Video Analysis of Argument and Explanation in an Introductory Classroom

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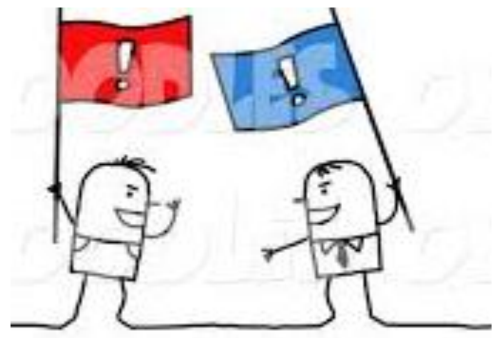
Research Question

How can we identify and analyze when students are practicing **constructing explanations** and **engaging in argument from evidence** in a classroom setting?

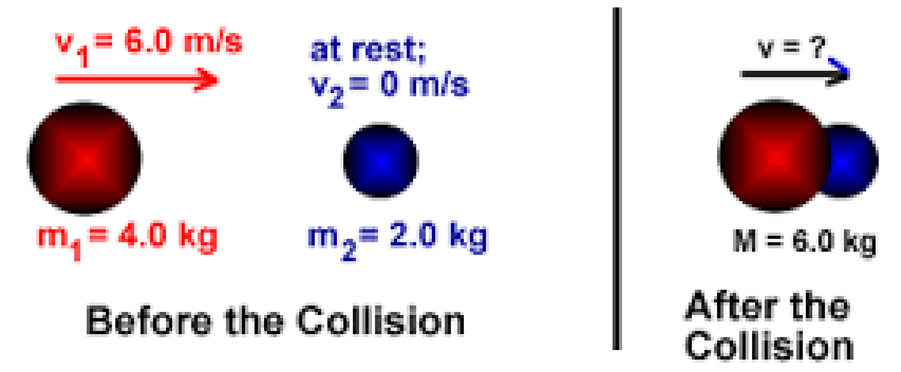
Definition



Explanation: Scientific explanations are <u>accounts that link scientific theory with specific observations or phenomena.</u> Scientific explanations are explicit applications of theory to a specific situation or phenomenon.

Argument: Scientists attempt to <u>identify the claim's weaknesses and limitations,</u> by making arguments based on deductions from premises, looking for the <u>best possible explanation</u>, or finding the best experimental design.

Video Information



The video:
Students from Michigan State University are working on a problem. Students work in groups of 3 to 4. They have 2 hours of class time to solve the problem.

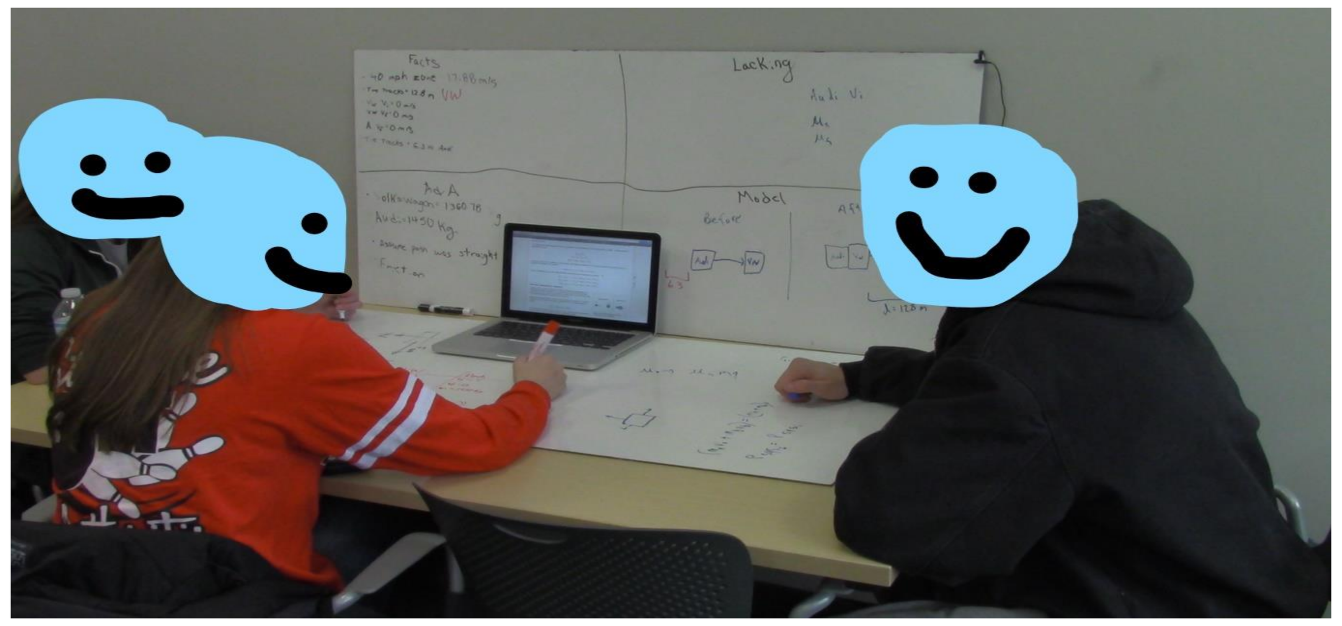
The problem:
You are a traffic forensic scientist and with your physics knowledge you must deduce whether an Audi that crashed into a Volkswagen was speeding. Using conservation of momentum find out if the Audi was speeding.

Rubric for Argument and Explanation

Both (This is necessary to follow to the next two)	In the clip, I am looking for 1. One student instructor/anyone has to <u>make a tentative statement (claim)</u> directed towards either another student, the group as a whole, or the instructor about the physics in the problem. (*tentative statement is one in which the student expresses some uncertainty) 2. The student/s <u>uses scientific principles or other physics equations</u> that they have at their disposal in order to make their statement valid (evidence). 3. The student/s then uses both items (claim and evidence) <u>to form a concise, valid scientific statement that would further someone else's understanding</u> of the original.
Explanation (The claim is not in question / the fight of differing evidence)	1. If a student does <u>not understand what the rest of the group is doing</u> they may need an explanation of this. ("What does this equation mean?") 2. Another student or an instructor can intervene and try to <u>answer their question using evidence</u> from scientific principles or an equation they have. 3. The original student should have <u>a better understanding after</u> this explanation. 4. The explanation should be <u>understood and accepted globally.</u>
Argument (The claim is in question/ the fight of differing explanations)	1. The claim that one student makes has to be <u>questioned.</u> 2. There must be a reason for <u>doubt in the claim</u> and not the evidence. 3. "Not all arguments have a <u>rebuttal</u>, but when a conversation has a rebuttal it is an argument." (A rebuttal is a statement indicating circumstances when the general argument does not hold true.) 4. <u>A competition of explanations.</u> 5. If the students know the outcome of the question, the argument is figuring out "how." (Example: Here is where the cars hit. One was stationary and the other was not. The students state that they know that the cars will continue their path. The question here is how.)

Explanation

Time	Transcript	Evidence
24:42	Y: <u>I still don't understand</u> that. (points at Don's equation)	Yolanda is confused about what the others are doing.
24:52	D: Momentum is <u>mass times its velocity</u>… Y: "Yeah.	
24:57	D: …Plus this mass times zero since it's not moving.	Using scientific principles of momentum, Don tries to help Yolanda understand.
25:06	D: So the momentum for before [collision] is <u>just mass of Audi times its velocity.</u>	
25:14	D: We want to know when [*pause*] we're trying to prove that momentum isn't changing.	This is the reasoning behind what they are doing.
25:24	D: The change in momentum is F_{net} times Δ T. <u>That's a fact.</u>	Stating that this claim is a fact pushes this towards the explanation definition.
25:36	Y: So then the, O.K., and then the O.K. (nods in <u>agreement</u>)	Yolanda is getting a better understanding and is on the same page as the rest of the group.
25:44	D: So what we're saying is <u>momentum is conserved</u> for no time at all.	More evidence makes the claim more concise.
25:48	W: Like right at that instant.	From here we see that Don's explanation is accepted globally.



From left to right: Wendy, Yolanda, Don

Argument

Time	Transcript	Evidence
32:09	D: But if you think about it, <u>20 meters per second times 1.24</u> seconds would be… (we don't see what he types) That would make sense because it would be going faster in the beginning.	Here we see Don try to explain the answer they're getting.
32:28	D: (starts writing) So you <u>have 20 meters per second</u>, so some amount of time you won't be traveling the entire 20 meters, it goes about 12.8. <u>I don't know, it seems like a reasonable number</u>. Or do you think it's going to be sliding a lot longer?	As Don continues to explain, there is some uncertainty in what he is saying.
32:53	W: Well yeah, I think it would be sliding for a lot longer because if <u>you think about it… If you are in a car accident.</u> (points at something obscured by Yolanda) This means that for the time it hits, it would be one and then it would stop. <u>It just doesn't make sense to stop so suddenly.</u> I feel like it would be...	Wendy looks at Don's explanation with doubt. So now it becomes an argument with this rebuttal.
33:13	D: … Sliding longer. O.K.	Don sees what she is saying.
33:20	Y: Would the distance be the 6.3 from the before? No, that doesn't make sense.	Yolanda tries to add her explanation.
33:32	D: Oh. We didn't account for the 6.3 here.	Don is quick to look at other frames.
33:42	Y: But that's from before they collided.	Yolanda can see that her explanation didn't have enough evidence.
33:44	D: What I'm saying is, if we plug in that speed, that would mean even after it was braking, it would still be going exactly...	Don adds more evidence.
33:50	Y: If we take the forty miles per hour we need to <u>convert it from meters per second.</u>	Yolanda sees holes in Don's math.
33:53	D: That's our problem! Good call! <u>I was using the miles per hour instead</u> of the other one.	Don sees the mistake now .
34:06	Y: "So now it's going to be 9.216.	This statement shows the understanding of the group.

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Conclusion

Using this rubric is promising in identifying the similarities and differences between **"constructing explanation"** and **"engaging in argument from evidence"** in a classroom setting. We hope to use this in analyzing the depth of these practices.

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