An OER Inventory of Innovative Online Physics Problems

OER Summit Panel
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Switch to OER

Under UM System's A&OER initiative

Course - College Physics 1, Enrollment: 300 to 400

Incentive - Reduce cost to students

Prior: Publisher's etext + access code: $130
Print + access code: $208
access code only: $70

Current: Openstax: etext – free
Varafy charge: $25
Print B&W MU campus: <$30
Amazon Colored print (2 courses): $48

How - Adapt OpenStax College Physics,
Select relevant chapters / sections

Biggest Challenge - Online Homework

Mains Issues with Available Online Homework

- Academic Integrity issue

Publishers' solutions can be found on the internet
Students could get the answers with little or no effort

- Alignment to my teaching and assessment style

Materials created by others - I had no control over the implementation

Conclusion: the best way to address these issues is to create my own assignment problems

Challenges to Creating My Own Physics Problems

- Find a suitable independent online platform

I must have complete access to the "Editor's" interface to create and modify my content instantly
Rather than using concierge service as middle person

After looking into several independent Online Homework systems,

I found one that could potentially satisfy my demand:

Varafy

- Extremely time - consuming

Pedagogy I

- Problems are explicitly connected to learning objectives.

- "Scaffoldings" are provided:

- conceptual questions aimed at clearing misconceptions and leading to a deeper understanding of the subject.

- tutorial sections designed to help students to set up the problem and get started with the solution. These tutorials are especially helpful for students with no prior experience of taking a physics course.

- diagrams and illustrations, which help students to visualize the situation to be analyzed. For many students this in an indispensable aid.

- reminders of common mistakes

Pedagogy II

- Each problem is broken into steps.

This makes it easier for students to understand the logic of the solution and track down mistakes. It saves time and reduces frustration.

- Problems are arranged in a sequence of gradually increasing complexity and difficulty.
  This allows students to gradually build their problem-solving skills.

- Problems are designed to demonstrate that a few basic concepts/principles can be successfully applied to seemingly different situations. This fact, when properly grasped, tremendously enhances students' problem-solving skills.

- Some problems are required to be solved using multiple approaches, so students learn to see the connections between various concepts/principles and appreciate the internal consistency of the discipline.

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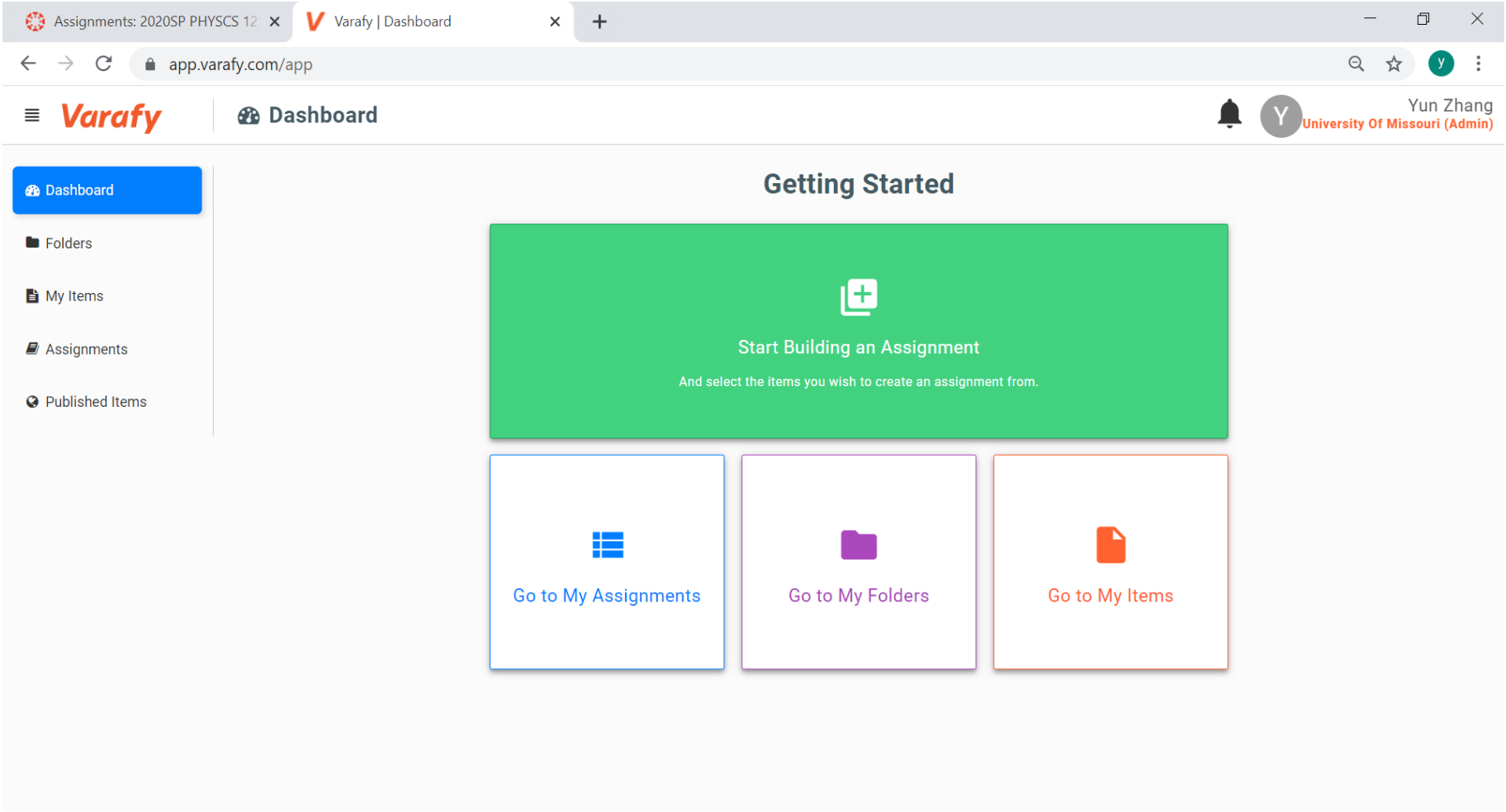
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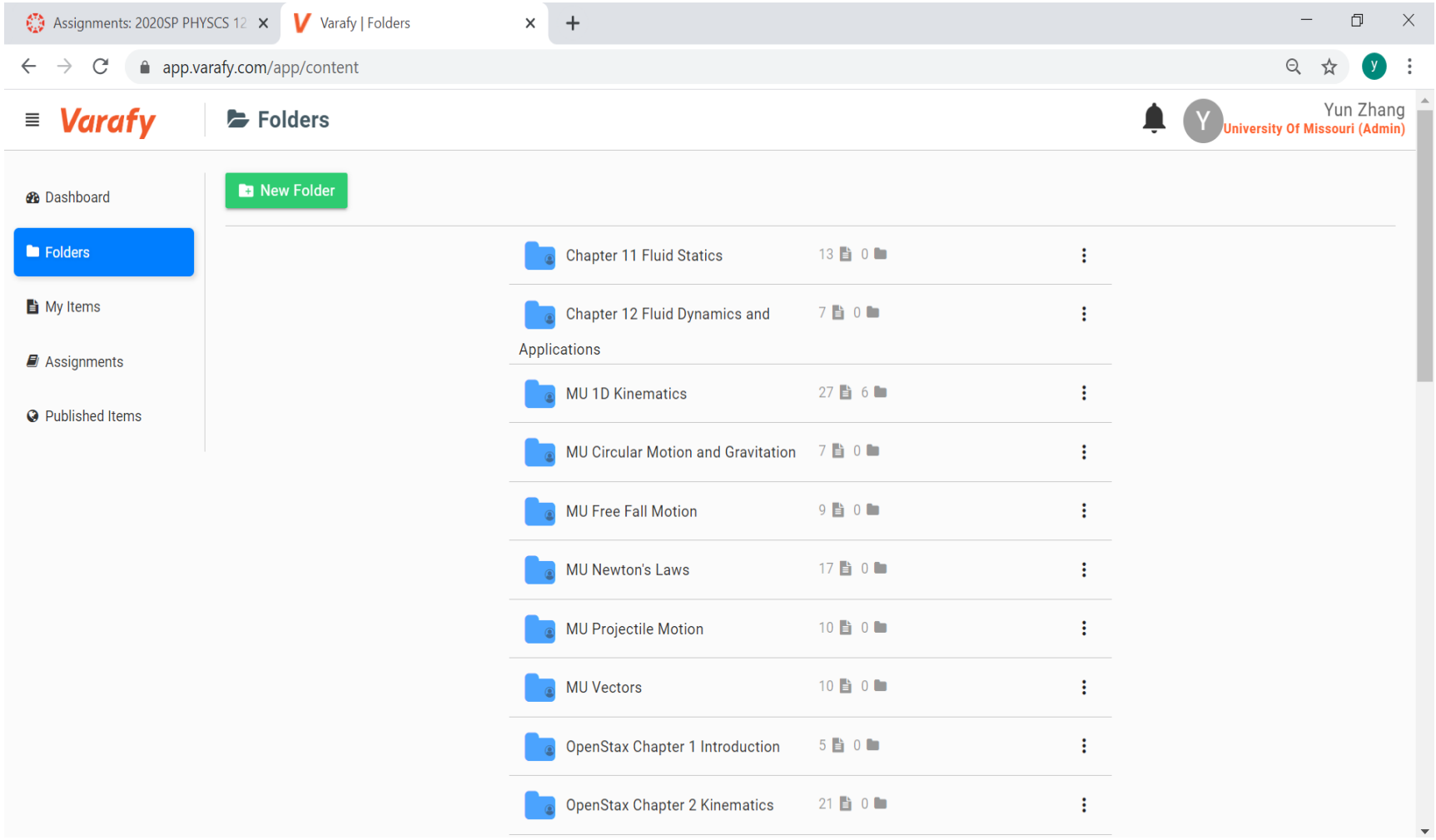
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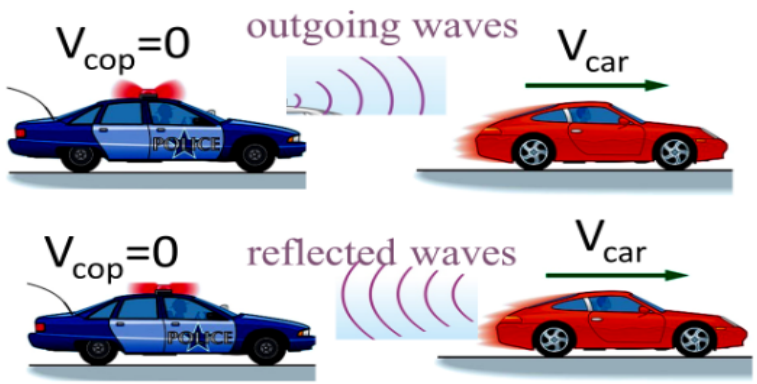
New Folder
Chapter 11 Fluid Statics 13 0
Chapter 12 Fluid Dynamics and Applications 7 0
MU 1D Kinematics 27 6
MU Circular Motion and Gravitation 7 0
MU Free Fall Motion 9 0
MU Newton's Laws 17 0
MU Projectile Motion 10 0
MU Vectors 10 0
OpenStax Chapter 1 Introduction 5 0
OpenStax Chapter 2 Kinematics 21 0

Doppler Effect - Catch a Speeder



Case 1. This is similar to Lecture example of catching a speeder.

As shown in the above picture, a statiionary police car is behind a speeding car which moves away from the police car at 39.60 m/s. The police car emits radar waves of 1000 Hz. The speed of sound in air is 343 m/s.

(a) For the OUTGOING WAVES, what is the frequency of the radar waves received by the speeding car?
Keep 2 decimal places in all answers.
Note: the acceptable range of answers is set to be very narrow

Enter a number Hz

Submit (5 attempts remaining)

An Inventory Covering College Physics 1 Course

Varafy

- Currently more than 250 items
- Selected problems from OpenStax College Physics Textbook with significant modifications, clarifications and corrections
- Selected problems from my previous exams (15 years)
- Straightforward integration into Canvas (LMS)
- Easily tailorable to individual instructor's own needs (within Varafy platform)
- Licensed under Creative Commons Attribution License

Available at no cost to instructors

Impact on Student Learning

"Scaffoldings"

Question: Some of the complex problems include hints or tips with the purpose of leading students through the analysis. **How much do you utilize these hints or tips?**

Answer Text	Percent
more than 75%,	44 %
between 50% and 75%,	30 %
between 25% and 50%,	12 %
less than 25%,	13 %

Question: Some of homework problems include **reviews** on theory, formulas, concepts and problem-solving procedure. **To what extent do you use them?**

Answer Text	Percent
I use between 50% and 75% of these reviews.	30 %
I use more than 75% of these reviews.	43 %
I rarely use these reviews .,	10 %
I use between 25% and 50% of these reviews.	17 %

“Scaffoldings”

Question: Some problems include hints to remind students of the most common mistakes, for example, the wrong signs, with the purpose of **reducing their frustrations. To what extent is this goal achieved?**

Answer Text	Percent
These hints don't matter to me that much. because I am already aware of the common mistakes.	4 %
These hints don't matter to me that much because I don't pay attention to them.	6 %
Heeding these hints somewhat helps me avoid the common mistakes.	35 %
Heeding these hints greatly helps me avoid the common mistakes.,	54 %

Question: Each problem is divided into multiple steps. Students know which step they get wrong. **How much does this approach alleviate your frustration in comparison to having one answer to a problem involving multiple calculations?**

Answer Text	Percent
This approach somewhat reduces the potential frustrations.	29 %
This approach significantly reduces the potential frustrations.	62 %
It doesn't matter that much.	8 %

Impact on Student Learning

"Problem Solving"

Question: Some problems include variations or extensions from the problems similar to lecture examples. **How much do you usually figure out on your own the ways to adapt to these variations or extensions?**

Answer Text	Percent
I figure out on my own for less than 30% of the problems.	5 %
I figure out on my own for about half of the problems.	26 %
I figure out on my own for most (or more than 70%) of the problems.,	63 %
I usually get help from others.	6 %

Question: Some problems are required to be solved in multiple ways. **How much do you actually solve them in multiple ways?**

Answer Text	Percent
I rarely solve them in multiple ways.	41 %
I solve some of them in multiple ways. Doing so provides reviews on the content, and helps me see the connections among the topics.	36 %
I solve most of them in multiple ways . Doing so provides good reviews on the content, and helps me see the connections among the topics.	22 %

“Problem Solving”

Question: The assignments have multiple problems based on the same physics principle with the purpose of deepening students' understanding and increasing the versatility of their problem solving. **They challenge students to go well beyond the "plug and chug" approach. How do you feel about this challenge?**

Answer Text	Percent
I think the challenge has positive effect on my learning and I handle it somewhat well.	37 %
Though I don't mind having challenge in general, this challenge is mostly overwhelming for me.	22 %
I think the challenge has positive effect on my learning and I handle it quite well.	28 %
I wish the problem-solving were within the "plug and chug" approach.	13 %

Impact on Student Learning

"Alignment"

Question: **How much do you think homework assignments are related to the exams?**

Answer Text	Percent
Homework problems and exams don't relate that well. because they are quite different.	19 %
Homework problems and exams relate very well, with similar formats and comparable level of difficulties.	40 %
Homework problems and exams relate to the extent of similar formats.	41 %

Question: **Overall, what effect did you see of the homework assignments on your exams performance?**

Answer Text	Percent
The homework assignments were not helpful to my exams performance	12 %
The homework assignments were very helpful to my exams performance.	42 %
The homework assignments didn't matter that much. My exams performance could have been achieved even without the homework assignments.	5 %
The homework assignments were somewhat helpful to my exams performance.	40 %

Impact on Student Learning

Open response:
Comment on the impact of homework assignments on your learning

Having to make effort to solve homework assignments made me a better learner.

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