Responses from the speakers to the questions asked during Session 1 are provided below.

1. Is there any data regarding the impact of community college experience/transfer for STEM students? In this study - did we consider 2 yr community college as part of the data collection?
   a. I have noticed that two-year college students are not represented in this study. Do the researchers believe the results obtained will transfer to this significant subset of higher education?

   **ANSWER:** When we were designing the study, we thought very hard about including 2-year colleges. In the end, we decided it would be more than we could handle in a study that is already very complex in methods and scope. However, our research team (led by Heather Thiry) proposed to our funders that we undertake such a study as a ‘satellite’ to this one, and that 5-year project is now underway. It is called, ‘The STEM Pathways Study’ and follows students from community colleges who transfer into 4-year institutions to learn whether and how they adjust and persist. It’s a ‘best case’ design focused on three institutions chosen because they have established pathways from local community colleges and also for their good record of graduating under-represented student groups. Heather Thiry and her team are about half-way through this work.

2. When looking at thepersisters and the switchers, what assets do you see the students to have?
ANSWER: Team member, Heather Thiry, undertook the analysis of data that might explain why some students were able to persist. She will be talking about her findings in Webinar 5 (27th October). In Chapter 12 of TALR she focuses exclusively on this topic.

3. **Do you have data on those who switched into a new STEM major?**
   a. Do the switches marked as 20% leave school altogether include any who left the 6 study institutions to attend a different institution? How were transfers into programs handled?
   b. Do you have any sense of switching in transfer students?
   c. Most liberal arts colleges don’t require students to declare a major until their sophomore years — could this alone explain their lower observed rate of switching?
   d. "Ill-founded major choice" influenced switching. What should influence choice? Emphasizing assets - without unfairly limiting or foreclosing choice - could be an important, actionable finding.

ANSWERS:

   a. Neither we, nor any other researchers as far as we know, have studied this group. But somebody should! It’s difficult to do because it would involve a track-and-trace strategy to find them.
   b. We didn’t break this group out-partly (again) because of the sampling complexity with which we were already dealing. We couldn’t build too many variables into the interview sample design. However, we have commented as we went along on what students from these and other groups reported in interviews. Such a study could be done with institutional data analysis, followed up by a targeted interview sample.
   c. In a way, I answered this question up-front with my statement about the problem with single factor observations. But late declaration was not the case with the liberal arts college in our sample.
   d. Our 2nd webinar (21 July) will unpack what we mean by ill-founded choices and discuss their consequences. We found the same issue caused persistence problems in the original study.

4. **The percentage of women receiving bachelor’s degrees in all STEM fields grew significantly from 1980 to 2002. But, since then, all percentages were basically unchanged or dropped. [Examples of relative change from 1980/2002 and 2002/2018: Engineering +110%/−5%; Chemistry +75%/−8%; Physics +80%/−12%. Why? What could have changed in the 5-year period, 2000-2005, that prevented further progress. Without understanding reasons, it would seem that actions to increase representation of women will fail, having “failed” from 2002 until today.**
David Bressoud’s comment: The number of men and women have both grown significantly. However, the reason the percentage of women has remained basically unchanged since 2002 means that the percentage increase in the number of women is the same as the percentage increase in the number of men. (Before 2002, the percentage increase in number of women was larger than for men. That is why overall fraction grew.)

ANSWER: This is not a question that our study was tooled up to answer. All we can offer is a snapshot of how things stand with women in the period of our study. Our women informants would have no way to answer this question, so neither do we.

5. Can you explain a little more about your rationale for including such high ACT/SAT Math scores? I think I understand but would like to hear this articulated, particularly given the known test bias for racially minoritized students.
   a. Teaching STEM majors at a community college I find that only a small fraction of students exceed 28 on their ACT.
   b. Could you talk about the SAT/ACT and the recent dropping of those tests by many institutions?

ANSWER: I tried to answer this during the webinar but didn’t get the text of the whole question, so my answer was partial. Sorry. But, as Anne-Barrie also stated, we surveyed faculty to find out at what level of ACT/SAT math attainment STEM faculty expected that students could ‘handle’ their majors. So, the demarcation lines that we drew were theirs. Our intention was to rule out STEM faculty assumptions that the students they encountered were simply mathematically unable to survive. Both in this study and in the original, we were able to show that STEM majors are losing some very able students—but that they don’t seem to know this. But we also selected for interview a sub-sample of students who fell below this line and were still able to persist to graduation. STEM faculty probably don’t know about them either! I don’t feel qualified to answer your last question except to say that our study suggests that these tests may not be good predictors of success. However, having been well prepared by high schools in calculus IS critical.

6. As an engineering Professor for 30+ years, I find the 8% to be amazingly low?

ANSWER: Tim Weston: Yes, the switching rates at the universities in our study were lower than national averages. However, switching rates for engineering students in both NCES and HERI studies are, while higher than our numbers, the lowest of any of the STEM disciplines. It is possible that the lower numbers are partly due to engineering schools having more provisional or probationary entry policies, and stricter admissions standards than other STEM disciplines. We did not have enough institutions in our study to prove or disprove this hypothesis.

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Elaine Seymour: We found a lower switching rate for engineers in the original study also—both in the CIRP national data and in our site samples (where engineers formed half of our interview sample).

7. **How does the % of STEM students who leave college altogether compare to the % of students overall who leave, regardless of major?**

**ANSWER:** We know very little about the 20% who leave altogether. We looked to larger national studies to estimate the pattern of losses nationwide. That’s where you also would have to look for an answer to your question.

8. **Perhaps students are more talkative these days?**

**ANSWER:** One of the things that ethnographers are aiming for is to establish the range of issues that are relevant to answering the research questions. And, as Anne-Barrie laid out, we did learn about some new problems, but most of the ‘old’ problems were still described and illustrated by students. In both studies all the interviews with switchers were one-on-one, so there was no way that any single interviewee could know what any other student was saying—or how much they were saying. So, could they ALL be more talkative than the students in the first study? Unlikely. What matters more is that (as in the original study) although switchers and persisters reported the SAME problems, the switchers reported more of them than the persisters.

9. **It strikes me that just about every factor (whether marginalization of URM/women, the pedagogical practices, or structures) that are associated with switching will be exacerbated in the coming year(s) due to COVID adaptation. a) Do you all see it this way? b) How might we be proactive now, as institutions are making existential decisions to adapt?**

**ANSWER:** Elaine: As I said in my live answer, I am concerned (for both the US and the UK) that K-12 students who have lost several months of schooling, and especially those with no access to a computer or the internet, will be hard pressed to make up for what they have lost, will find it harder to get into college and to thrive if they do. We are discussing some of the (pre-Covid) structured disadvantages for working class students of all races and ethnicities in webinars 2 and 4. Anne-Barrie: Responded expressed her hope that STEM faculty will continue to use and find benefit in the online teaching methods that teaching though the Covid-19 period has encouraged them to explore. To add: Faculty who teach online have had to carefully and proactively plan their courses, Teaching online requires faculty to think about and define their learning objectives, and how they plan lectures,
resources, assignments, and exams to produce the specified learning outcomes. This is often not the case with faculty teaching in the classroom. The shift to online learning, then, becomes an opportunity for faculty to address issues of poor course design and over-fast pace, and thus to ameliorate some of the factors that push students out of STEM.

10. When the TALR data was collected, DBER had most recently come out and funders were starting to switch to fund more institutional awards to address improvements to foundational STEM courses that were expected to systemic and department-wide. How do you see your findings in light of the recent period of institutional priority to implement inclusive evidence-base instruction?


11. I am curious what work/study has gone into preparation of the faculty to teach effectively?

**ANSWER:** As we discuss in Chapter 13, and at other points throughout TALR, we see the introduction of professional preparation in learning theory, curriculum development and pedagogy as a critical component in making system-wide improvements in the quality of education that students receive. It needs to begin in graduate school and be a requirement for all new faculty and instructor hires. We discussed the relevance and availability of an adequate educational preparation for teaching in a book that presented our findings from three STEM education improvement projects that involved students in teaching and support roles: 2005 Seymour, E. with G. Melton, L. Pedersen-Gallegos, & D.J. Wiese. *Partners in Innovation: Teaching assistants in college science courses.* Boulder, CO: Rowman and Littlefield.

12. Can you talk about how you differentiated between poor teaching and poor curricular design?

a. Do we know how the students qualified poor teaching in the original versus TALR study? I am wondering if students have had a switch in expectation of instruction that has moved more quickly than changing pedagogies to more active instruction.
b. I don't understand. How is poor teaching cited by 46% men, 49% women in TALR, but the rate it's cited by both switchers and persisters is higher than 46-49%?
c. The ability of students to distinguish poor teaching has increased, I believe. I suspect the teaching has not gotten worse. Any thoughts on that?
d. Do we know anything about students' expectations regarding curriculum and teaching, and whether the expectations themselves have changed since 1990?
e. One finding in TALR is that students are now much more aware of active learning approaches.
f. Can you elaborate on what aspects of pedagogy failed the students so miserably and resulted in switching?
g. Was poor teaching more often correlated with a discipline?
h. Was any data collected on descriptions of teaching styles in introductory STEM courses? Was class size collected? Given the breadth of institutions does this attribute to data?
i. Re: the current discussion about student expectations concerning pedagogy style: did you in any way 'control for' or consider the broadly described generational differences (e.g., Millenium v. Gen Z) in interpreting these data? E.g., I have found current/recent students generally expect more personal attention than did students 15-20 years ago.

**ANSWER:** The students made this distinction clear—both in TAL and in TALR. We will be discussing this and answers to some of your questions below in Webinar 3 (August 18th, “STEM learning experiences and their consequences”). As I said during the webinar, students have had more experience of active and interactive, hands-on learning throughout K-12 than in the 1990s. But, even then, some students negatively judged STEM faculty for not knowing how to do, e.g., group work—which they had experienced and found productive. Our team will be addressing all these questions in Webinar 3. However, I will say that the expectation of personal attention has not changed. What is stronger now—given that more students are paying for part or whole of their education themselves—is student consumerism. They expect better a quality education than they see themselves getting.

13. Is there an opportunity for deploying this study at our institution to gauge how we compare to the national study?

**ANSWER:** We would be delighted if institutions everywhere got serious about collecting data on an ongoing basis to see how they and their students are doing and I argue for this in Chapter 13. With this in mind, we have included in our TALR Appendices our instruments, protocols and sampling methods. Tim Weston describes his methods of analysis for institutional data analysis and could discuss this with you.
14. Were analyses done that examined differences across socioeconomic status, and/or first-generation college status?
   a. Is the racial/ethnic difference in the area "Difficult transition to college" possibly impacted by first-generation status?
   b. I am curious if there is a correlation between under preparation and difficulty transferring to college?

**ANSWER:** We are going to discuss these issues in Webinar 2 and again in Webinar 4.

15. Do you think an increase in reported micro-aggressions is an increased awareness and ability to identify them?

**ANSWER:** As Anne-Barrie presented, as I described in my live answer, and as we report in TALR, the daily experience of hostility, rudeness, and inappropriate speech and behavior by male peers towards women in their STEM classes had all but disappeared in the 6 institutions in TALR—the same institutions in which we had interviewed for TAL1. You can read the questions that we asked women in the TALR Appendices. It is salient that we had to explain what we had found in the 1990s (see TAL1 pp. 248-265) and the TALR female interviewees did not understand and/or were surprised that this had happened to women in the 1990s. So, this was very good news—although it may, of course, still be happening in other institutions, disciplines or departments.

The picture was less sharp re students of color. It became clear that contemporary young people avow no tolerance for discriminatory speech and action against any group—and it is this culture shift that we were witnessing. However, the issues that we reported in TAL1 Chapter 6 were still in place and, although overt racial/ethnic discrimination or unpleasantness was little reported in TALR, both students of color and aware and sympathetic white peers reported that racist aggressions continued at a more subtle level because the culture norms no longer tolerate openly racist speech and behavior.

16. How many were Black/White? What is the breakdown of demographics? If you shared that I don’t recall? Could you also remind us about what types of schools? PWI. I am concerned that the fewer accounts related to race simply reflects the small number of URMs enrolled in those institutions.

**ANSWER:** It may be best to refer you to the parts of TALR that address your questions. The types of schools are described on p 38. Some schools were selected because they had a highly diverse student population. There were not fewer accounts in TALR ‘related to race’. Tim Weston’s breakdowns in Chapter 2 will answer some of your queries. Anne-Barrie Hunter’s breakdown of ‘the problem iceberg’ by race/ethnicity is offered in Chapter 3 (on
pages 108-108), and our findings on STEM college experiences by students of color are threaded throughout the book.

17. **Switchers andpersisters are not different types of students, but URM women are more likely to switch, correct? could you please explain this?**

**ANSWER:** By ‘types’, we do not at all imply types by race/ethnicity. Both on TAL1 and in TALR, we counter the ‘traditional’ STEM faculty view that students leave or stay because of disparities in their intellect, capacities for hard work and commitment, strength of interest in the discipline etc. In neither study did we find this to be the case.

18. **Did you examine stereotype threat? That is, do switchers (more than persisters) attribute their lower scores in a class to their aptitude or their achievement (how hard they work)?**

**ANSWER:** I think this is best answered in the detail that the question deserves in Chapter 12 by Heather Thiry. She will be discussing her findings in Webinar 5, October 27th.

Dimensions of STEM persistence. Meanwhile (happily) our publishers, Springer, have made the book available, quite inexpensively, chapter by chapter, as an electronic document. So, you might like to read ahead.

19. **I would be interested in knowing if there is any evidence of success from institutional changes designed to respond to TAL in TALR?**

**ANSWER:** The evidence from the classroom observational study led by our collaborating colleague, Joe Ferrare (U. Washington) is included in Chapter 8 and discussed in points throughout the book (including the final summary in Chapter 13). Ferrare logs shifts in the ways in which ‘lectures’ are taught and in STEM faculty thinking about how students learn. In another concurrent collegial study, Mark Connolly (UW Madison) has been exploring what has and has not changed that bears upon persistence rates at these six institutions. His work is not yet published, but you might contact him to learn first-hand what he has discovered at mark.connolly@wisc.edu.

20. **How might the diff between how women students are treated and how SoC are treated be related to the numbers of those students at an institution. Women are often in the majority now, but SoC are surely not.**

**ANSWER:** Numeric representation, by itself, does not explain variations in treatment. Tim Weston’s regression analysis calls into question the idea that ‘race’ is an independent variable. Both this and Chen’s (NCES) study find that other variables related to social class (notably under-preparation in poorer high schools), more affectively explain losses among students of color.
21. To what extent does financial status affect persistence in STEM?

**ANSWER:** As Anne-Barrie laid out, financial problems among students were much worst that in the original study. In Webinar 2, we will present some of the dimensions of structured disadvantages such as financials status.

22. *I am a big fan of the original book, but one shortcoming I thought it had was a lack of attention to intersectional differences by race/ethnicity, gender, income, and/or first-gen status. It seems that the new study does directly address and find significant intersectional differences. Can you address this contrast more directly and comment on what changed? Was it that the original study was not designed to investigate intersectional differences, or that they simply weren’t significant back then?*

**ANSWER:** There were whole chapters devoted to ‘Women’ and Students of color in TAL. No one then was talking (at all) about ‘first generation students’ –that reflects a more recent sensitivity. But it is no wonder you are having difficulties in making the comparison. The reason is that there were no electronic institutional records in the 1990s--at any school as far as we know--certainly not at the 7 schools in our site sample. So, we depended on national data sets (like CIRP) and the few studies then available to get a sense of the size of losses for particular student groups--notably by gender and race/ethnicity. Indeed, CIRP did a special pull of data for us to estimate the size of losses caused by switching out of particular STEM disciplines. No one had asked them to do this before so everyone who had begun to discuss these issues was working somewhat in the dark. What we could discern is described in TAL in our overview in Chapter 1 (for women) and at the start of Chapter 6 for race/ethnicity.

So, our TAL study was devoted solely to investigating the contributory causes of losses--the size of which was still rather hazy nationwide. All our work was ethnographic--a very early example of computer-assisted ethnography. Neither we nor the sample institutions knew the size of their own losses. However, our study was funded because people had started to understand that the problems that we investigated existed, but they had no way to explain them.

The new (TALR) study is multi-methods (see Chapter 1, pages 36-45) and it includes an extended replication of the original interview study. It also includes the institutional data study that was not remotely possible for TAL1. We have triangulated our data from several component studies, including the institutional records analyses done by Tim Weston. Tim would be your best resource for questions about his findings. ([timothy.weston@colorado.edu](mailto:timothy.weston@colorado.edu)).
You may find it incredible that universities and their departments were keeping paper-only records of their students in the 1990s—and that national data sources laying out the size of particular student groups who were lost from STEM barely existed. But such was the case. However, you will find in TALR Chapter 1, pages 3 and 4 a description of what (little) we did know about this at the time that we undertook the TAL study.

23. **Currently the BLM movement is demonstrating significant youth involvement. Would the panel care to speculate on how that might impact losses in the future?**

**ANSWER:** I hope that it does. However, as we discuss in the final chapter of TALR some structural and attitudinal change are needed to make this happen.

24. **Is the TALR volume advertised on the opening slide Open Access? How will members of this webinar series who do not have access to this volume (limited library access, budget constraints, etc.) study these findings?**

**ANSWER:** The publishers (Springer) have made electronic copies of the book—and individual chapters—available very cheaply. There’s a 20% discount for webinar participants—so you might get together and share a copy. Pester your college library to buy it and ask for it on inter-library loan. All the webinar slides, scripts and video recording are being made available via the AAAS.

25. **Have you broken the data out to look at students with disabilities? My experience has been that there is a lot of prejudice from faculty against these students, resulting in micro-aggressions.**

**ANSWER:** Anne-Barrie Hunter and I did what may be the first study of the STEM experiences of students with disabilities at the University of Minnesota in 1998: Seymour, E. & Hunter, A-B. *Talking About Disability: The Education and Work Experiences of Graduates and Undergraduates with Disabilities, in Science, Mathematics and Engineering*, Washington, D.C. AAAS. And you are right that faculty are given to making ‘lay diagnoses’ and undermining formal accommodations that has been granted. We found that the issues faced by students with the ‘disadvantages of time’ that disabilities and illnesses bring were quite singular. As such, they deserve a study in their own right. It wasn’t really possible to incorporate this into the TALR study, but others have drawn on our findings and continue to explore ways to address the singular difficulties that students with disabilities face. The largest, most active group (IAGD) was founded by Christopher Atchison to address ‘Disability Inclusion in Science’. They can be reached at the-iagd@googlegroups.com I hope this is helpful information.
26. What were the relationships between the student perceptions of teaching/course design and the TDOP observations of the courses?

**ANSWER:** As the team will discuss as part of Webinar 3: August 18\(^{th}\), STEM learning experiences and their consequences, there was clear concordance—also with the results of the SALG survey.

27. Could you identify any intersections between SoC reported difficulties with the Competitive ethos of STEM and the issues around STEM curricular design and/or STEM Instructor Pedagogy? Or is the Competitive Ethos of STEM arising from other student issues?

**ANSWER:** These are matters that the team will address in Webinar 3: August 18\(^{th}\), STEM learning experiences and their consequences. However, as Anne-Barrie Hunter reported, a major contributor to the widespread competitive ethos of many STEM classes was the entirely artificial competition set up and engendered by highly ranked curved grading practices. All students suffered from this, but those most affected were women of color.

28. Given that all students had the same concerns, will we be hearing in a later session about why some students persisted despite these concerns?

**ANSWER:** Yes, you will. Heather Thiry (who devotes a whole chapter –12—to explaining this) will be offering highlights from her findings in Webinar 5. (As we mentioned, we devoted a sample sub-set to students who enter mathematically underprepared but who persisted to graduation despite this. We wanted to learn how they did it!)

29. What are suggestions for researchers who want to work with K-12 STEM systems?

**ANSWER:** I suspect that you will find particularly relevant to your research interests our findings related to weed-out class practices and which students they push out (Chapter 7 in TALR; Webinar 4, September 22\(^{nd}\). Dysfunctions of the STEM weed-out system). Also, Heather Thiry’s findings about who are the under-prepared students (Chapter 5 and Webinar 2: July 21\(^{st}\) Entering an uneven playing field) should give you a lot of leads to think about for K-12 research.