Increasing Student Engagement In Introductory Online Physics

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Introduction:

Research* shows that interactive teaching techniques have learning gains above traditional lecture. These interactive teaching techniques are difficult to apply in an online setting.

Goal:

Incorporate interactive teaching techniques in an online setting.

Previously, Dr. Price would use discussion groups to incorporate peer instruction into his online classes. He measured an increase in conceptual learning in online sections, but a growth below his lecture growth.

We are trying to improve on his previous efforts.

Materials and Methods:

To increase the interaction online, we altered the discussion board requirements:

Before:

- Post answer and reasoning
- Minimal student communication
- Students just posting to complete the assignment

After:

- Post a total of three times
- Post what they think the answer is and why
- Comment on another student's response.
- State whether they agree or disagree with the other student's answer choice and why.
- Post final answer
- Increased student communication

With this, students commit to an answer, then discuss to get the correct final answer.

Results:

Before: Example Discussion Board

In the amusement park ride the Gravitron, riders stand on the edge of a circular platform facing the center of the platform, with their backs against the wall. The platform then rotates rapidly at a constant speed so that the riders feel pinned against the wall, and the floor is removed from under the riders' feet. What is the force that keeps the riders from falling down?

A. Gravity B. The Normal Force C. Centripetal Force D. Friction

Ricky
The coefficient of static friction has not been overcome. If it had, the person would move in one direction or the other. So I chose friction.
Thomas
Friction keeps them from falling down. The force of friction keeps the force of gravity from pulling them down.

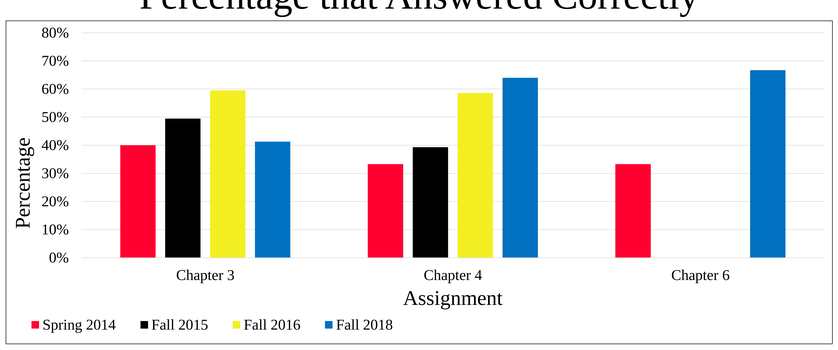
After: Example Discussion Board

A heavy stone and a normal feather fall through the air. How does the force of gravity on the stone compare to the force of the gravity on the feather?

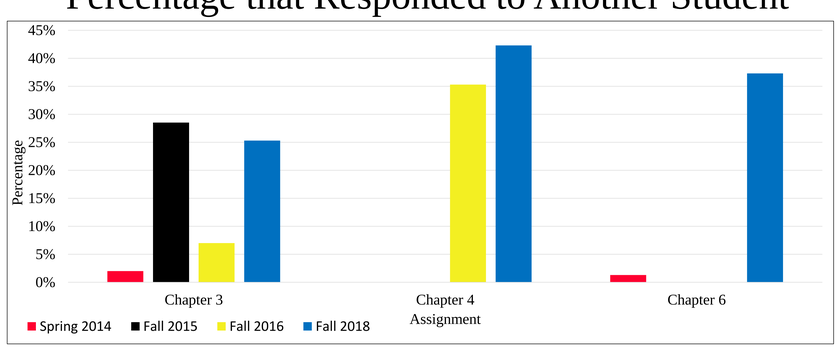
A. The force is the same on both because of Newton's 3rd Law
B. The force of the stone is greater because the stone is heavier
C. The force is zero because they are both falling
D. The force on the feather is zero because of air resistance

9/18/18 Brian
I chose A because without air resistance they will both travel at the same speed.
Gravity will be acting on both objects.
9/19 Jason
I chose the force on the stone is greater because the stone is heavier, B, because weight is the force of gravity on the object. The heavy stone will have a greater mass and therefore have a greater force of gravity acting on it.
9/20 Dylan
I chose A because they both have the same gravitational pull but the feather will have to account for air resistance more.
9/21 Jason
I still think thought both the stone and the feather would fall at the same rate without air resistance, the force on the stone is still greater, F=ma. I think that there is something else occurring.
9/21/18 Brian
Jason, I agree with you. Without air resistance, they will be travelling at the same speed. However, the force of the stone will be greater because it has a larger mass.
9/22/18 Landon
I chose A for my answer. Even though air resistance is present and the force of air will be much greater on the feather than the stone, the force of gravity will still be the same for both objects. The stone would still hit the ground first because it has less drag and a greater mass. We're only concerned with the force of gravity on the feather and the stone, correct?
9/23/18 Alexa
I chose A thinking the force of gravity was the same on all objects.
9/24 Jason
Yes, we are only concerned with the force of gravity, and it is independent of air resistance. If both of the objects have the same acceleration, but one has a larger mass, how can they both have the same force?
9/24/18 Alexa
I want to change my answer to B. Gravity is the same for all objects but the force of gravity is greater on objects with a greater mass. The equation F=ma shows that if a mass increases with the acceleration of gravity, that force will also increase. Without air resistance, they would still fall at the same rate.
9/24/18 Landon
I'm switching my answer to B. Thanks Jason and Alexa for explaining this to me. After reading my groups thoughts and doing a little more reading, both Alexa and Jason are correct. The force of the stone would be greater because of its larger mass.
9/24 Dylan
I want to switch to B. I chose this after further reading my classmates responses. As stated above the gravitational force on the stone would be greater because the objects mass is larger.

Percentage that Answered Correctly



Percentage that Responded to Another Student



Conclusion:

Unfortunately, irregularities in post-test results made the measurement of gain unreliable. Because of this, the only measure of success we have is a student survey.

- 88% of students found the discussion board questions helpful in preparing them for exams.
- 76% of students found that posting three times on the discussion board and reading other students' responses was beneficial for group communication.
- 82% of students found that responding to another student or having another student respond to them during discussion board assignments was beneficial.

Future Plans:

In the future, we plan to try our methods again and get an accurate gain to see if this method is actually successful.

If the learning gain is not where we would like it to be compared to the on campus sections, we will incorporate different interaction methods into the online section.

*Fagen, Adam, et al. "Peer Instruction: Results from a Range of Classrooms: The Physics Teacher: Vol 40, No 4." *AAPT: Physics Education*, 2002, aapt.scitation.org/doi/pdf/10.1119/1.1474140?class=pdf.