Transformative Experiences and Conceptual Understanding of Force and Motion

Brian W. Frank & Paul Mittura, Middle Tennessee State University, Department of Physics & Astronomy

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What are Transformative Experiences?

"Experiences in which students actively use science concepts to see and experience their everyday world in meaningful new ways."[1]

- Free-choice transfer outside of class
- Deep engagement and interest in content
- Meaning-making in the everyday world

Transformative Experiences (TE) Survey [1,2]

Student respond on a 4-point Likert scale to 31 statements. The stems below are modified to specify physics content and contexts.

1.	During class, I talk about…	Talk
2.	I think about…, when I see…	
3	Outside of class, I talk about…	
4.	During class, I think about…	Think
5.	I talk about… just for the fun of it	
6.	Outside of class, I think about…	
7.	I find myself thinking about… in everyday life.	
8.	During class, I use the knowledge I've learned about …	Use
9.	Outside of school, I use the knowledge I've learned about…	
10.	I use the stuff I've learned about…even when I don't have to.	
11.	I look for chances to use my knowledge of…in my everyday life	
12.	During class, I see things in terms of the laws I've learned about…	
13.	When I am working on a class assignment about… I tend to think of them in terms of…	
14.	If I see a really interesting situation (either in real life, in a magazine, or on TV), then I think about it in terms of…	
15.	I can't help but see situations in terms of the laws of…	
16.	During class, I notice examples of…	Notice
17.	I notice examples outside of class of…	
18.	I look for examples outside of class of…	
19.	Learning about…is useful for my future studies or work.	
20.	Knowledge of…helps me to better understand the world around me.	
21.	Knowledge of… is useful in my current, everyday life.	
22.	I find that knowledge of…makes my current, out-of-school experience more meaningful and interesting.	
23.	Knowledge of…makes learning physics much more interesting.	
24.	In class, I find it interesting to learn about…	
25.	I think…is an interesting topic	
26.	I find it interesting in class when we talk about… in terms of…	
27.	I'm interested when I hear things about…outside of school	
28.	I find it exciting to think outside of school about…	
29.	The ideas we learned changed the way I see…	
30.	I think about…differently now that I have learned about…	
31.	I pay more attention to…now.	

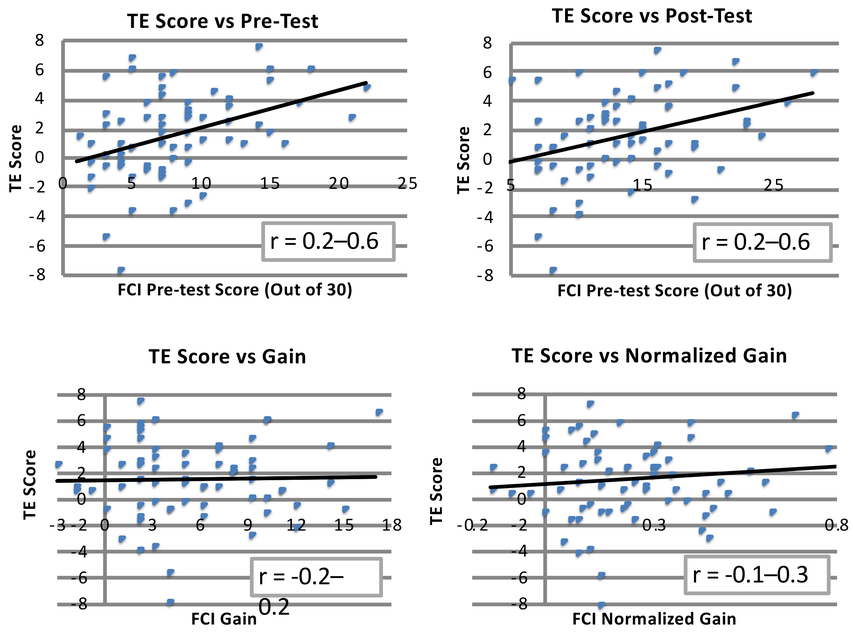
Multiple Scoring Methods for TE Survey

Percentage Agreement (PA)= This percentage of responses that are agree or strongly agree.

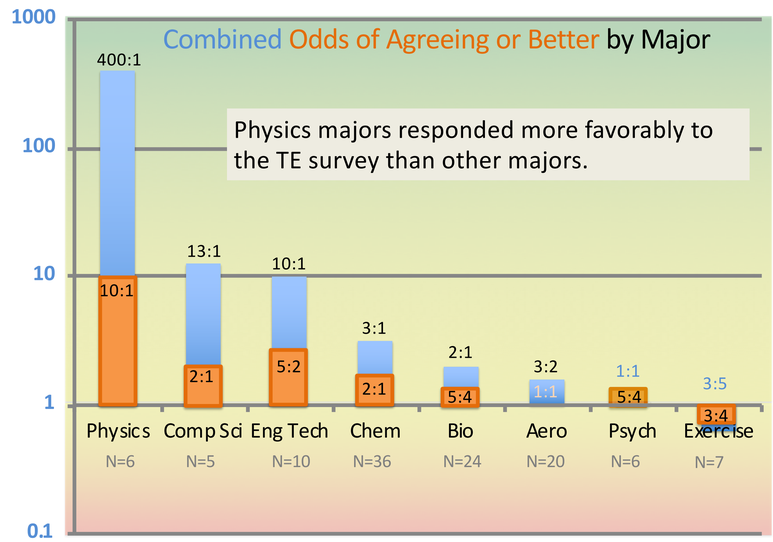
Logarithm of the Odds (LO) of Agree = First calculate the odds that a student agree or strongly agrees and then take natural logarithm.

Combined Log Odds (CLO) Method: Take the logarithim of product of three odds: the odds of strongly agreeing, the odds of agreeing or strongly agreeing, and the odds of not strongly disagreeing.

TE Scores Correlate with FCI[3] Scores (Not Gains)

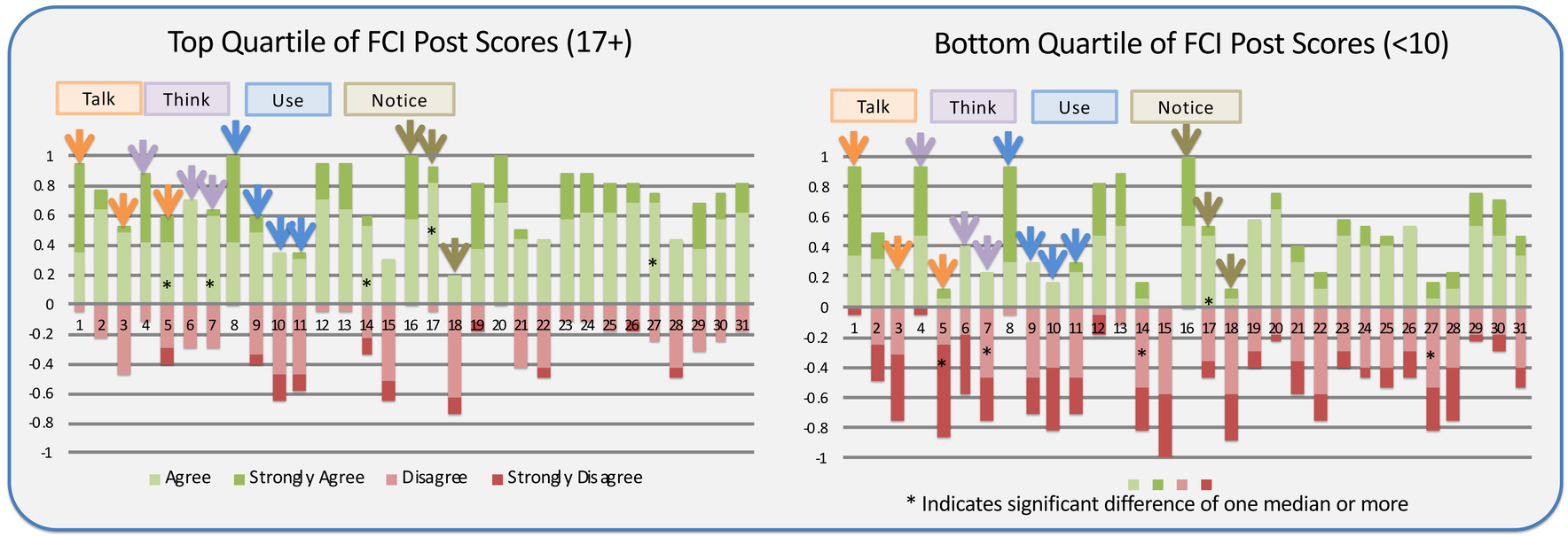


TE Scores Trend with Declared Major



Very small numbers of students in many categories makes direct comparisons of groups not meaningful. However, physics majors as a group score significantly higher on the TE survey than non-physics majors.

Students from Top and Bottom Quartiles Differ Most with Out of Class Engagement



* Indicates significant difference of one median or more

Conclusions and Directions for Ongoing Research

Summary of Findings

- Increased engagement outside of class did not correlate with conceptual gains
- Conceptual knowledge did correlate with increased engagement outside of class
- Students from top/bottom quartiles were most different for questions about engagement outside of class and most similar for questions about engagement in class.

Question for Further Research

Does stronger conceptual knowledge directly support transformative experience? Or does conceptual knowledge and TE correlate with other variables such as physics identity / interest?

Course Context

- Introductory algebra-based physics
- 5 hrs of a studio environment / 1 hr lecture
- Interactive engagement pedagogies
- FCI normalized gains between 0.2–0.3

References

1 K.J. Pugh, *Sci. & Ed.*, **88**, *182-196 (2004).*
2. B.W. Frank & L.J. Atkins, *2013 PERC Proc. (2014).*
3. D. Hestenes et al., *Phys. Teach.*, **30**, 141-158 (1992).