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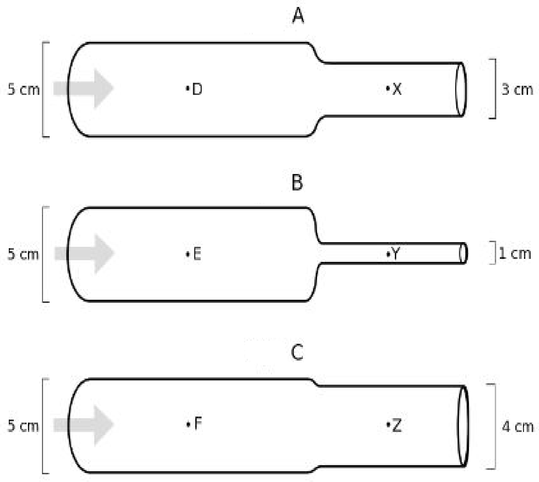
Does Context Matter?

Does item context effect student responses?

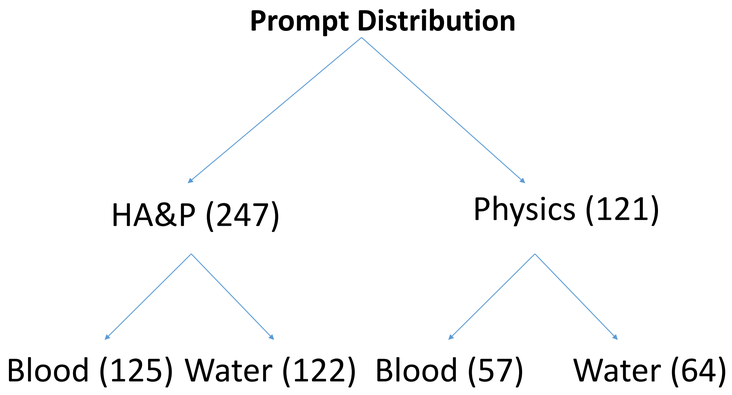
- Context - "The features of an item used to frame a question and response choice"[1] in this case the students class, prompt, and reasoning used.
- No previous studies done in human anatomy and physiology.
- NDSU study comparing student reasoning on population growth rate as compared to the rate of travel of a car[2].
- The differences in student reasoning abut fluid flow between an algebra based physics class and HA&P were compared

Fluid Context Prompt



The figure shows two different pipes/blood vessels (A, B and C) with water/blood flowing through them (designated by the gray arrow on the left). The volume of water/blood entering on the left end of the pipe/blood vessel is the same in systems A, B and C. The pressure of water/blood is the same at points D, E, and F. The water/blood viscosity is very low. The diameter on the left end of each pipe/blood vessel is the same (5cm).

1. Order the *fluid flow rate* (volume of water/blood flowing per unit of time) coming out if the right at point X,Y, and Z. If two points have equal resistance, put an equals sign between the blanks
2. Order the *speed* of the water/blood coming out of the right end of the pipes/blood vessels A, B, and C. If two pipes/blood vessels have equal speeds at the exit, put an equals sign between the blanks.
3. Order the *pressure* of the water/blood in the pipes/blood vessels at points X,Y, and Z. If two points have equal pressures, put an equals sign between the blanks.
4. Order the *resistance* of the water/blood at point X,Y, and Z. If two points have equal resistance, put an equals sign between the blanks.



Prompts were distributed among a HA&P class and an algebra based physics class, the numbers of students in each class and the number of students which were in a certain class/prompt combination (group) can be seen in parenthesis.

Student Answers

Task 1

CAB			BAC		
	Physics	Bio	**	Physics	Bio
Blood	19.30%(11)	9.60% (12)	Blood	54.39% (31)	87.2% (109)
Water	14.06% (9)	9.84% (12)	Water	65.63% (42)	77.05% (94)

"="			Other		
***	*Physics*	*Bio*		Physics	Bio
Blood	*24.56% (14)*	*2.40% (3)*	Blood	1.75% (1)	0.00% (0)
Water	*20.31% (13)*	*13.11% (16)*	Water	0.00% (0)	0.82% (1)

Task 2

CAB			BAC		
**	*Physics*	*Bio*		Physics	Bio
Blood	*73.68%(42)*	*65.6% (82)*	Blood	19.30% (11)	23.20% (29)
Water	*75.00% (48)*	*63.93% (78)*	Water	18.75% (12)	27.87% (34)

"="			Other		
	Physics	Bio		Physics	Bio
Blood	5.26% (3)	9.60% (12)	Blood	1.75% (1)	1.60% (2)
Water	4.69% (3)	5.74% (7)	Water	1.56% (1)	2.46% (3)

Task 3

ZXY			YXZ		
	Physics	Bio		*Physics*	*Bio*
Blood	73.68%(42)	88.80% (111)	*Blood*	*12.28% (7)*	*5.60% (7)*
Water	76.56% (49)	87.70% (107)	*Water*	*7.81% (5)*	*8.20% (10)*

"="			Other		
***	Physics	Bio		Physics	Bio
Blood	12.28% (7)	2.40% (3)	Blood	1.75% (1)	2.40% (3)
Water	15.63% (10)	2.46% (3)	Water	0% (0)	2.46% (3)

Task 4

ZXY			YXZ		
	Physics	*Bio*		Physics	Bio
Blood	*61.40%(35)*	*88.00% (110)*	Blood	14.04% (8)	7.20% (9)
Water	*67.19% (43)*	*84.43% (103)*	Water	10.94% (7)	6.56% (8)

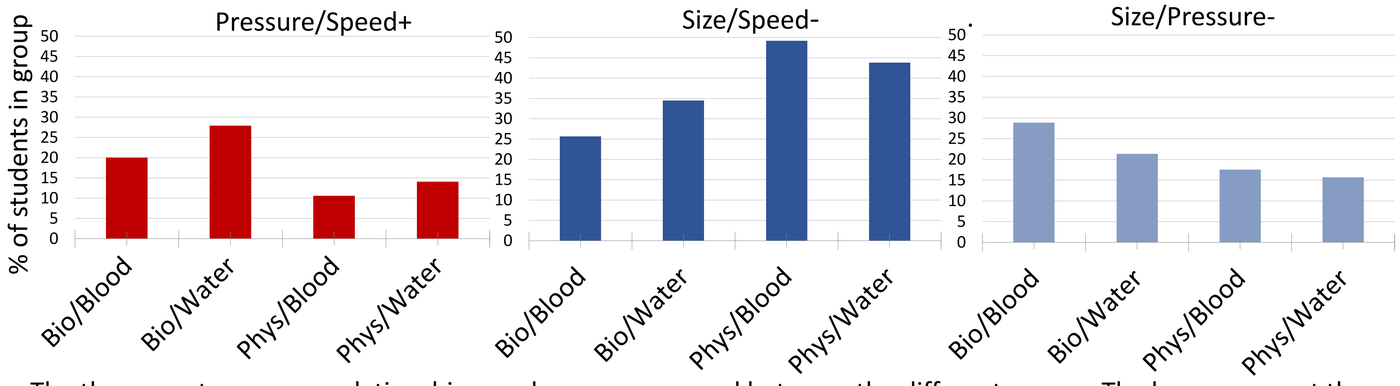
"="			Other		
***	Physics	Bio		Physics	Bio
Blood	17.54% (10)	2.40% (3)	Blood	7.01% (4)	2.40% (3)
Water	17.19% (11)	4.92% (6)	Water	4.69% (3)	4.10% (5)

The percentage of students which gave a certain answer in each group was calculated for each question, the number of students is shown in parenthesis**. The test taken appears to effect student answers within a class.** Italics Indicates a correct answer. Significant p-values are indicated by ** ($p<0.05$) and *** ($p<0.001$).

Student Reasoning

	Pressure	Size	Flow	Resistance	Speed
Pressure	X	4	1	5	81
Size	-74	X	3	9	35
Flow	0	-2	X	0	6
Resistance	0	-19	0	X	9
Speed	-2	-130	-1	-8	X

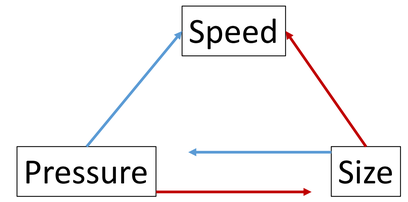
The students were also asked to explain their reasoning. The reasoning for question 2 were then coded for the relationships students made. A box which is more red represents a large number of positive (direct) relationships while a box which is more blue represents a large number of negative (inverse) relationships made. **The positive relationship between pressure and speed and the negative relationships between size and speed and size and pressure were used most often.**



The three most common relationships made were compared between the different groups. The bars represent the percent of student in a specific group to make a certain relationship. **This demonstrates that despite the majority of the students giving the same ranking, students in different groups differed in the reasoning they used to get there.**

What did we find?

- Student may answer questions differently based om item context
- Students who come to the same conclusion may use different reasoning
- Reasoning is often multi step, making connections between several concepts



Refferences
[1]Heredia et al. (2012) Item Context: How Organisms Used to Frame Natural Selection Items Effect Student Response Choices. Annual Meeting of the National Association of Research on Science Teaching.
[2]Bennett et al. (2015) The Contextual Sensitivity of Graphical Skills in the Domain of Physics and Biology. NDSU REU Poster Presentation.

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