to other quiz review mechanisms in addition to PIVoT.

(3) How do students experience the educational technology? How do they use it? What are their attitudes?

The survey data, particularly from Wellesley and RPI, show that technical issues need to be corrected prior to incorporating these technologies into the classroom since technical difficulties can interfere with the effectiveness of computer-mediated educational materials. If corrections are not made prior to the start of class to ensure the smooth functioning of the Web site, students may be discouraged from using it. Aside from the technical issues, a number of students had difficulty finding relevant information, in spite of the fact that PIVoT has several different ways that students can search for content. The preferred way of accessing PIVoT is from students' living groups. Lecture and Help Session Videos were the most frequently-used media types. In spite of technical problems and difficulties locating appropriate content, students generally had positive attitudes toward the Web site. In particular, they liked having access to PIVoT 24 hours a day, thought PIVoT reinforced what was learned in class, would recommend PIVoT to others, and wished other classes had this type of resource.

(4) Do these materials help enhance student learning?

The RPI experiment showed that PIVoT users experienced greater gain in conceptual understanding than non-users. PIVoT users were more likely to improve their post-FCI scores and show higher FCI gain scores than non-users. However, the impact was not uniform; it was the students with stronger high school preparation who derived benefit from PIVoT use, while those with weaker preparation did not. There were no differences between PIVoT users and non-users in exam scores and final grades, a finding that was not surprising since exams test not only conceptual knowledge but also algorithmic problem-solving abilities and final grades are based on homework and in-class activities, in addition to quiz and exam scores.

The amount of time students spent using PIVoT was unrelated to gains in conceptual understanding or to final grade. Even when academic background was held constant, the amount of time students spent on the Web site was not related to these outcome variables.

Further Research

Since educational technology is used within a particular pedagogical context, the specific context must be taken into account to better understand the impact of educational technology on student learning. This report described two usage models (the voluntary supplement model and the linked subject model) and three educational contexts (large lecture, small lecture, and studio format) within which PIVoT was used. Further research is needed to understand which combinations contribute the most to student learning. A number of students had difficulties locating relevant content. Whether the problem rests with students who want to be "spoon-fed" or with the technology is a question that

cannot be answered without qualitative research. For example, a study that utilizes the “Think Aloud” procedure might help to answer this question.¹⁵ Further study is also needed to understand why PIVoT does not seem to help less adequately prepared students improve their conceptual learning and how PIVoT might offer them better support. Research is also needed to assess whether and the extent to which educational technology increases student engagement.

¹⁵ In the “Think Aloud” procedure students are asked to say whatever comes to mind while they are performing an activity. In the case of PIVoT, it would be while they are using PIVoT to help them solve a physics problem or to look up a concept.

8.01 PIVoT Survey, Fall 2000

1. Have you used PIVoT? Yes No

Did you have any problems with:	Type of problem(s)	Were the problem(s) resolved?
2. Registering for PIVoT?	<input type="checkbox"/> yes <input type="checkbox"/> no _____	<input type="checkbox"/> yes <input type="checkbox"/> no
3. Configuring your computer?	<input type="checkbox"/> yes <input type="checkbox"/> no _____	<input type="checkbox"/> yes <input type="checkbox"/> no
4. Accessing the Web site?	<input type="checkbox"/> yes <input type="checkbox"/> no _____	<input type="checkbox"/> yes <input type="checkbox"/> no
5. Navigating the Web site?	<input type="checkbox"/> yes <input type="checkbox"/> no _____	<input type="checkbox"/> yes <input type="checkbox"/> no
6. Watching the PIVoT videos	<input type="checkbox"/> yes <input type="checkbox"/> no	<input type="checkbox"/> yes <input type="checkbox"/> no
7. Finding the information you were looking for?	<input type="checkbox"/> yes <input type="checkbox"/> no _____	<input type="checkbox"/> yes <input type="checkbox"/> no
8. Other technical problems?	<input type="checkbox"/> yes <input type="checkbox"/> no	<input type="checkbox"/> yes <input type="checkbox"/> no

9. Did any of the problems mentioned in questions 2-8 discourage you from using PIVoT?

yes no Which problem(s)? _____

10. Where do you generally access PIVoT? *(Check all that apply)*

- Athena cluster
- Living group — my room
- Living group — in location other than my room
- Other *(Please specify)* _____

11. Which computing platform (s) do you generally use to access PIVoT? *(Check all that apply)*

- ___ Athena Workstation
- ___ PC
- ___ Mac
- ___ Other *(Please specify)*

12. What time of day or night do you usually use PIVoT? *(Check all that apply)*

- 8am - 12pm
 1pm - 5pm
 6pm - 10pm
 11pm - 3am
 4 am - 7am

13. Since registering for PIVoT, approximately how many times have you logged on to PIVoT?

_____ times

14. In addition to using PIVoT for PIVoT homework problems, if you've used PIVoT for other reasons, please indicate these reasons. (Check all that apply)

- To help with non-PIVoT problem set homework
- To review for quizzes or exams
- To help me better understand physics concepts
- Other (Please explain) _____

15. Which PIVoT features have you used? If you've used one or more features, to what extent have they helped your understanding of physics concepts and/or your problem-solving skills?

	<u>Used</u>		Not helpful at all	Only slightly helpful	Somewhat helpful	Moderately helpful	Very helpful
	yes	no	1	2	3	4	5
Lewin help session videos	yes	no	1	2	3	4	5
Lewin lectures	yes	no	1	2	3	4	5
Electronic textbook	yes	no	1	2	3	4	5
Practice problems	yes	no	1	2	3	4	5
Simulations	yes	no	1	2	3	4	5
Frequently asked questions	yes	no	1	2	3	4	5
Personal tutor	yes	no	1	2	3	4	5
Search tool	yes	no	1	2	3	4	5

16. How often, if at all, do you study with others while using PIVoT?

- Not at all Infrequently Sometimes Often

17. Please indicate the extent to which you agree or disagree with each statement:

	Strongly Disagree	Disagree	Agree	Strongly Agree
When a topic is difficult to understand or I'm having trouble with a problem set, it's helpful to have access to PIVoT 24 hrs. a day.	1	2	3	4
Using PIVoT has had a positive impact on my ability to keep up with this class.	1	2	3	4
I've had a hard time understanding the material presented in this class.	1	2	3	4
PIVoT reinforces what I learn in class.	1	2	3	4

17. Please indicate the extent to which you agree or disagree with each statement (cont'd):

	<u>Strongly Disagree</u>	<u>Disagree</u>	<u>Agree</u>	<u>Strongly Agree</u>
Although PIVoT is useful, sometimes it's very time-consuming to find the information I'm looking for.	1	2	3	4
By using PIVoT I can learn at my own pace.	1	2	3	4
PIVoT lets me learn about a subject in depth.	1	2	3	4
It's inconvenient to use PIVoT in an Athena terminal.	1	2	3	4
PIVoT has helped me learn better problem-solving strategies.	1	2	3	4
My high school Physics preparation was inadequate.	1	2	3	4
It's intimidating to ask the instructor or tutor for help when I'm confused.	1	2	3	4
I would recommend PIVoT to students who will be taking 8.01 next year.	1	2	3	4
PIVoT helps me visualize and understand ideas that are difficult to learn from lectures, labs, and the textbook.	1	2	3	4
Because of PIVoT, I've had access to a greater variety of learning materials.	1	2	3	4
I wish other classes had Web sites like PIVoT.	1	2	3	4

18. Please use this space for any other comments you would like to make about PIVoT and/or your Physics class.

THANK YOU!

Appendix B

**Fall 2000 PIVoT Survey Frequency Distributions
Comparison of Three Schools:
MIT (N=103), Wellesley (N=37), RPI (N=145)**

February, 2001

PIVoT Survey, Fall 2000

Have you had any problems with:	"Yes"		
	MIT	Wellesley	RPI
Registration	2%	14%	29%
Configuring your computer for PIVoT (MIT, RPI)	11%	N/A	5%
Accessing the Web site	8%	41%	34%
Navigating the Web site	7%	26%	10%
Watching videos	23%	42%	12%
Finding the information you were looking for	20%	51%	24%
Other technical problems	4%	18%	4%

If "Yes," were the problems resolved?	"Yes"		
	MIT	Wellesley	RPI
Registration	0%	100%	91%
Configuring your computer for PIVoT (MIT, RPI)	44%	N/A	14%
Accessing the Web site	50%	79%	84%
Navigating the Web site	17%	20%	27%
Watching videos	41%	11%	33%
Finding the information you were looking for	14%	25%	27%
Other technical problems	20%	40%	0%

Did any of the problems above discourage you from using PIVoT?	"Yes"		
	MIT	Wellesley	RPI
	23%	54%	25%

Where did you access PIVoT? [multiple response]	"Yes"		
	MIT	Wellesley	RPI
On-campus computing facility (Athena - MIT; Room E225 - Wellesley; Computer lab - RPI)	9%	43%	6%
Living group -- my room	76%	62%	73%
Living group -- location other than my room	7%	16%	0%
Other location	3%	5%	2%

PIVoT Survey, Fall 2000

Which computing platform(s) do you generally use to access PIVoT? [multiple response]	MIT	Wellesley	RPI
Unix workstation (RPI only)	N/A *	N/A	5%
PC (Wellesley, RPI)	N/A	97%	74%
Mac (Wellesley, RPI)	N/A	11%	2%
Other platform (Wellesley, RPI)	N/A	0%	3%

What times of day did you access PIVoT? [multiple response]	MIT	Wellesley	RPI
8am - 12pm	8%	14%	8%
1pm - 5pm	7%	38%	17%
6pm - 10pm	54%	70%	46%
11pm - 3am	50%	68%	37%
4am - 7am	11%	0%	2%

* Due to a programming error, MIT's responses to this question were not recorded.

PIVoT Survey, Fall 2000

Since registering, how many times each week do you use PIVoT?	Wellesley
Once	54%
Twice	38%
3 times	5%
5 times or more	3%

Since registering for PIVoT, approximately how many times have you logged on to PIVoT?	MIT	RPI
Once	15%	6%
2-3 times	36%	39%
4-5 times	16%	36%
6-7 times	17%	9%
8-9 times	3%	5%
10-11 times	1%	0%
12-13 times	0%	3%
More than 13 times	10%	2%

Why did you use PIVoT? [multiple response]	MIT	Wellesley	RPI
Help with problem set homework	23%	19%	59%
Review for quizzes or exams	42%	14%	4%
Help me better understand physics concepts	55%	41%	21%
Other	17%	8%	13%

PIVoT Survey, Fall 2000

Which PIVoT features have you used?	MIT	Wellesley	RPI	TOTAL
Lewin help session videos	54%	52%	55%	54%
Lewin lectures	70%	55%	74%	70%
Electronic textbook	37%	52%	12%	27%
Practice problems	26%	50%	23%	28%
Simulations	18%	32%	31%	26%
FAQ's	21%	45%	8%	18%
Personal tutor (MIT only)	17%	N/A	N/A	17%
Search tool (MIT, Wellesley)	46%	76%	N/A	55%
Discussion board (RPI only)	N/A	N/A	3%	3%

PIVoT Survey, Fall 2000

If used, to what extent have they helped your understanding of physics concepts and/or your problem-solving skills?	Percent Who Said "Helpful/ Very Helpful"				Mean (scale: 1=Not helpful at all, 5=Very helpful)			
	MIT	Wellesley	RPI	TOTAL	MIT	Wellesley	RPI	TOTAL
Lewin help session videos	60%	31%	73%	62%	3.65	3.00	4.02	3.74
Lewin lectures	68%	53%	68%	66%	3.82	3.41	3.91	3.81
Electronic textbook	38%	18%	36%	32%	2.97	2.59	3.18	2.89
Practice problems	57%	47%	48%	51%	3.52	3.40	3.48	3.47
Simulations	53%	40%	56%	53%	3.40	3.40	3.44	3.42
FAQ's	59%	43%	38%	49%	3.29	3.29	3.13	3.26
Personal tutor (MIT only)	36%	N/A	N/A	36%	2.64	N/A	N/A	2.64
Search tool (MIT, Wellesley)	57%	27%	N/A	44%	3.43	2.85	N/A	3.19
Discussion board (RPI only)	N/A	N/A	33%	33%	N/A	N/A	3.00	3.00

How often, if at all, do you study with others while using PIVoT?	Percent Who Said "Sometimes/Often"			Mean (scale: 1=Not at All, 2=Infrequently, 3=Sometimes, 4=Often)		
	MIT	Wellesley	RPI	MIT	Wellesley	RPI
	12%	24%	7%	1.36	1.89	1.25

PIVoT Survey, Fall 2000

Please indicate the extent to which you agree or disagree with each statement:	Percent Who "Agreed/ Strongly Agreed"				Mean (scale: 1=strongly disagree, 4=strongly agree)			
	MIT	Wellesley	RPI	TOTAL	MIT	Wellesley	RPI	TOTAL
It's helpful to have access to PIVoT 24 hrs. a day	90%	85%	77%	83%	3.27	3.12	2.89	3.07
Using PIVoT has had a positive impact on my ability to keep up with this class.	64%	55%	66%	63%	2.74	2.45	2.64	2.65
I've had a hard time understanding the material presented in this class.	42%	37%	28%	35%	2.40	2.31	2.06	2.23
PIVoT reinforces what I learn in class.	83%	80%	80%	81%	3.05	2.77	2.85	2.92
Sometimes it's very time-consuming to find the information I'm looking for.	60%	68%	64%	63%	2.65	2.94	2.76	2.75
By using PIVoT I can learn at my own pace.	65%	61%	73%	68%	2.73	2.65	2.76	2.73
PIVoT lets me learn about a subject in depth.	63%	41%	66%	61%	2.72	2.26	2.64	2.62
It's inconvenient to use PIVoT. ["... in an Athena terminal." - MIT, "... in E225." - Wellesley]	66%	48%	36%	48%	2.90	2.41	2.28	2.51
PIVoT has helped me learn better problem-solving strategies.	36%	29%	40%	37%	2.26	2.06	2.34	2.27
My high school Physics preparation was inadequate.	64%	46%	47%	53%	2.95	2.46	2.50	2.67
It's intimidating to ask recitation instructors for help when I'm confused.	35%	17%	30%	30%	2.21	1.78	2.04	2.06
I would recommend PIVoT to students who will be taking 8.01["Physics 107" - Wellesley, "Physics I" - RPI] next year.	81%	67%	73%	75%	3.04	2.75	2.76	2.86
PIVoT helps me visualize and understand ideas that are difficult to learn from lectures, recitations, and	69%	59%	73%	70%	2.85	2.55	2.78	2.77
Because of PIVoT, I've had access to a greater variety of learning materials.	79%	82%	74%	77%	2.92	2.85	2.78	2.84
I wish other classes had Web sites like PIVoT.	85%	70%	70%	76%	3.20	2.70	2.78	2.92

Appendix C

Open-Ended Comments from
Fall 2000 PIVoT Survey

MIT	1
RPI	6
Wellesley	13

MIT STUDENTS, FALL 2000

2. Type of problem(s) registering for PIVoT [were problems resolved?]

Somehow PIVOT has the wrong password registered for my name, and I can't access it now. [no]

3. Type of problem(s) configuring computer for PIVoT [were problems resolved?]

It was hard to find the free copy of TechExplorer to download. [Yes]

I have a Macintosh with Netscape Navigator. [No]

I didn't have the program necessary to show it [Yes]

Had to install real player [Yes]

Getting it to run on an Athena machine was more than tricky, it was downright hard [No]

Couldn't find the right RealPlayer - link was to wrong RealPlayer page [Yes]

4. Type of problem(s) accessing the Web site [were problems resolved?]

There were couple of times when I couldn't access PIVoT. I got error messages. The problem was solved usually after a few hours. [Yes]

The webpage sometimes took a while to work. [Yes]

The site would stop responding occasionally.[Yes]

Takes too long to load [No]

Sometimes page doesn't load. [No]

Gets stuck on connecting all the time.

5. Type of problem(s) navigating the Web site [were problems resolved?]

Unless you were told what lecture number to go to, it was very difficult to go a specific topic, if you were searching for an experiment or specific example problem of a unit. [No]

Organization not as intuitive as it should be. [No]

Keep having to log back in [No]

It seemed slightly confusing once when I needed to get back to where I had been and I'd forgotten on the precise manner in which I had arrived there. I ended up somewhere else that was also useful but not the same place. [Yes]

I have to refresh page often in order for it to be fully loaded. [No]

6. Type of problem(s) watching videos [were problems resolved?]

Congestion (6):

This is because I am living out in the countryside, and page sometimes buffers. But still it is very good and I expect a better line in 6 months. [No]

Problems due to congestion and image quality [No]

Usually very congested [No]

Once in awhile, the video's sound would continue while the image would freeze frame... so I had to reload. [Yes]

Very often the video stops to rebuffer and continues after a few minutes; sometimes it pauses and stays there, so I have to start all over again; sometimes the image freezes and the sound continues; sometimes (not as frequently as the previous problems) I just lost the connection (the error message was something like 'time out'), and I had to restart RealPlayer. [No]

Sometimes the videos would simply stop, or the audio would continue, but the video would stop. [No]

MIT STUDENTS, FALL 2000

6. Type of problem(s) watching videos [were problems resolved?] cont'd

Poor image quality (5):

Blurry

Poor image quality made it difficult to read board. [No]

Problems due to congestion and image quality [No]

I thought that the low resolution of the videos was slightly distracting, but otherwise okay. [Yes]

Videos could be of better quality picture [No]

Other (5):

Had wrong viewer program [Yes]

Once again it was hard to use from Athena

The computer kept trying to open the videos with some random program which did not work. [No]

Old browser. [Yes]

Didn't work the first time. refreshed. and it worked fine. [Yes]

7. Type of problem(s) finding information [were problems resolved?]

Hard to find info (6):

Finding particular things using key word

I didn't find it [No]

It didn't cover enough topics. I would have liked more interactive video clips.

Subject matter was not found, or had to change search criteria. [Yes]

Unless you were told what lecture number to go to, it was very difficult to go a specific topic, if you were searching for an experiment or specific example problem of a unit. [No]

I tried to find videos on several important subjects that returned no results. [No]

Too much info (2):

Too much stuff

Too much information organized unintuitively. The volume of info isn't necessarily a bad thing, though. [No]

Not helpful (5):

Some of the topics covered in the headings were too vague. [No]

Well it just wasn't as helpful as I was hoping it would be. [No]

The material seemed very limited [No]

Just took time. Wasn't organized TOOO well. [Yes]

The information wasn't shown in a way that showed which lectures were analagous to the lectures [instructor was] doing [No]

Other (2):

I think it is very, very good. This is extremely useful for me. I never believed it would be possible. My best christmas gift ever.

Sometimes the videos were too small, making it difficult to see writing on the blackboard. [No]

MIT STUDENTS, FALL 2000

8. Other technical problems [were problems resolved?]

The sample problem sets would not show up on my computer [No]

TechExplorer didn't work with Macintosh at the beginning of the semester and it works now [Yes]

Logins aren't secure. Anyone can sniff passwords used to login, which are most likely the same as those for the users' Athena accounts. Not a good thing. [No]

9. Did any of the problems mentioned in questions 2-8 discourage you from using PIVoT?

All of them (2):

all

All

Registering for PIVoT (1):

2 [registration]

Configuring computer (3):

My computing environment is not supported.

Getting it to work

3 and 4 but only in Athena cluster as home it was fine. [configuring computer, accessing site]

Accessing site (3):

Finding the website and figuring out how to use it... and the whole idea of studying from a computer screen for a few hours

3 and 4 but only in Athena cluster as home it was fine. [configuring computer, accessing site]

4 [accessing site]

Videos (3):

Watching videos

The troubles viewing the videos

6&7 [watching videos, finding info]

Finding information (9):

6&7 [watching videos, finding info]

Too much stuff, would take more time to find the material I was looking for, than the time it took me to answer my question.

Time consuming to find what I wanted

The fact that I couldn't easily locate topics I wanted to.

The limited material

Spending time looking at links that hopefully covered the topic I wanted was a bit time consuming

Number 7 [finding info]

Not finding answers to my questions

I have yet to be able to find the answer to the question I had - so I stopped using it.

Other (1):

I tried it once, and realized I was better off asking someone to explain things to me

MIT STUDENTS, FALL 2000

14. Other reasons for using PIVoT

To watch lectures (12):

- Watch lectures I missed because of absolute emergencies :-)
- Watch lectures
- To watch professor Lewin's lectures, occasionally to read the text online
- To make up for a missed lecture
- To view the Lewin 8.01 lectures as a complement to my current professor's lectures
- To listen to Professor Lewin's funny jokes. His accent is awesome.
- To learn concepts covered in unattended lectures
- To hear things I don't understand explained in a different way
- Sometimes I miss the day lectures or they're unclear
- If I do not understand all the lecture topics
- Hear a different version of the lecture
- Check it out, saw a video for a missed lecture
- Because the professor from PIVoT is excellent

Other (4):

- Used during MITES 99
- I never had the opportunity to obtain this very good background. Now it was suddenly possible. I have a good mathematical background, but I liked to improve on the physics.
- Never
- I have not been able to use it successfully.

18. Other comments about PIVoT

PIVoT is good (7):

- I missed a few lectures and Lewin's PIVoT lectures saved me (if I passed, which I'm praying on right now...)
- I like the online lectures. It gives me a chance to hear the information again, so I can clarify my notes. I really wish that 18.01 had a site like PIVoT.
- Prof. W. Lewin is an excellent lecturer. He makes Physics easy to understand.
- I find the Lewin lectures to be outstanding. He is very enthusiastic about the subject matter and makes the learning experience a lot easier.
- A lot of people use the PIVoT lectures because they have missed a lecture. Therefore if the date of the lecture that [instructor] gave which corresponds to the PIVoT lecture could be giving this would save tons of time.
- The thing I like most about PIVoT is the Lewin lectures.
- It is a great resource and there should be one of these for every class. My professor now is excellent, however sometimes it is good to hear the concepts explained from a different prospective - Walter Lewin is the perfect lecturer to be on this website. Never get rid of PIVoT please!!
- I'd like to PLEASE continue to have access to PIVoT, I believe it's going to continue to be helpful for my next physics class.

MIT STUDENTS, FALL 2000

18. Other comments about PIVoT (cont'd)

Don't use PIVoT much or at all (6):

I should use it more than I do, I think it's a very helpful tool to have access to, it's a great idea. If I used it more I would have a better idea of what bugs needed to be ironed out.

As an 8.01L student, I felt our class has been 'hidden' from PIVoT. The COMPLETE contents of the PIVoT website were never made obvious to us. I realized the full contents of the PIVoT website for the first time while filling out this survey. Had I at least known of the other study-helpers on physics, I would have at least looked at them to see if they were helpful.

I have never used it, but I really think that it may have helped when studying for tests. I just never really felt like I had time to access it and figure out how to use it when I may as well just read the study guide.

PIVoT seems like a good thing; I saw someone else use it. But I cannot use it on my computer. That's kind of bad.

I do not have any incentive to use PIVoT.

I had not heard of PIVoT before the e-mail.

Wish other classes had Web sites like PIVoT (2):

Once again, I wish other classes had Web sites like PIVoT. It would make learning so much easier for us folks who just don't pick it up in class.

I have only been connected for 2 days and am planning to use this wonderful tool every day when I am home from my flying duties as a captain and I plan to take all lectures and exams in a short time and wonder if MIT has also current possibilities regarding other undergraduate courses? Or have plans to do so in the future?

PIVoT is a great idea, I really wish it can be promoted and popularized. Other classes should definitely have PIVoT; it's especially helpful when someone misses class.

Other (2):

PIVoT makes for a fine addition to the class. But it is just that, an addition, I would never use it as a primary learning tool.

Need videos for more of the topics, if not all of them, if it is at all possible.

RPI STUDENTS, FALL 2000

2. Type of problem(s) registering for PIVoT [were problems resolved?]

Server problems (17):

server crashed [yes]
web site was down [yes]
site down [yes]
server went down [yes]
server went down [yes]
At first, there was a problem where the page wouldn't load [yes]
site down initially [yes]
server went down in middle of registration [yes]
connecting to server
site down once or twice [yes]
server is down a lot [yes]
usually site down [yes]
website was not working properly [yes]
server messed up often [yes]
PIVoT server was temporarily down [yes]
server error [yes]
server down [yes]

Registration problems (5):

It wouldn't let me register, hence never used.
Can't go to the add [yes]
wouldn't let me register [yes]
wouldn't go through [yes]
I could not register at all for awhile [yes]

Login problems (3):

couldn't log in [yes]
didn't get a password to log on [yes]
couldn't log in [yes]

Other (2):

Would not work at home w/ Road Runner [yes]
my own error; can't remember though [yes]

3. Type of problem(s) configuring computer for PIVoT [were problems resolved?]

My browser didn't load the navigation/registration program. So I was unable to use PIVoT at all. [no]
I run open based and real video is not supported [no]

RPI STUDENTS, FALL 2000

A web site shouldn't require configurations [no]

4. Type of problem(s) accessing the Web site [were problems resolved?]

Server problems/site busy or down (24):

- site was often down [yes]
- one or two nights the server was down [yes]
- web site was down [yes]
- occasionally in the beginning site down [yes]
- sometimes the site would be down [yes]
- server problem [yes]
- ridiculously busy, site busy [no]
- it was occasionally down [yes]
- just network problems (connection) [yes]
- just that it sometimes loaded slower
- server down occasionally [yes]
- site often down [yes]
- one week-end the website was down [yes]
- took much time to get into when school first started [yes]
- problems connecting to the server [yes]
- it went down once [yes]
- site down once or twice [yes]
- site is often down [yes]
- refreshed the page [yes]
- in the beginning server moving trouble [yes]
- sometimes I had problems accessing [yes]
- server occasionally down [yes]
- server down [yes]
- it was down once or twice [yes]

Page not found/address problems (4):

- page not found [yes]
- at first I didn't know the IP address, then I bookmarked it [yes]
- didn't find it [yes]
- address problems [yes]

Other (2):

- I had trouble logging in once but I may have set IE to not accept cookies [yes]
- Died under UNIX [no]

RPI STUDENTS, FALL 2000

5. Type of problem(s) navigating the Web site [were problems resolved?]

Trouble finding material (3):

Had trouble finding appropriate content.[yes]

Couldn't find any useful help for a homework problem I was having trouble with

The organization and material didn't help me much [no]

Other (2):

My browser didn't load the navigation/registration program.

So I was unable to use PIVoT at all [no]

Died under UNIX [no]

6. Type of problem(s) watching videos [were problems resolved?]

Issues with Real Player (4):

Require Real Player [yes]

Had to get Real Player [yes]

I run open based and Real video is not supported [no]

Proprietary video format [no]

Buffering problems (3):

buffering stopped in the middle and crashed my computer [yes]

Slow to load [yes]

Don't like using Real Player. It tends to log resources & crash.

Hard to see (1):

some of it was hard to see b/c of the way it was recorded [no]

7. Type of problem(s) finding information [were problems resolved?]

Hard to find material (11):

It was hard to find material.

PIVoT did not have all topics covered in this course. [no]

It did not have one topic which I needed. I forgot which one.

Had trouble finding appropriate content. [yes]

I know it's hard but not all the important topics were covered. At least I couldn't find it. [no]

information need to be better organized

Some of the information I wanted was not there [no]

Never really had material that was related to what we did in class

Sometimes not enough information

A little cluttered [no]

Not a wide spectrum of information as of yet [yes]

RPI STUDENTS, FALL 2000

7. Type of problem(s) finding information [were problems resolved?] (cont'd)

Search engine needs improvement (5):

- Search engine for the site was terrible.
- Search function was not always helpful. [no]
- It was tedious to search for a certain subject.
- Search seemed to watch topics oddly [no]
- Not easy to use.

Slow (2):

- Didn't find it because slow to load
- The stream speed was slow

8. Other technical problems [were problems resolved?]

- Java on the site has syntax errors/menu leaks

9. Did any of the problems mentioned in questions 2-8 discourage you from using PIVoT?

Registering for PIVoT (4):

- Problems with questions #2,3, 5-8 (unspecified) that were not resolved
- Registration problems
- Lack of Registration
- couldn't register

Configuring computer (2):

- Problems with questions #2,3, 5-8 (unspecified) that were not resolved
- # 3, 6; I run open based and real video is not supported.

Accessing site (5):

- Site down
- #4 ridiculously busy, down frequently
- Site down
- server being down!
- Sometimes it went so slow I gave up

Navigating site (2):

- Problems with questions #2,3, 5-8 (unspecified) that were not resolved
- #5 The organization and material didn't help me much

Watching videos (6):

- Not being able to download videos
- Problems with questions #2,3, 5-8 (unspecified) that were not resolved
- #6 buffering stopped at the middle and crashed my computer
- #6 slow to load
- # 3, 6; I run open based and real video is not supported.
- going to get the movies

RPI STUDENTS, FALL 2000

9. Did any of the problems mentioned in questions 2-8 discourage you from using PIVoT? (cont'd)

Finding information (5):

not a wide spectrum of information as of yet

#7 Some of the info I wanted was not there

#7 search engine for the site was terrible

#7; had problems with finding needed information, and this problem was not resolved

Problems with questions #2,3, 5-8 (unspecified) that were not resolved

Other technical problems (1):

Problems with questions #2,3, 5-8 (unspecified) that were not resolved

All of them (2):

all of them (no further detail)

ALL (usually site down as well)

14. Other reasons for using PIVoT

It was required (8):

when required to by H.W

b/c they were recommended

only because web assign tells you to

homework the requirement

when the homework says so

the problem said to use it

Because we were supposed to

only when required

Curious (4):

For the joy of learning

When I'm bored

just curious to see what kind of examples they give

just to look around as to see what it was about

Other (2):

for labs

All of the above; (help with problem set homework, review for quizzes/exams, help me better understand physics concepts)

Didn't use (2):

I do not use PIVoT

didn't use

RPI STUDENTS, FALL 2000

18. Other comments about PIVoT

Liked PIVoT (8):

I love the PIVoT website

I didn't use it that much, only used lectures - but when I did, it helped.

I enjoyed physics, and PIVOT was useful.

I didn't use PIVoT very much, but if I had trouble with the course I'm sure it would be useful.

I didn't use it that much. But it was a good idea, and would probably be useful if made a more regular thing.

I loved the problems/lectures on video. Being able to watch them over and over helped a lot.

PIVoT RULED. It helped A LOT with my homework. I wish the class was taught the way the lectures on PIVoT were taught. Going through example problems on the board helps IMMENSELY!!! Use more PIVoT.

It helped - mostly with homework though. It's always great to have extra resources when you're confused.

Didn't like PIVoT (5):

PIVoT was pointless

annoying when it wasn't working

It wasn't very useful (PIVoT).

I prefer lectures where instructor chooses what to teach when. I went to RPI to AVOID super-standardization. This class seems to thrive on it.

PIVoT isn't that great.

PIVoT, Web Assign, and those ridiculous laptop labs ruined this course.

PIVoT wasn't well-integrated with class (4):

PIVOT was quite helpful in approaching certain difficult problems/exercises. I wish lecture more closely fit with PIVOT in terms of topics covered. I think that the problems on Web Assign should be closer in difficulty level to exam or activity questions. Often times web assign problems were much harder than exam/activity questions but that could be b/c web assign problems were to be completed often before that material or certain approaches to the material were covered in class. Web assign was nice in that it kept me caught up with the material and I got instant feedback from how I was doing. Basically, I like the concept of Web Assign but the problems were too time-consuming.

PIVoT is only good if you have the time for it. It's too bad the lectures are not worked into the curriculum, because they are helpful!!

Honestly, I think PIVoT is a nice idea but too extraneous. It wasn't integrated into the course well and always took EXTRA time - it could be useful but something else has to go. I never had enough time so PIVoT always the 1st thing to be sacrificed because I could cope without it.

PIVoT not used in class enough

Hard to find material (2):

Suggest ways to find the material we did in class on PIVoT

Not all the information I tried to find on PIVoT was easily accessible.

RPI STUDENTS, FALL 2000

18. Other comments about PIVoT (cont'd)

RealPlayer bad (2):

The website is good in general, but the videos take too long to buffer and sometimes induce problems. Basically, the website is good, but RealPlayer is bad.

Real Video is not a very good format for most students and here is why: 1) is not supported on all standards 2) Never gives clear pictures 3) Not an open standard 4) Often crashes 5) Causes many security problems 6) Cannot be viewed off-line

Didn't use (1):

Because PIVoT wasn't mentioned much in class, I forgot about it shortly after registering.

WELLESLEY STUDENTS, FALL 2000

2. Type of problem(s) registering for PIVoT [were problems resolved?]

It took me a while to figure out how to register. [yes]

I don't remember.

I couldn't get on my computer... it was complicated. [yes]

It took me a while to realize that the only place where I can access PIVoT is Room E225. [yes]

Would not let me in after putting password. [yes]

3. Type of problem(s) accessing the Web site [were problems resolved?]

Site busy/down (6):

Site down. [yes]

Busy or wouldn't load. [no]

Sometimes it took a very long time. [no]

A few times it was down or busy, so I tried again hours later and it was back up. [yes]

Occasionally the Web site would take forever to load. [yes]

Web site often down. [yes]

Couldn't log in (6):

Sometimes won't let me sign in. [yes]

Sometimes it wouldn't let me log on. [yes]

Could not log on. [yes]

No access log. [yes]

Many times I had to put in my password. [yes]

Would not let me in after putting password.

Computer didn't work (2):

Sometimes, I would try again or on a different computer. [yes]

My computer didn't work for PIVoT. [no] I just used someone else's computer.

Other (1):

Sometimes it was hard to get to the PIVoT problems. I couldn't get it once or twice, because the URL was missing. [yes]

4. Type of problem(s) navigating the Web site [were problems resolved?]

Trouble finding material (5):

Couldn't find things in searches.

Searches for keywords were not so helpful.

I found it difficult to go back and forth, and to find the info under the topic headings. [no]

It was a little confusing at times, and tedious to find certain things.

Incredibly confusing search system — often, a link would take you to an unrelated topic. [no]

WELLESLEY STUDENTS, FALL 2000

4. Type of problem(s) navigating the Web site [were problems resolved?] (cont'd)

Problems getting URL (2):

Sometimes the pages would not load properly, so I stopped using it to browse.

When I tried to copy and paste the weekly address it didn't get past login, and I had to type the address in. [no]

Other (1):

Many times I had to put in my password. [yes]

5. Type of problem(s) watching the PIVoT videos [were problems resolved?]

Problems with player (12):

They kept stopping. [no]

Very choppy, sound bad.

Yes, they never worked. I have both RealPlayer and Windows Media. [no]

Video would stop, sound would jump. [no]

Some didn't come up and mostly the videos were really slow to download.

The videos would stop and I'd have to wait for them to resume.

There was a problem with buffering/traffic, etc. I wrote to the help people and they couldn't help me. [no]

Movies would stop playing mid-lecture. [no]

Rebuffering (constant interruptions); disconnects (timed out); image freezes/sound continues. [no]

Major problems. The videos would not play in E225 because the computers would always freeze. I was not able to watch any videos and wrote to PIVoT support twice. I gave up.

Sometimes the sound ran ahead of the video, but that's just RealPlayer. [yes]

I didn't really watch them, because the Internet takes so long.

Other (1):

The only time I tried the computer, didn't have tech [sic] explorer.

6. Type of problem(s) finding the information you were looking for [were problems resolved?]

Hard to find material (9):

PIVoT seems to be not well structured. [no]

See 4 ["couldn't find things in searches"]..

It was hard to find the information that I wanted.

Sometimes the videos were hard to find.

I think that it's a bit difficult to find the specific subject we want. [yes]

Sometimes I just had trouble guessing under which lecture the info would be covered. [no]

See #4 [I found it difficult to go back and forth, and to find the info under the topic headings.]

There was one subject (cannot remember now — something about gravity) and I could never find clarification of the question I had. [no]

It was often difficult to narrow down exactly which concept I was looking for. Centripetal accel, for example, brought up so many non-specific topics it took forever to answer my question.

WELLESLEY STUDENTS, FALL 2000

6. Type of problem(s) finding the information you were looking for [were problems resolved?] (cont'd)

Search engine needs improvement (3):

I could never figure out the syntax for the searches, so I never got the information I was looking for.

The search function was a pain. I wish they had a table of contents or a directory.

Search system difficult to use — information was lifted verbatim from the text, rather than being an additional resource. [no]

Other (1):

See above [Sometimes it was hard to get to the PIVoT problems. I couldn't get it once or twice, because the URL was missing].

7. Other technical problems [were problems resolved?]

Make it Mac friendly.

When I wanted to submit problems, they did not submit. [no]

The links for the simulations give error messages. [no]

The link on the hw didn't work. [yes] I copied and pasted the address.

The speakers also don't work when playing information. [no]

One morning I couldn't sign in to submit my problems — but that was eventually fixed. [yes]

8. Did any of the problems mentioned in questions 2-7 discourage you from using PIVoT?

Accessing the site (3):

3 ["Sometimes won't let me sign in"]. I wouldn't be able to answer questions and had to go back the next day to E225.

It didn't work on my computer.

Pain to use on Mac.

Navigating (2):

4 [navigation], 5 [videos], 6 [finding info].

Every time I changed screens it would ask for my password -- it only did that about half the time, though.

Watching videos (7):

The PIVoT videos not working.

4 [navigation], 5 [videos], 6 [finding info].

[videos, finding info]

5 [videos], 7 [other technical problems].

Not being able to see video.

[videos, finding information]

Navigating the Web site.

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8. Did any of the problems mentioned in questions 2-7 discourage you from using PIVoT? (cont'd)

Finding information (6):

[finding info -- "PIVoT seems to be not well structured"]

Too difficult to get help, specific information.

4 [navigation], 5 [videos], 6 [finding info].

[videos, finding info]

6 [finding information].

[videos, finding information]

Other technical problems (1):

5 [videos], 7 [other technical problems].

Other (3):

Problems not always correct.

I basically only used PIVoT to do the required problems each week; I rarely looked up info on it. make a habit out of going to SciCentre to solve one more problem for Physics (while so many others can do it in their room because they have a computer!). That IS discouraging and unfair ('cause I can concentrate better in my room).

18. Please use this space for any other comments you would like to make about PIVoT.

There were problems with the structure of PIVoT (6):

PIVoT is a good idea (in theory), but in practice it needs a lot more work to make it user-friendly.

I truly loved my physics class, yet sometimes found PIVoT confusing.

I would have liked to use PIVoT more, but there was just never any time and I had trouble navigating. The class was great, and I think if I had it to do over, I would use PIVoT more, especially the problem review sets.

Suggestion: A page with all the practice problems would be very helpful, or all the lectures. Sometimes I wanted to work out review problems, but had to search for each set. It would be more convenient to have them all on the same page. PIVoT was a good resource to have. I sincerely wish there was a similar setup for other physics classes. How is 108 going to be without it?

I wish that PIVoT had more resources in explanations of problems and how to set up problems. Occasionally I could find videos that would supplement this, but it was not consistent or anything for which I could search.

I found PIVoT difficult to use as a resource. Practice problems were useful only if I already had a basic understanding of the material. In terms of getting that understanding... The search engine led me in circles to unrelated material. The text was lifted verbatim from the textbook, instead of acting as a supplement, and when I had trouble understanding the text, this wasn't terribly helpful. The lectures were difficult to use. Wading thru lectures and videos to find helpful and relevant information was terribly time-consuming. However, taken in the context that any resource is better than none at all, it's not too bad. It cannot ever take the place of a 15-20 minute conversation with a tutor or teacher. "Face-to-face" interaction can nail down a misunderstanding and fix it more efficiently and more satisfyingly than any program.

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18. Please use this space for any other comments you would like to make about PIVoT. (cont'd)

PIVoT was inconvenient to access (6):

It was nice having problems that I could check to see if they were right or wrong, but it was a pain to turn them on and access PIVoT. I have a computer in my room, but I couldn't get PIVoT on it. When working with friends and using the problems they copied down it was annoying to turn on by myself.

It would be great to have ALL the computers in the physics room and the science library READY with the required (updated) software at the beginning of the semester. I've talked to a reference librarian and they're willing to help (they just didn't know this resource was available).

I think that PIVoT was very good to have; however, I found it inconvenient to have to submit the answers, as I do not have my own computer and had to walk over from Claf[??] to submit answers. I found the textbook useful. When you submit your answers, the solutions are not always clear. Sometimes, I did the problem differently, but couldn't figure out what the computer had done. I hated fighting with the computers to make them play videos, and eventually gave up. PIVoT support said they would evaluate the problem, but nothing changed and they did not contact me again.

I think that more computers on campus should have been equipped with tech explorer. If I had had more access to PIVoT I would have used it more. I think if I had had more time this semester I would have spent more time on PIVoT. As it is I hardly used it except for the problem set problems.

I am just really not handy with computers. Therefore, it was difficult for me to access homework presented in the computer form. I felt I was put at a disadvantage to other students who have access to computers in their own room. Having to go all the way to Sci Centre can be annoying. Other than that, PIVoT problems are fun (but they require a lot of tedious calculations). Class was challenging, but it did not make me hate physics. And I really loved the labs.

I didn't get to use PIVoT a lot since I do not have a computer in my room, so I had to go ONLY to the room E225, which was sometimes inconvenient. I think, though, that it is a good resource for those who have the ability to use it, and I even put the URL on my Web site for computer science. I liked that the textbook was online, because sometimes I read slower in the book, though I like having either option.

PIVoT was a good resource (6):

I liked having it available. I hope it remains available.

Keep PIVoT. It had the best questions on the problem set.

I found it helpful, especially on problem sets, when I didn't know how to approach the problem.

PIVoT is a great program if there's no trouble accessing the videos.

PIVoT really helped me conceptually and it had good practice problems.

I believe it is a great resource for people who just want to review topics taught in lecture. I also used PIVoT to learn about things we didn't touch on in lecture. Prof. Lewin's videos are very interesting and informative.

Would rather use a book (2):

The material done in class was understandable, so PIVoT is not necessary to be used. It is rather useless. I would prefer to have an additional problem from the book instead of the additional PIVoT problems.

I would much rather learn from a book. Don't like the format of PIVoT. Pain to use. Only use it when I have to for the problem set. I know Ohanian is the book PIVoT uses, but I hate Ohanian. It is literally "old and stinky". I don't read the book 'cause I don't like the way it presents and explains things.