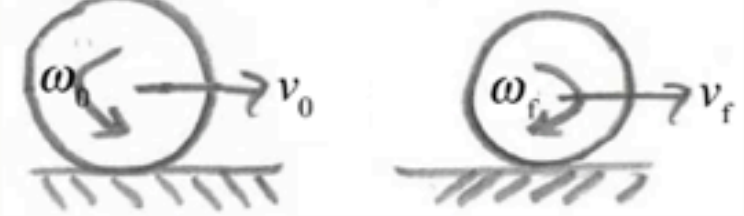

SYMBOLIC CHECK

For the symbolic check, express your answer using some or all of the following variables: R, v_0 for v_0, omega_0 for ω_0.

Integrating MITx into MIT's First-Year Physics Courses

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Office of Digital Learning xTalk Series
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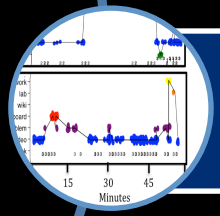
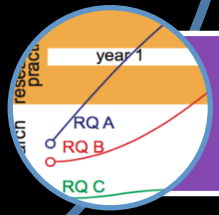
Outline

Background
Literature, history, and motivation

Our Ongoing Study
Data, methods, and multimodal approach



Findings
Quantitative and qualitative results that inform each other



Discussion
Implications for research and practice

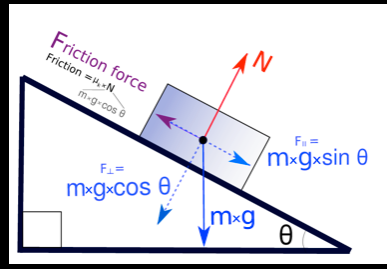
Complex Learning Environments

College/university students are asked to navigate a variety of learning environments – face-to-face lectures, laboratories, and, more recently, online content, assessments, and collaborations.

Best practices and impact of online resources still unknown

- U.S. Dept. of Education meta-analysis (Means, et al., 2010)
  - Learning outcomes for f2f and purely online =
  - Learning outcomes for blended learning slight ⬆
- For MOOCs, jury still out on how best to
  - Structure
  - Take advantage of biases of new medium
  - Use social interaction
  - Help students persist

Introductory Classical Mechanics On-campus (8.01T+x)



Supplemental blended learning model (Twigg)

- Face to face
  - Twice per week: short lectures & activities done in teams
  - Once per week: problem solving sessions with instructors & TAs available for coaching
- Online
  - Some online psets with Checkable Answer Feature
  - Text and video content

Data description

Quantitative

- Clickstream Data
  - Detailed tracking of all students' individual clicks on the course website
  - Includes page views as well as submission of answers to "Checkable Answer Feature"
  - Used to determine student online behaviors
- Assessments
  - Homework scores (online submission and written submission)
  - Final Exam scores
  - Overall course grade
- Background and Demographic Information
- Survey:
  - Student self-efficacy
  - Perceptions of utility of the platform

Qualitative

- Survey
  - Open-Ended Responses
- Interviews
  - Semi-structured student conversations
  - Eighteen individual interviews
  - Stratified sample (Interphase participation, High-Mid-Low cumulative grade)
- Observations
  - Think aloud student problem-solving sessions (videotaped)
  - Cameras on affect and on clicking behaviors

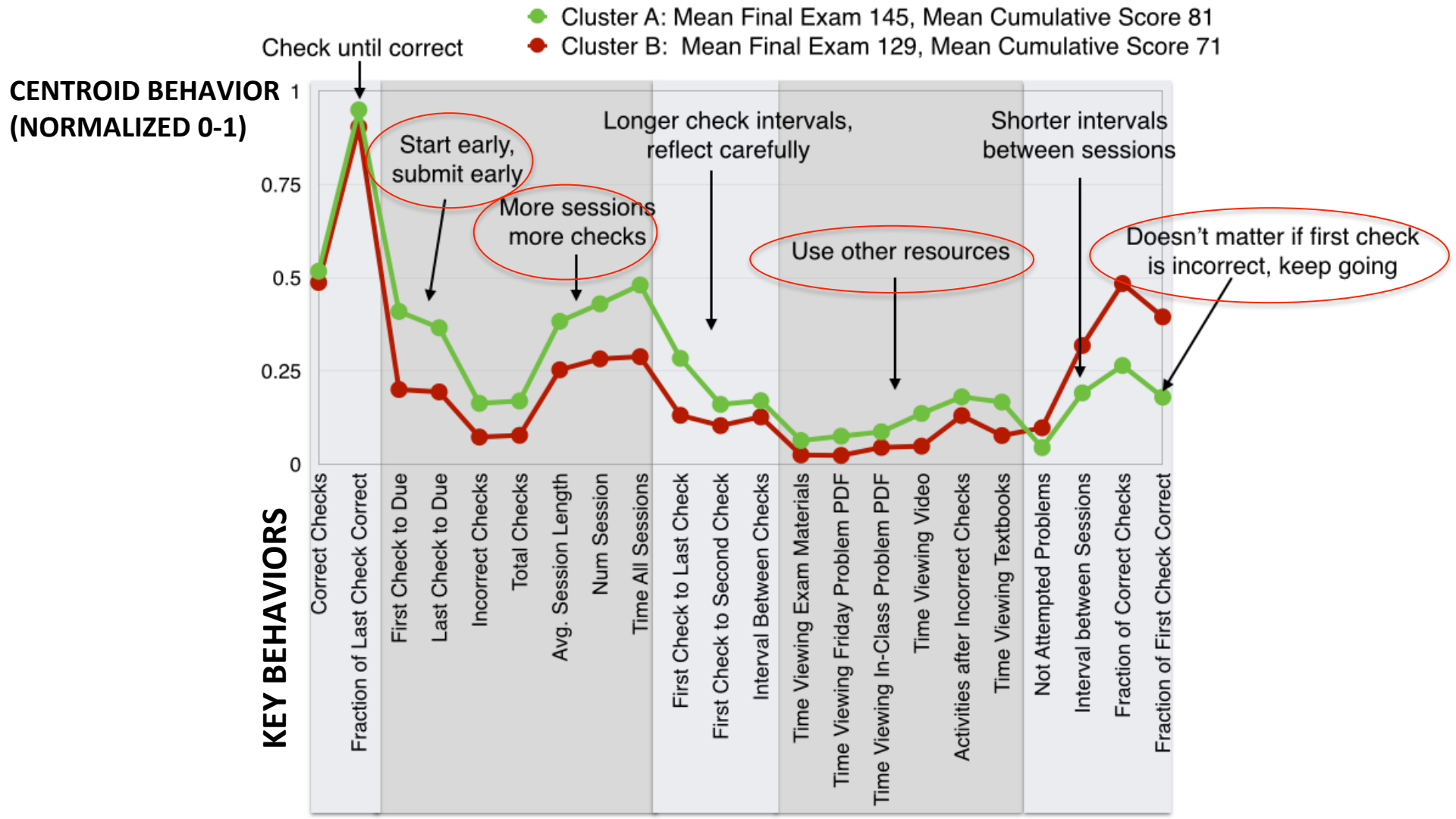
Mixed Methods Studies

- Traditional predictive statistics
- Data-mining
  - Hierarchical clustering of variables
  - K-means clustering of students
- Grounded Theory
  - Emergent themes and sub-themes
  - Illustrative quotes to convey aggregate themes

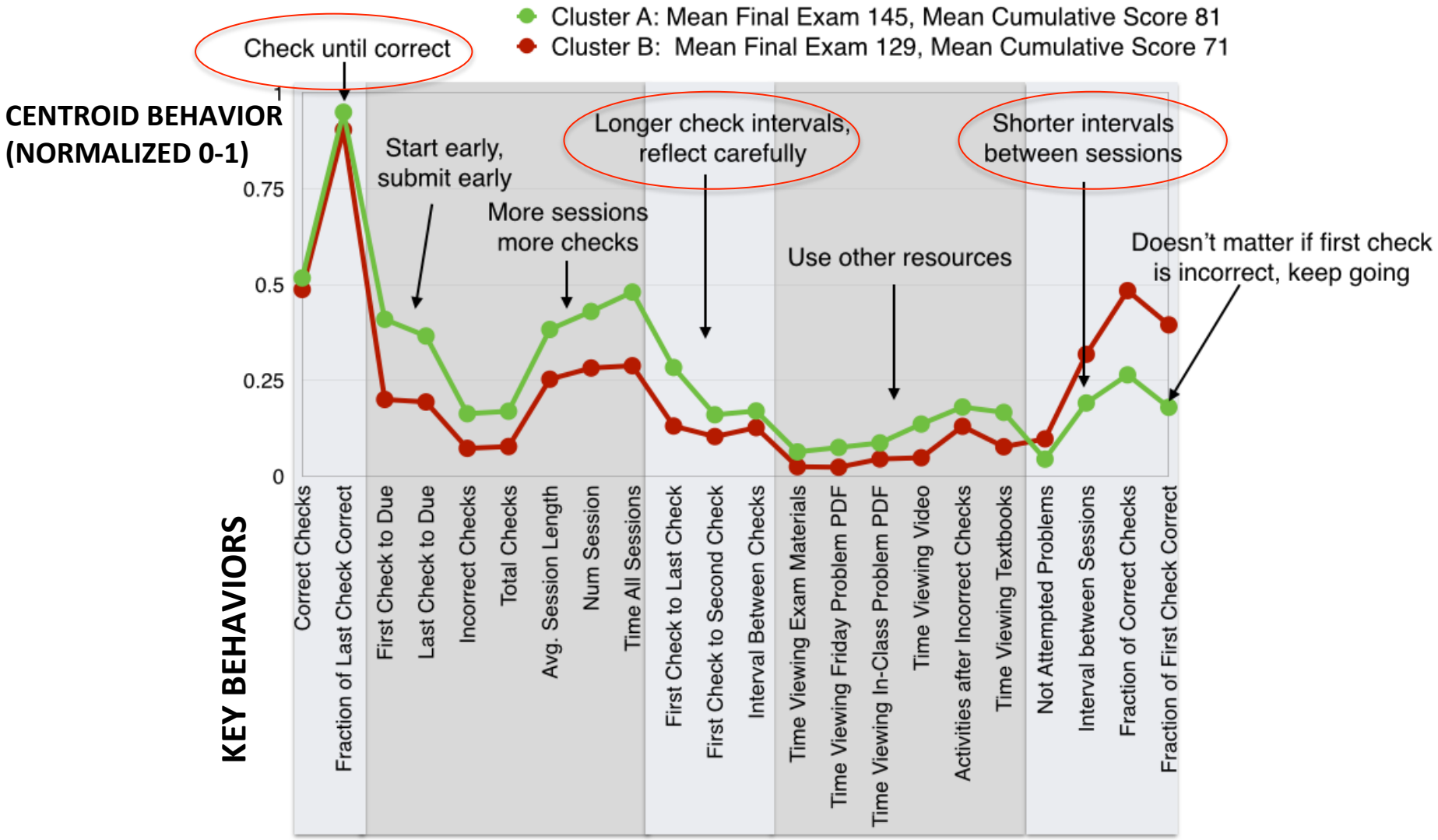
RQ 1 – Resource Choice

What can the data generated by the use of the MITx platform in on-campus, on-term 8.01 reveal about **resources and strategies on-campus students use** when trying to learn difficult concepts and solve problems in mechanics? In particular, what **patterns of use** can be discerned for students using the platform's checkable answer feature?

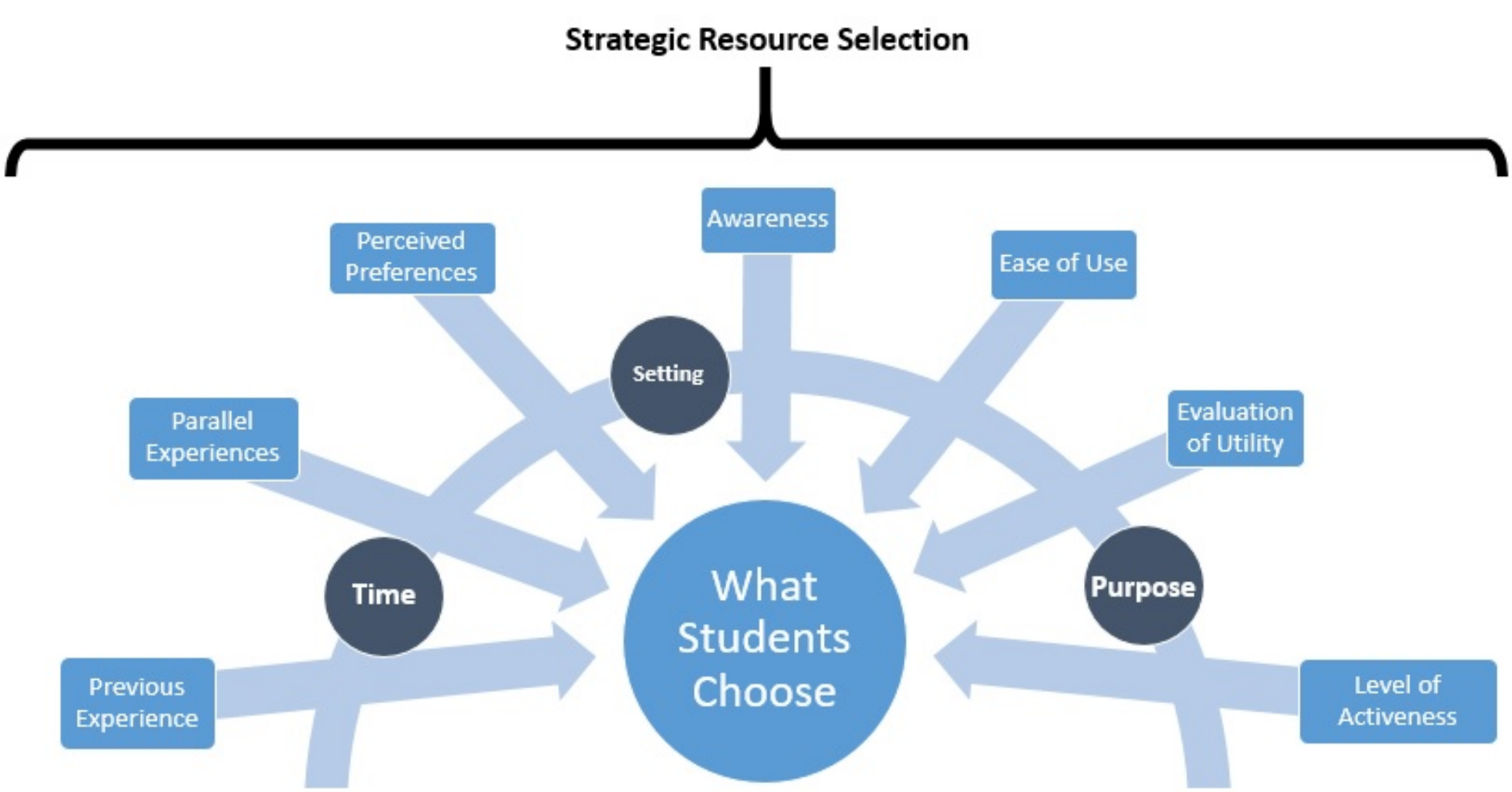
Active engagement with online feedback is the most important factor



Strategic, spaced engagement with online (and, reportedly, in-person) feedback is helpful



Strategic, Instrumental Resource Selection



Subthemes

Sub-theme	Description
Previous Experience	In unknown environment, prior cognates inform navigation.
Parallel Experience	Comparisons, contrasts, and suggestions for improvement from concurrent classes are the only analogs, other college experiences.
Perceived Preference	Preferences and perceived personal resonance are articulated as leading to different resources.
Awareness	Navigation is subject to user interface design factors.
Ease of Use	Resource choice is informed by knowing how to use and level of confusion associated with use.
Evaluation of Utility	Helpfulness can lead to resource choice.
Level of Activeness	Students prefer more interactive resources due to both immediacy and return.

Prior Experience

"Ok, so I like it because in my class, my old high school, I started in science and technology in 11th grade, so I was trying to get all my books, because when I have physical textbooks I would never write in them because I thought they would look ugly or whatever so I never dared to write in them.

But then when I started getting them like on the iPad or tablets like that, I actually used it better because I have other things and write notes which I didn't do in the textbooks because you have the margins and that is small and I didn't want to write in them. So I was pretty used to already using those kinds of books and for the physics class."

Ease of Use

- I: So do you use the online textbook and highlight in it and make notes and stuff?

- *R: Well that one is like a PDF so I don't highlight it because I don't know if I can, like my tablet doesn't let me highlight it because a PDF is a picture basically so and the ePub files, but I will just write on post it notes and put them on my desk or on my wall.*

Evaluation of Utility

"…the checkable answers. It is definitely helpful because I think I have gotten the correct answer like for the whole question on the first try; I think I have done it one time this whole year. So, um yeah, a lot of times it's just really nice because it's just like feedback for like whenever you get a different answer, like it might work this time. "

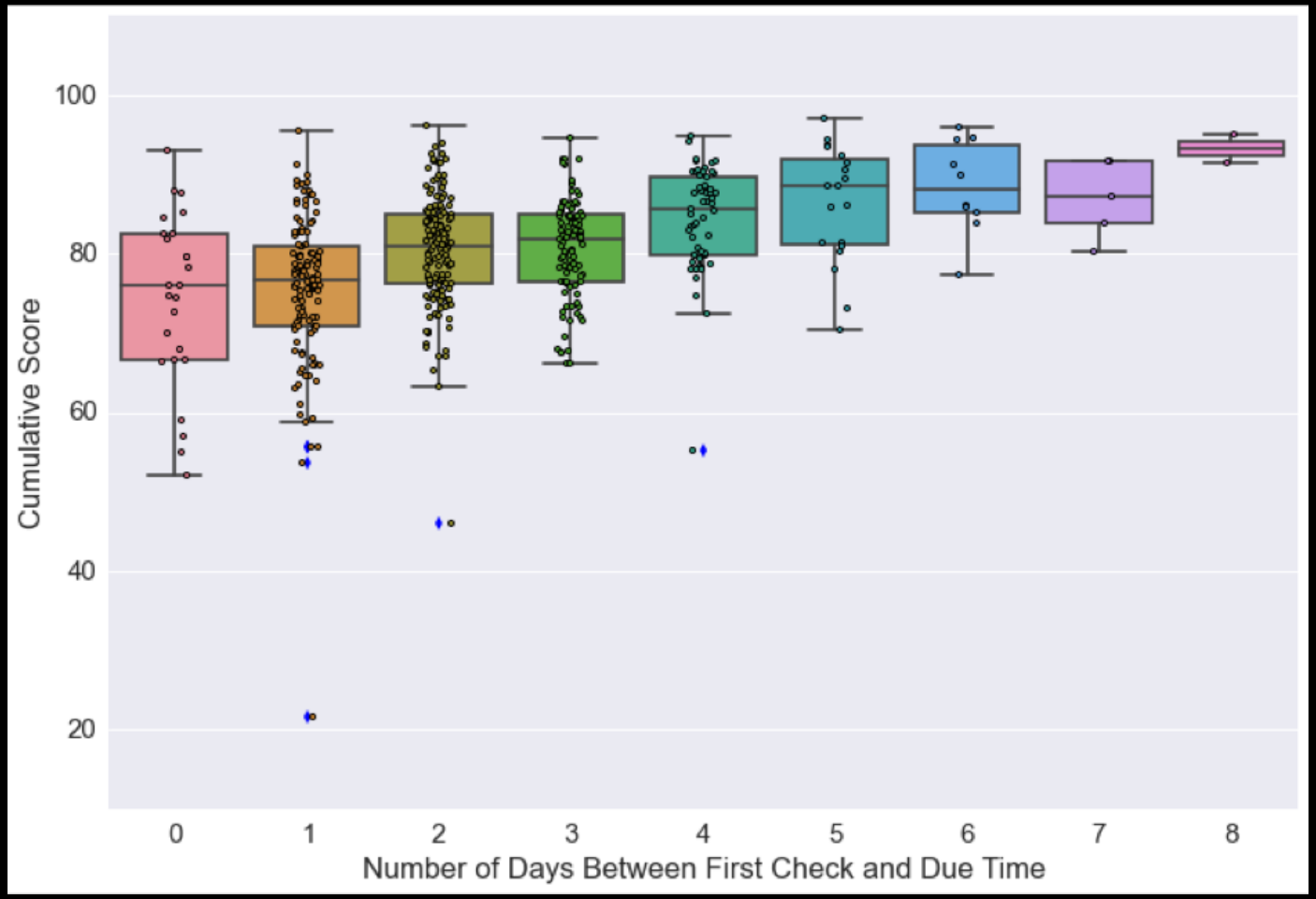
Level of Activeness/Interactivity

"Um, I think I think it's good because it forces you to re-look at your work I think. Like [pause], if I didn't have the checkable answers, I would get an answer and I would be done with the question, like I wouldn't have anything more to do with it, buy by re-looking at that question, I think it reinforces the concepts. "

Time, purpose, setting

" I tend to look at those while I'm studying for the tests just to go back through them because I feel like that is a pretty good like consolidated source of all the information that's a lot quicker than reading the textbook again. Um, but if it is not right before a test then I don't normally look at those again."

Students who started the problem set well before the due date (5-6 days earlier) do better on the final exam and in 8.01 overall



Qualitative Analysis Informs Quantitative Findings

- I: Do you feel the online materials in 8.01 have influenced this change [aforementioned change in study strategies]?

- *R: "Uh, yeah. I try to kind of space things out more and procrastinate less so… if I want to like start the 8.01 Pset like way early, then I will have like the resources still online like if I want to look at formulas or read about examples in the book and stuff, it's like all there and I can not necessarily teach it to myself before class, but like get a grasp enough to like try problems and like take a look at the Pset early and stuff like that. So, I think it has kind of helped me like organize myself better and space out my learning instead of like cramming everything into like the night before the test."*

RQ 2 – In- and out-of-class

What is the relationship between **out-of and in-class behaviors** particularly in the use of online materials? Does the students' use of online materials differ significantly between the **two environments**? What linkages can be observed?

Descriptive Statistics

Variable	Ave	Med	Min / Max
Total # of hours in problem-solving sessions	27	26	6 / 59
Average time (hrs) between 1st check and due time for each attempted problem	69	64	5 / 216
Average interval (days) between problem-solving sessions	4	4	2/ 13
Average # incorrect checks for each problem	4.69	4.00	0.23 / 36.73
Fraction of attempted problems where first try correct *	0.19	0.16	0.00 / 0.69
Average time (min) viewing videos in each session	18	0	0 / 180
Average time (min) viewing e-text in each session	49	29	0 / 360
Average time (min) viewing class PDF notes in each session	18	6	0 / 240
Average time (min) viewing problem-solving session notes	7	0	0 / 120

All variables are averaged across students (noted where averaging across problems/sessions).

**weighted by problem difficulty*

Relationship between out-of and in-class behaviors

- Most informed by social dynamics

- Subthemes
  - Students tend to work in groups outside of class even though 24/7 resources available.
  - Norms and environment of a traditional classroom setting (e.g., affective and emotional reactions, instructor distance) are reflected in blended setting.
  - Students prefer familiar or traditional resources over new resources.

CAF exception

Group Work

- I: So the 3-person group, you are only working problems inside of class? Do you work together outside of the class?

- *R1: "Uh, yeah, like we're friends, I mean we are a group of 4 because like someone joined us previously and we work out of class. There's a kid in Section 1, he is a floor below me in Baker, so we work together on Psets occasionally…"*

- *R2: "…I am 100% in favor to the checkable answer because I feel like 8.01 is pretty hard and if we don't have checkable answers I feel like 100 people would come up with 100 different answers and then if we don't check it, we will all have different answers and we never know who is right or wrong. So if we thought we got the right answer and it was a wrong answer and we teach someone else who struggled or when we compared answers to other people it's like, "Who is right or who is wrong" and we never know."*

Norms of Traditional Face-to-Face Classroom Transfer Here

- I: Do you post there [Piazza] or just look?
- *R1: "I don't post, no. Um, because usually I get a little self conscious and I'm like maybe I'm the only one making this mistake and everyone is going to think I'm stupid. Then someone will post it and I will be like, "oh good, ok, these people are really smart and they are struggling too".*

- *R2: "in the beginning I think what happened in our team, everyone tried to prove that they make sure that they feel OK or that they look really well in the eyes of the other two which is not a good strategy… I wouldn't ask just because I would be afraid that people wouldn't want to work with me for the rest of the term if I don't get the material because why work with me if I'm not useful.*
  But it turned out fine and now I get along with them pretty well. I think we work well together, we already know who can do what so we will listen to one another and we will know who is drawing what and we know how to correct each other so that you don't feel bad about [it]…."

Norms of Traditional Face-to-Face Classroom Transfer Here

- I: Is there anything else you would like to share?

- *R: "Actually there is one thing. I just want to point that after the suicide that occurred earlier they had the 15 minutes thing right on…..and we were right in the middle of our 8.01 class during that and the professor shared a little bit about himself and about himself when he was younger and I think that really helped like a lot of students. It was just very nice to hear. I think a lot like to hear about professors more of a personal level instead of just as your professor. I think them engaging with the class more, I think that's good."*

Familiar over Novel

"…for me I think I have just always liked physical books. It is kind of an old school thing, but I think I like to have something tangible that I can kind of hold and read. I like that I can write in it and highlight things, um and also it is something that I will always have with me, even after I'm done using the site, if I'm ever in a class down the line and need a piece of information from classical mechanics, I will have the textbook at hand to use it. So for me it was worth going out an buying it."

Checkable Answer Feature Exception

- *Affordance:* Perceived intersection of actionable properties between product and person (Gibson, 1977; Norman, 1988)

- Checkable answer feature as affordance

- CAF the exception because no parallel resource

Checkable Answer Feature Exception

"It's a lot better to have the Pset and be able to check your answers online because if I didn't have that feature, I would probably just do the problem, get like my first answer and be like, 'oh well, I don't know if that is right or not' and just turn it in and I never like learn… For 8.01, like if I get a problem wrong then I know it's wrong and I can keep trying until like I understand why it is wrong and I get the right answer which is more helpful for learning than just turning in something that is wrong and getting a bad grade."

Checkable Answer Feature Exception

“Me and my friends dressed up for Halloween, I was the green checkmark, she was the red X, she had devil horns. Um that pretty much sums up the experience. Everyone really, really likes checking their answers.”

Goal/RQ 3 – Research to practice

How can the findings of this study be used to **strengthen the type and number of resources and pedagogical strategies** incorporated into on-campus, blended learning courses?

Discussion

- What might explain these findings? Metacognition? Taking time for reflection?
- With characteristics of both environments, need to find new equilibrium point
  - Education human endeavor (even with new tech)
  - What unique affordances of blended learning can we use to encourage productive study strategies? E.g., how can we build on the CAF success?
- What (if any) differences might exist between this context and what we already know about traditional classrooms? How can these findings support or challenge existing research on student learning ?

Thank you

DeBoer Lab

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- 8.01 course team

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