



Evaluation of Publisher Provided Online Learning Systems as Pedagogical and Curriculum Assessment Resources

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1. Introduction

Recent years have seen an explosion of publisher provided online learning resources, including online homework management systems, simulations, video tutorials, and demonstrations for use in introductory physics courses. If fully utilized, these resources can provide the students with an “instructor on demand”, giving them another voice from which to hear the concepts the instructor is trying to convey and on their own time. These resources provide instructors with the ability to allow the students to adequately practice applying physical concepts and using their problem solving skills even in large enrollment courses. Instructors can assign pre-lecture assignments and are provided with the needed data to use Just-In-Time Teaching strategies and quickly modify lecture content to best serve the students’ overall strengths and weaknesses. This same data can be used to determine if a topic should be revisited before an exam. Student achievement can be tracked through the provided learning outcomes or objectives connected to each assigned problem. This data can be used when assessing individual student learning or reporting course efficacy for purposes of institutional assessment.

This paper will evaluate the online learning systems Pearson’s MasteringPhysics and Wiley’s WileyPlus as used by the physics program at the University of Southern Indiana (USI) for both algebra and calculus based first semester introductory physics courses. Student feedback and performance will be discussed. This paper will also provide a brief overview of the resources available with each online learning system and a discussion on how such resources are used by the physics program at USI. Additionally, as USI is currently redesigning its core curriculum with a focus on detailing what a student should know and be able to do at the end of instruction and assessing student learning accordingly, this paper will also discuss how the physics program at USI utilized the resources offered by these systems to design course assessment protocols.

2. Online Homework Systems and Resources Used at USI

MasteringPhysics is the online learning system produced by Pearson. In addition to End of Chapter questions and problems from the accompanying textbook that can be assigned, MasteringPhysics also has assignable tutorials, reading questions, multiple choice “test bank” problems, and Video Tutor Demonstrations. The “Study Area” available to students features practice problems and questions, a copy of the eText, PhET simulations¹, and a set of interactive simulations coupled with questions called ActivPhysics.

Use of MasteringPhysics in courses at USI began in 2010 as a publisher provided test for the calculus based Intermediate Physics I (PHYS 205) using the resources affiliated with Young and Friedman’s University Physics with Modern Physics 12th edition while I was still using Wiley’s Fundamentals of Physics by Halliday, Resnick, and Walker for the course text. It was not used again in PHYS 205 until the opportunity arose to change textbooks in 2012 to Physics for Scientists and Engineers, 3rd edition by Knight. MasteringPhysics was more quickly adopted for

the algebra based General Physics I (PHYS 175) as the department was already using Giancoli's Physics: Principles with Applications 6th edition. It was used with Giancoli's text from Fall 2010 until Fall 2012 when the text for this course was changed to College Physics 2nd Edition by Knight, Jones, and Field.

In all of these instances, students were assigned 8-12 End of Chapter problems AND 2-4 concept questions per chapter, along with the video tutor demonstrations available for that chapter that were graded for credit. Practice problem sets composed of approximately 80-120 End of Chapter problems and questions that were found to be relevant to the lecture were assigned for no credit. Students were also strongly encouraged to use the other resources offered by the system.

WileyPlus has also been used by the physics program at USI and offers assignable End of Chapter problems and concept questions, reading questions, simulations, and multiple-choice "test bank" problems. The End of Chapter questions and problems have a link that will take the student to the relevant section of the text and can include mathematical remediation. The "Link to Text" was very popular with the students. The "Read, Practice, Study" section available to students has e-text content, animated illustrations, additional sample problems, videos of sample problems being worked out, mini-lectures, concept simulations, and Interactive Learningware problems, and a solution manual that includes selected End of Chapter problems.

Use of WileyPlus at USI is limited to the Fall 2013 semester. WileyPlus was used in conjunction with Physics, 9th edition by Cutnell and Johnson for PHYS 175 and Fundamentals of Physics 10th edition by Halliday, Resnick and Walker for PHYS 205. In both of these courses, students were assigned 8-12 End of Chapter problems AND 2-4 concept questions per chapter that were graded for credit. Practice problem sets of problems relevant to the lecture were also assigned for zero credit. Once again, students were encouraged to use the other resources offered by WileyPlus.

3. Comparison of student performance by course

As noted above, these systems are publisher specific and at times the course text had to change in order to implement the new online system. I am a strong believer in ensuring that the course text is a student resource that works in harmony with the material presented in lecture. This required that my classroom presentation of material change to fit the flow of the narrative in the text. The metric that has remained constant in both PHYS 175 and PHYS 205 is the cumulative final exam.

System	MP	HW	MP	WP
Text	HRW	HRW	Knight	HRW
Avg Final Exam Grade	65% (52 students)	65% (48 students)	66% (47 students)	64% (46 students)

Table 1: Final Exam grades for PHYS 205 with online learning system and textbook used. MP = MasteringPhysics. WP = WileyPlus. HRW = Halliday, Resnick, and Walker. HW = Conventional Homework

Table 1 shows the cumulative final exam grade for the calculus based PHYS 205 with the number of students enrolled. During one semester (shown in the second column) no online

homework system was used and assignments consisted of approximately 6-8 End of Chapter problems turned in weekly and several in class homework problems in which the students were required to work with a partner to solve a homework problem in 10 minutes.

System	HW	MP	MP	MP	MP	MP	WP
Text	Giancoli	Giancoli	Giancoli	Giancoli	Giancoli	KJF	CJ
Avg Final Exam Grade	65% (29 students)	67% (48 students)	63% (29 students)	62% (29 students)	64% (26 students)	62% (30 students)	69% (22 students)

Table 2: Final Exams grades for PHYS 175 with online learning system and textbook used. MP = MasteringPhysics. WP = WileyPlus. KJF = Knight, Jones, Field. HW = Conventional Homework

Table 2 shows the cumulative final exam grade for the algebra based PHYS 175 with the number of students enrolled. Like the results from PHYS 205, during one semester no online system was used. Timed in class problems worked in with partners made up most of the homework grade, although End of Chapter problems were assigned throughout the semester.

Along with the use of online learning systems, many other variables are involved including variation in student population, textbooks, changes in my presentation of material in lecture, and changes in the accompanying laboratory section make it impossible to suggest that online learning systems alone affect student critical thinking skills and conceptual understanding of physics as measured by the cumulative final exam. Along with these other variables, the small sample size make any significant conclusions about cause and effects impossible to quantify. The results so far seem to agree with published results² that online homework systems certainly do not harm student learning.

There are certain intangibles that indicate both online learning systems have a positive impact on the students. The students that utilize my office hours come to me with more informed questions regarding physical concepts and practice or homework problems they are working on. Anecdotal student feedback for MasteringPhysics has overall been positive. After a week or two of use, students are able to navigate the system's resources with no complaint. Students have relayed to me that they find the format of WileyPlus to be much more difficult to navigate, even after using it for most of the semester.

4. Comparison of instructor resources

There are many instructor resources that aid in the development of lectures and exams that will not be discussed here. The focus of this comparison will be on the presentation of student performance on assignments to quickly address potential problems in lecture³ and the storage and tracking of learning outcome data for individual or course assessment.

In all of the instances presented above in which an online homework system was used assignments were due at 11:55 PM on a noted due date that was usually the night before a lecture meeting. Grades could then be checked before lecture to identify specific weakness that the class may have as indicated by a low average score on a homework problem.

Figure 1 shows the default Diagnostics View for an assignment in MasteringPhysics. Starting in the upper-left hand corner and moving clockwise we are presented the time students spent on the assignment, the average score for each item in the assignment, the assignment score by student and a score histogram. By clicking on an assignment item, the wrong answers given by students is displayed along with a break down of how many students succeeded in answering the problem with a comparison to all students using MasteringPhysics as shown in Figure 2.



Figure 1: Default Diagnostics View for an assignment in MasteringPhysics

Answer Stats:	Students	% Correct	% Unfinished	% Req'd Solution	Wrong/student	Hints/student
System Average	14115	93.5%	2.6%	3.9%	0.9	0
This Course (KPURCELLF12)	31	93.5%	0%	6.5%	0.7	0

Wrong Answers for This Course (KPURCELLF12)		
% Wrong	Answer	Response
14.3%	.8	
9.5%	1.97	
9.5%	.2	
9.5%	.1	
9.5%	0.60	
4.8%	2.25	
4.8%	.25	
4.8%	1.25	
4.8%	1.68	
4.8%	2.42	

Figure 2: Student Data view for one item in a MasteringPhysics homework assignment

Compare this to the Graph View of grades in WileyPlus in Figure 3. Information is broken down to show if students how many students succeeded and indicating which problems students simply ignored. Clicking on one item does not give any more information. In the normal view of the grade book, one can find the amount of time that each student worked on the assignment.

While both systems can be used for Just-In-Time teaching and determining if a topic should be revisited before an exam by identifying student weaknesses, the depth of information given by MasteringPhysics makes it a much more powerful tool. In many instances, knowing which wrong answer students are finding opens up a discussion to a conceptual misunderstanding that they have thus giving us an opportunity for us to work though this misconception as a team. Doing this with the information provided by WileyPlus would require an outspoken student to admit their wrong answer to the class, which is unlikely to happen.

View Graph

CLOSE

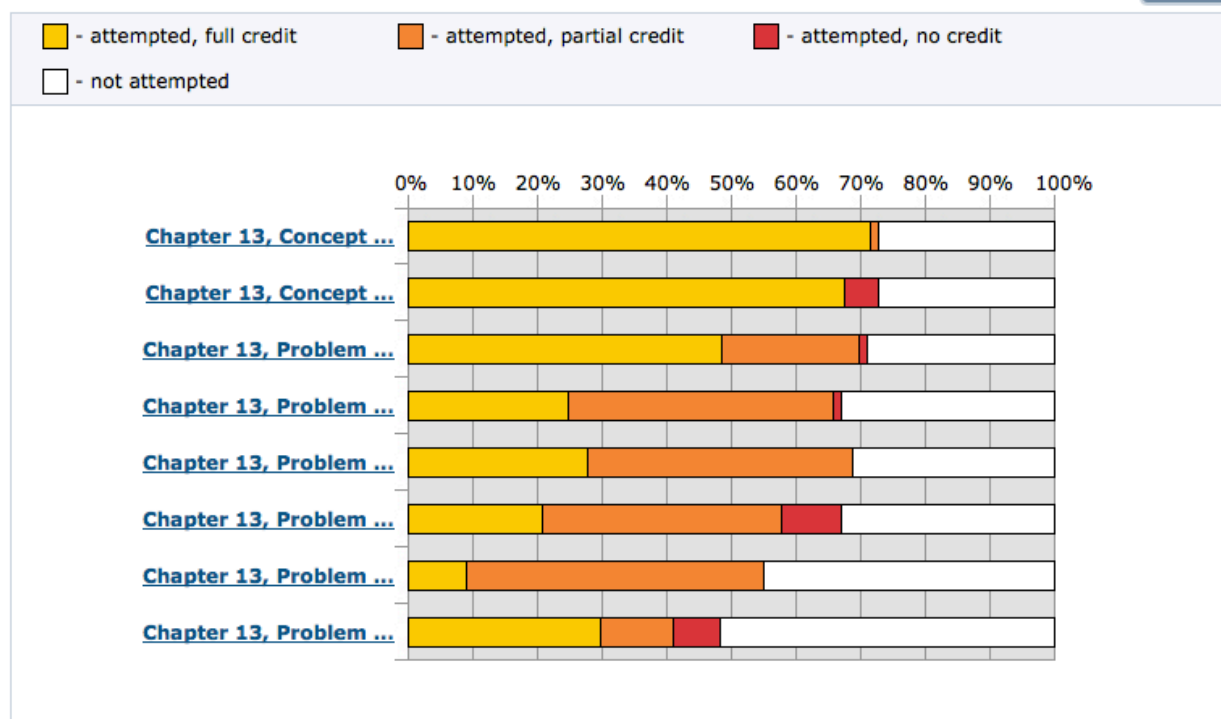


Figure 3: Graph View of assignment results in WileyPlus

USI is currently redesigning its core curriculum with a focus on detailing what a student should know and be able to do at the end of instruction and assessing student learning accordingly.⁴ Both PHYS 175 and PHYS 205 (and the second semester courses that follow) are natural choices to satisfy the Natural Science with a Lab component of core. The physics program, however, was charged with the task of providing measurable outcomes by which these courses can be evaluated to determine if they are meeting the goals of the University Core Curriculum. The following items had to be addressed.

- Students will be able to describe the roles of observation, hypothesis, and testing in the process of generating and modifying scientific explanations.
- Students will demonstrate the ability to use appropriate discipline-specific observational, quantitative, or technological methods to test hypotheses and determine their potential validity.
- Students will be able to apply foundational knowledge and discipline-specific models and/or theories to explain or predict natural phenomena and to solve problems.

The first two bullet points are addressed by the laboratory component of the course. The third point is one that is addressed primarily in the lecture. One such measure of the ability to apply models and solve problems can be the exams, but this was determined to vary too much from instructor to instructor. Both online learning systems have “tagged” each problem with a physics specific topic that can be used to choose which problems to assign to the class and to determine what topics a homework assignment covers. These are available as reports in both systems (Study Objectives in WileyPlus and Learning Outcomes in MasteringPhysics). In this respect,

the difference between the two systems is minimal with MasteringPhysics presenting the tags not only by assignment but also summarizing for all assignments in the course. We could use these physics specific topics to build a more general group that could be tracked and recorded for future assessment of this course in the Core. MasteringPhysics has apparently anticipated this need and provided a second “tag” on problems that are global learning outcomes. They are

- Demonstrate an understanding of the principles of scientific inquiry.
- Demonstrate the ability to think critically and employ critical thinking skills.
- Read and interpret graphs and data.
- Demonstrate the quantitative skills needed to succeed in Introductory Physics.
- Demonstrate an understanding of the impact of science on society.
- Evaluate the credibility of scientific information from various sources.
- Demonstrate the ability to make connections between concepts across physics.
- Communicate effectively in writing.
- Apply the scientific method in lab experiences to interpret information and draw conclusions.

These global learning outcomes can be reported to the instructor as a summary for all assignments in the course just as the physics specific outcomes are. The total number of items assigned that meet each outcome is given, as well as the average grade of items in each category. A report of these global outcomes will be used to assess our introductory physics courses as required by the guidelines of Core Curriculum Council.

5. Conclusions

While both WileyPlus and MasteringPhysics provide students with immediate feedback and many pedagogical resources and instructors with valuable tools for both classroom and institution assessment, MasteringPhysics is superior in the student data provided and in ease of use for both the instructor and student. It is however, missing some features popular with students using WileyPlus, such as the “Link to Text” feature. The publishers are currently waging a pedagogical resources “arms race” and the systems seem to constantly evolve. It is for this reason that this report should be understood as an evaluation of a snap shot in time of these evolving resources.

References

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