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Socioscientific Modeling as an approach for Justice-Centered Science Pedagogy

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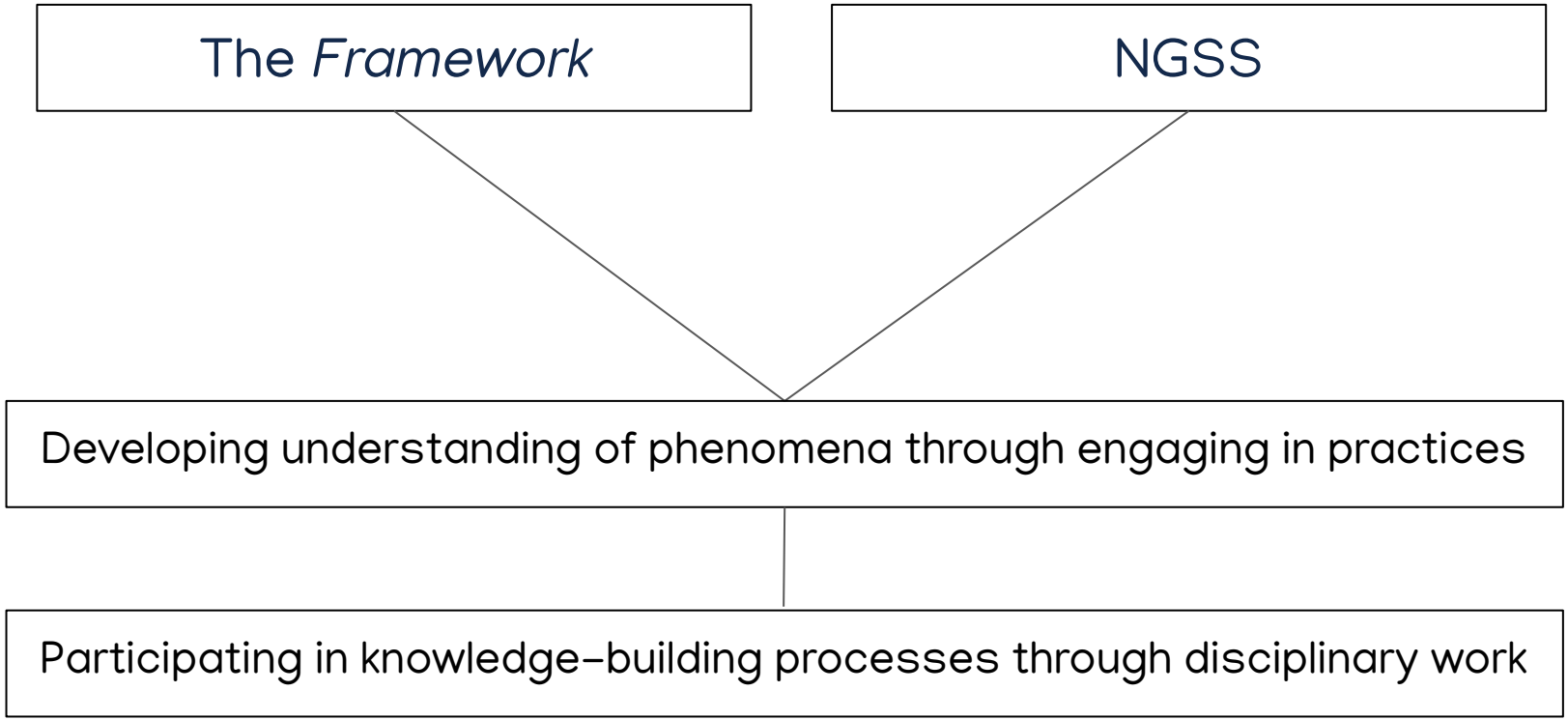
The *Framework*
NGSS
Developing understanding of phenomena through engaging in practices
Participating in knowledge-building processes through disciplinary work

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Participating in knowledge-building processes through disciplinary work

Traditional instructional approaches can fail to appreciate the diverse repertoires of cultural practices, knowledge, experiences, and motivations students bring with them to the classroom (Bang et al., 2012; Rosebery et al., 2010).

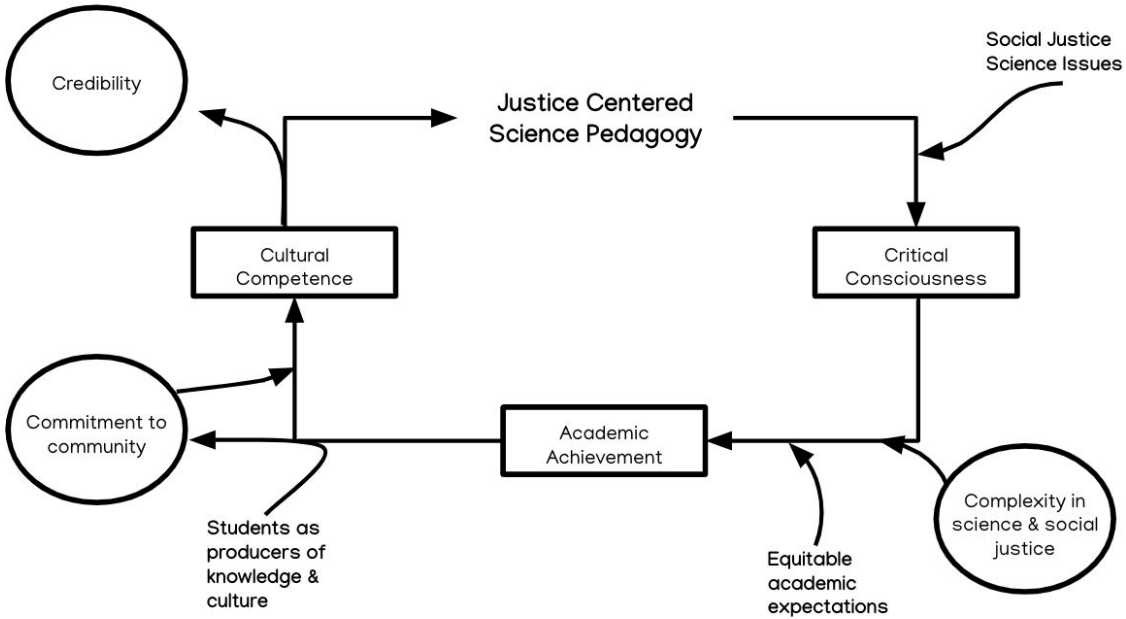
Developing understanding of phenomena through engaging in practices

Participating in knowledge-building processes through disciplinary work

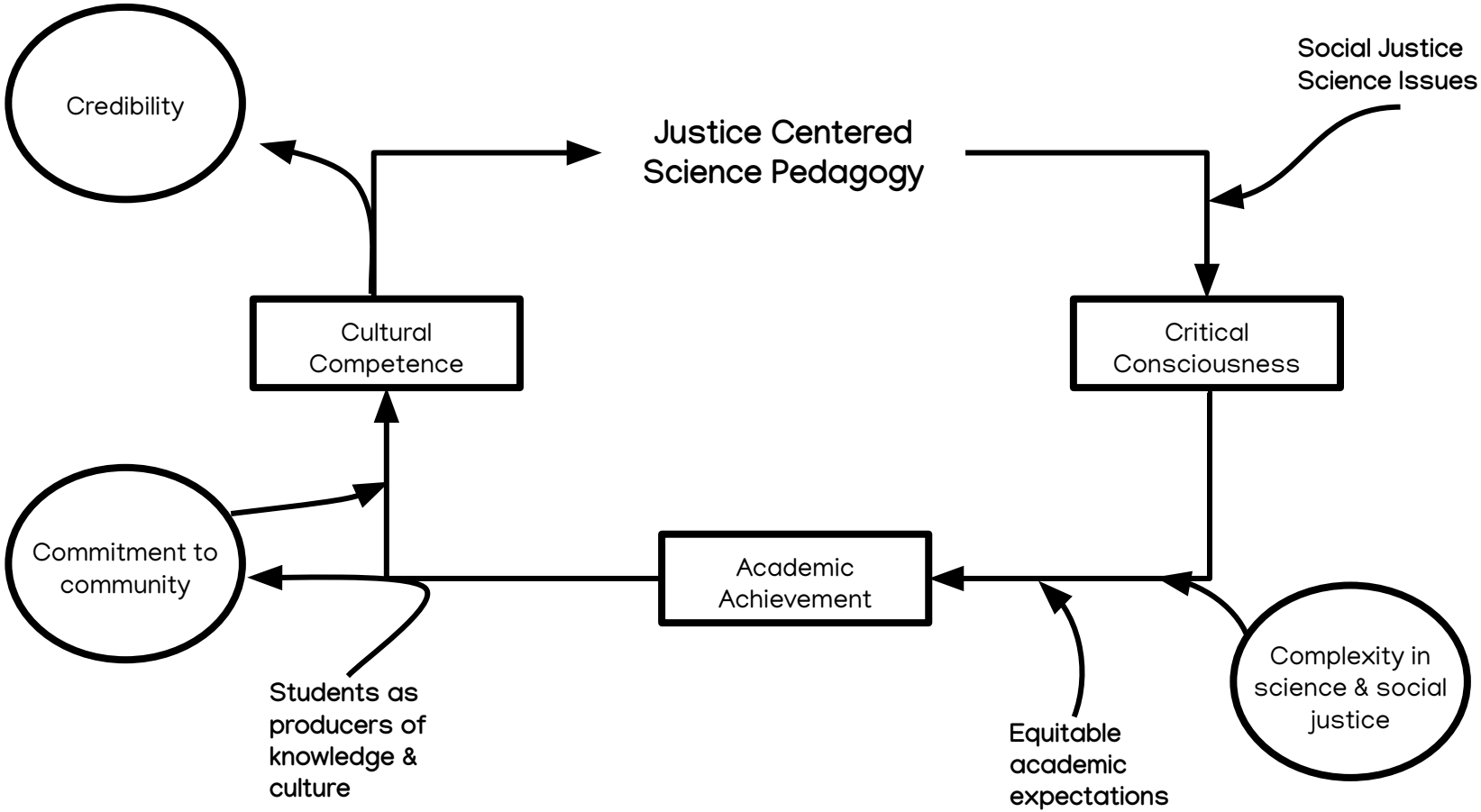
Traditional instructional approaches often fail to appreciate the diverse repertoires of cultural practices, knowledge, experiences, and motivations students bring with them to the classroom (Bang et al., 2012; Rosebery et al., 2010).

Morales Doyle (2017) offers justice-centered science pedagogy as a way to leverage the diverse resources & motivations students come with

Justice–Centered science pedagogy (JSCP) empowers teachers to make science learning more **inclusive** of **authentic student experiences** and aligns well with *NGSS*



Modified from Morales–Doyle (2017)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Social Justice
Science Issues
Cultural
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Critical
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Commitment to
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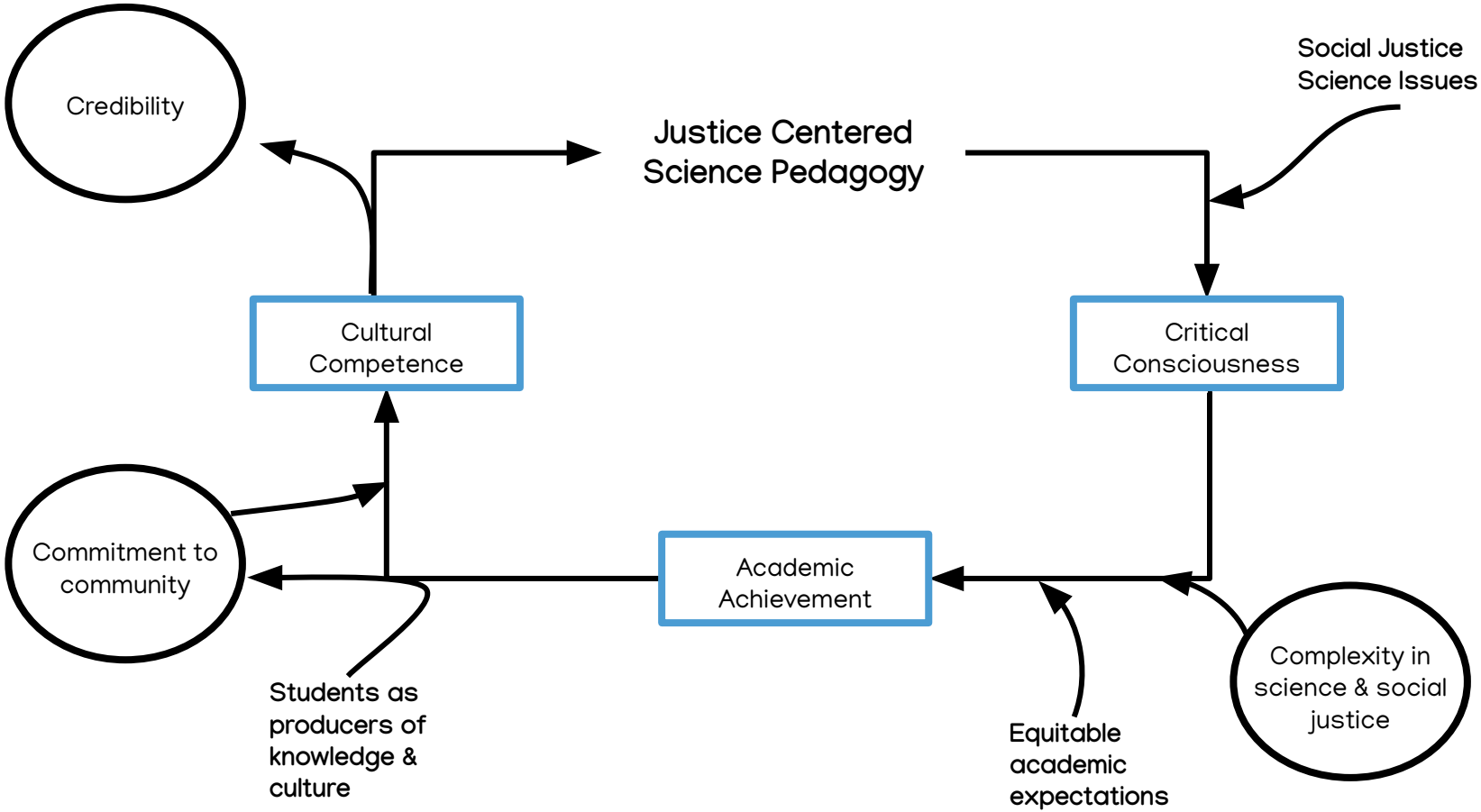
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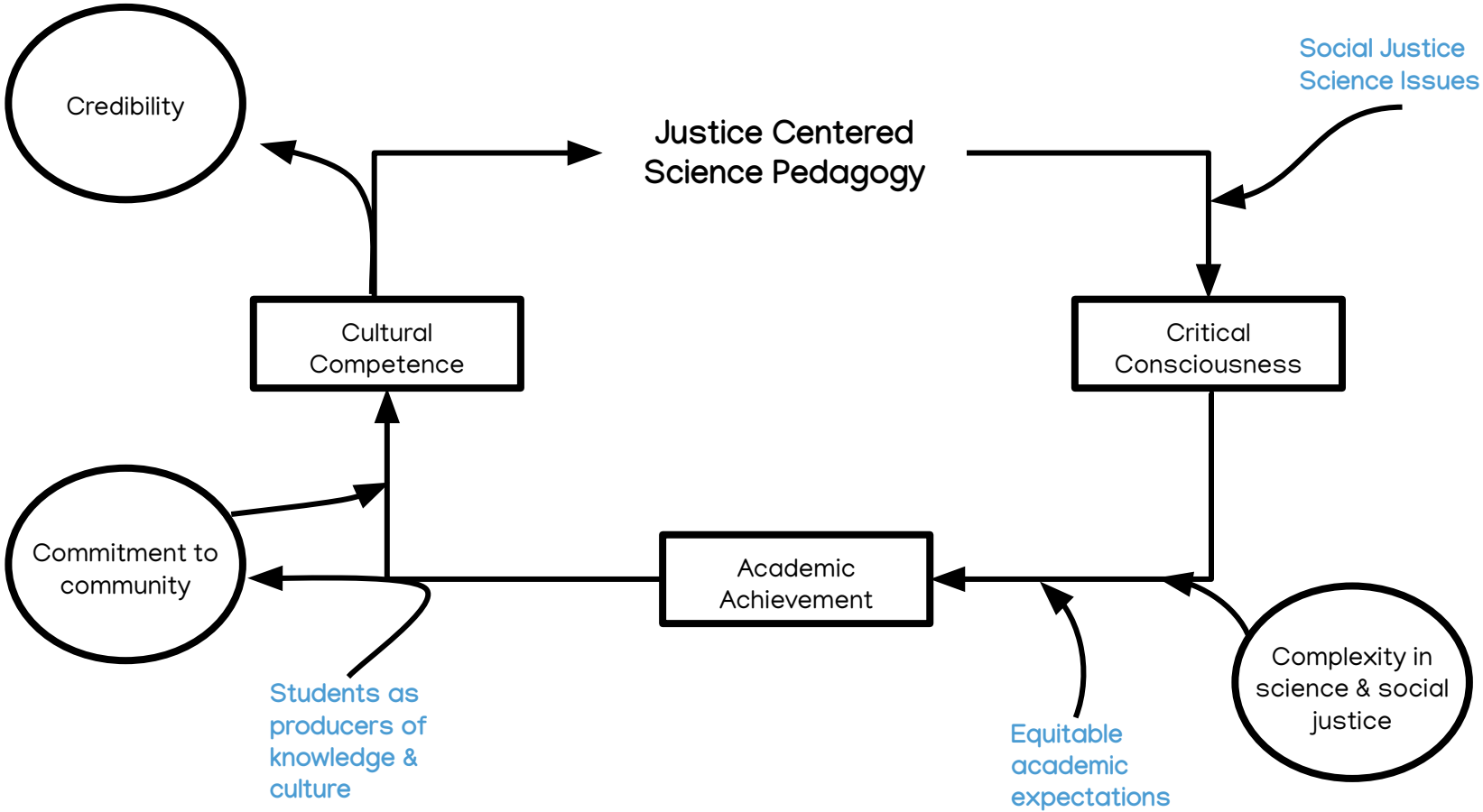
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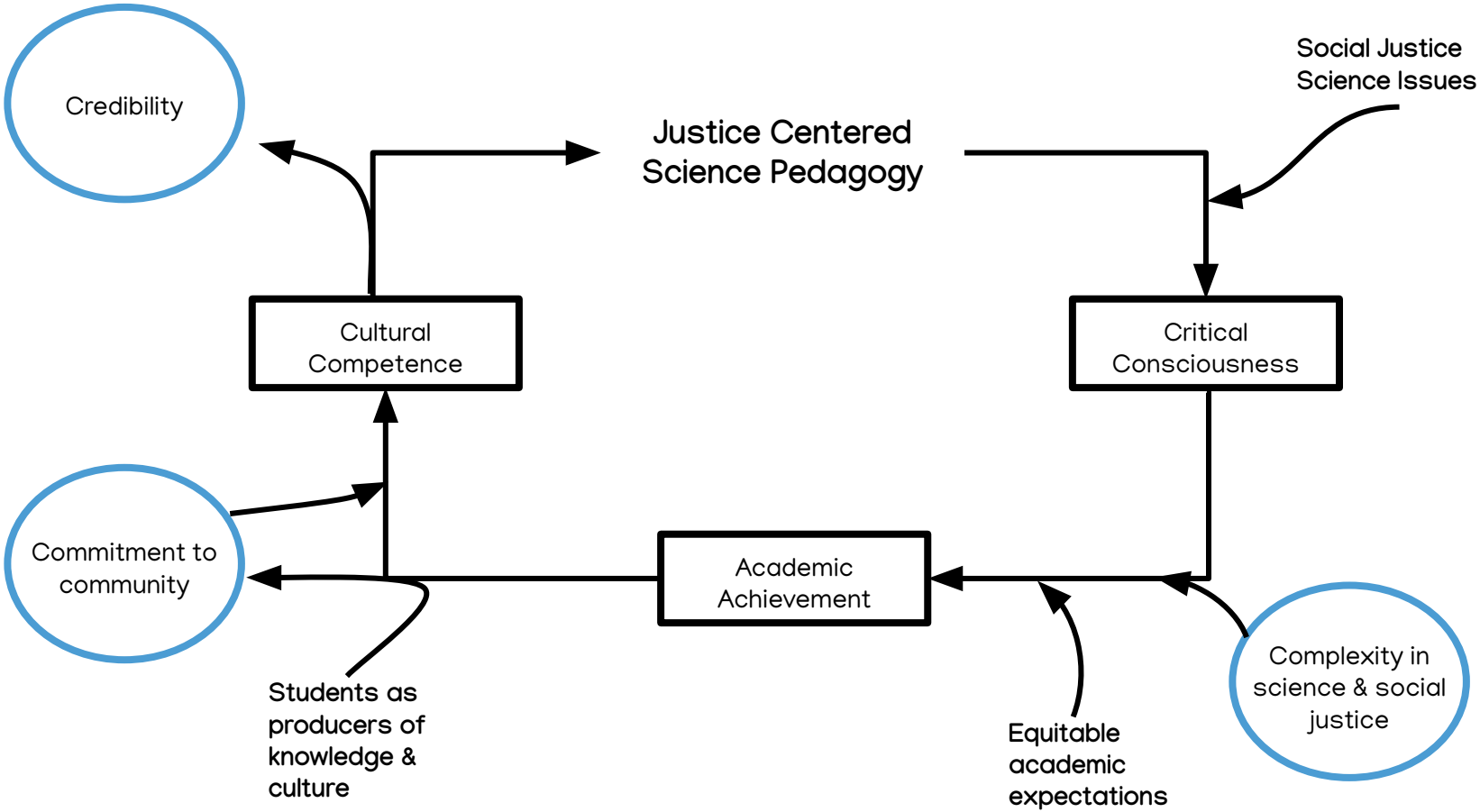
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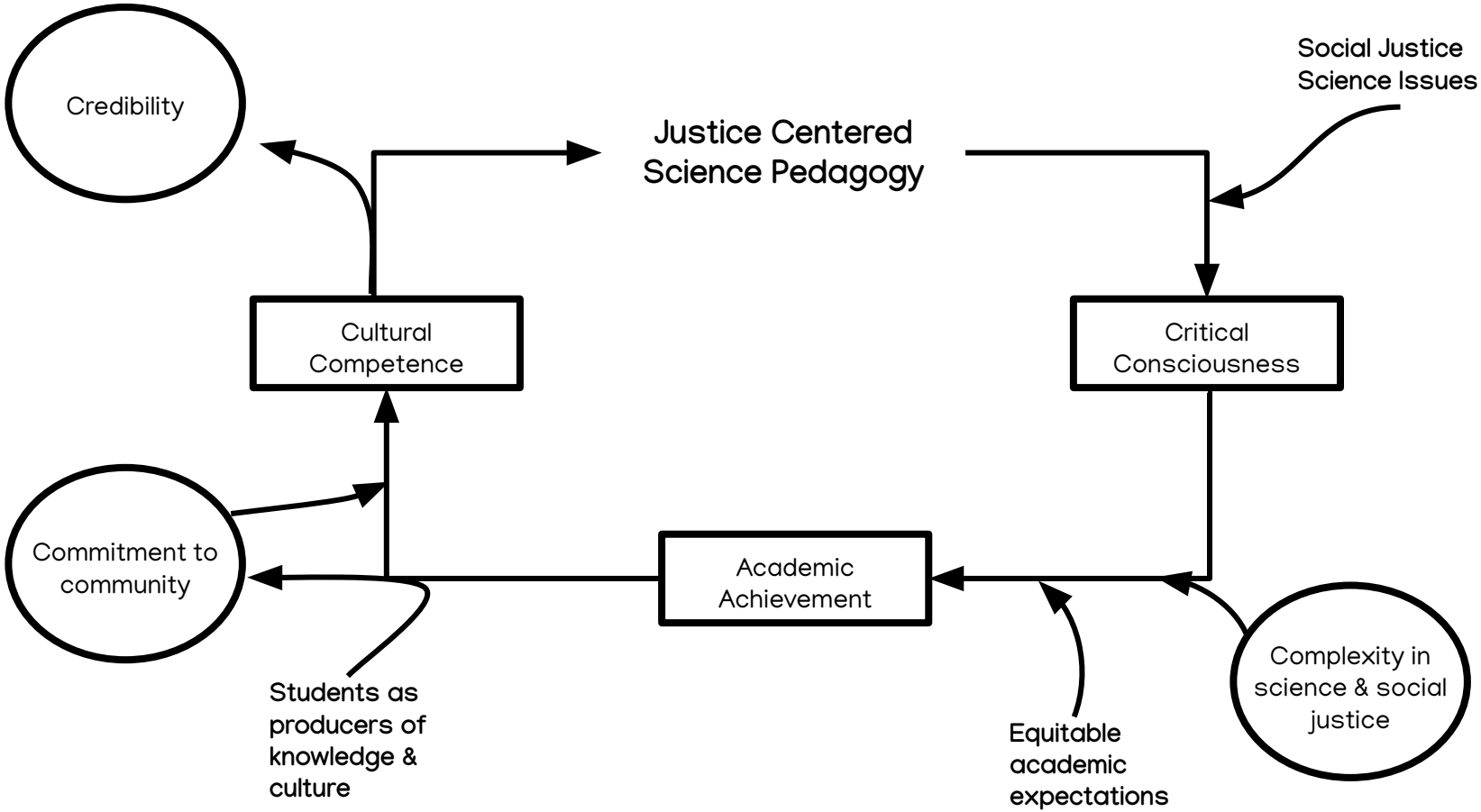
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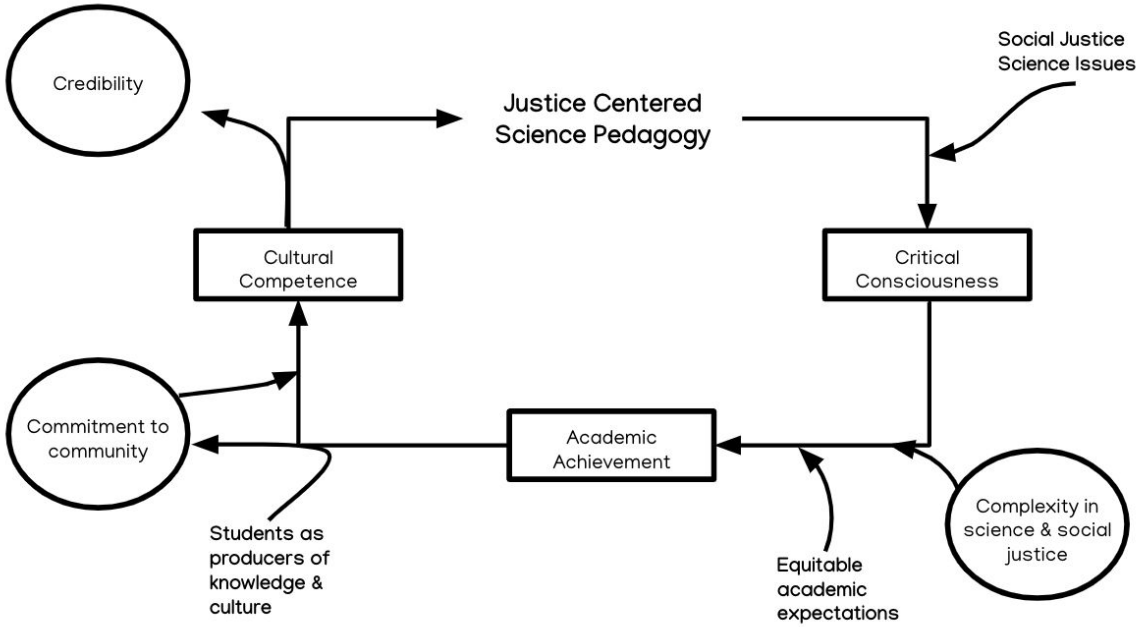
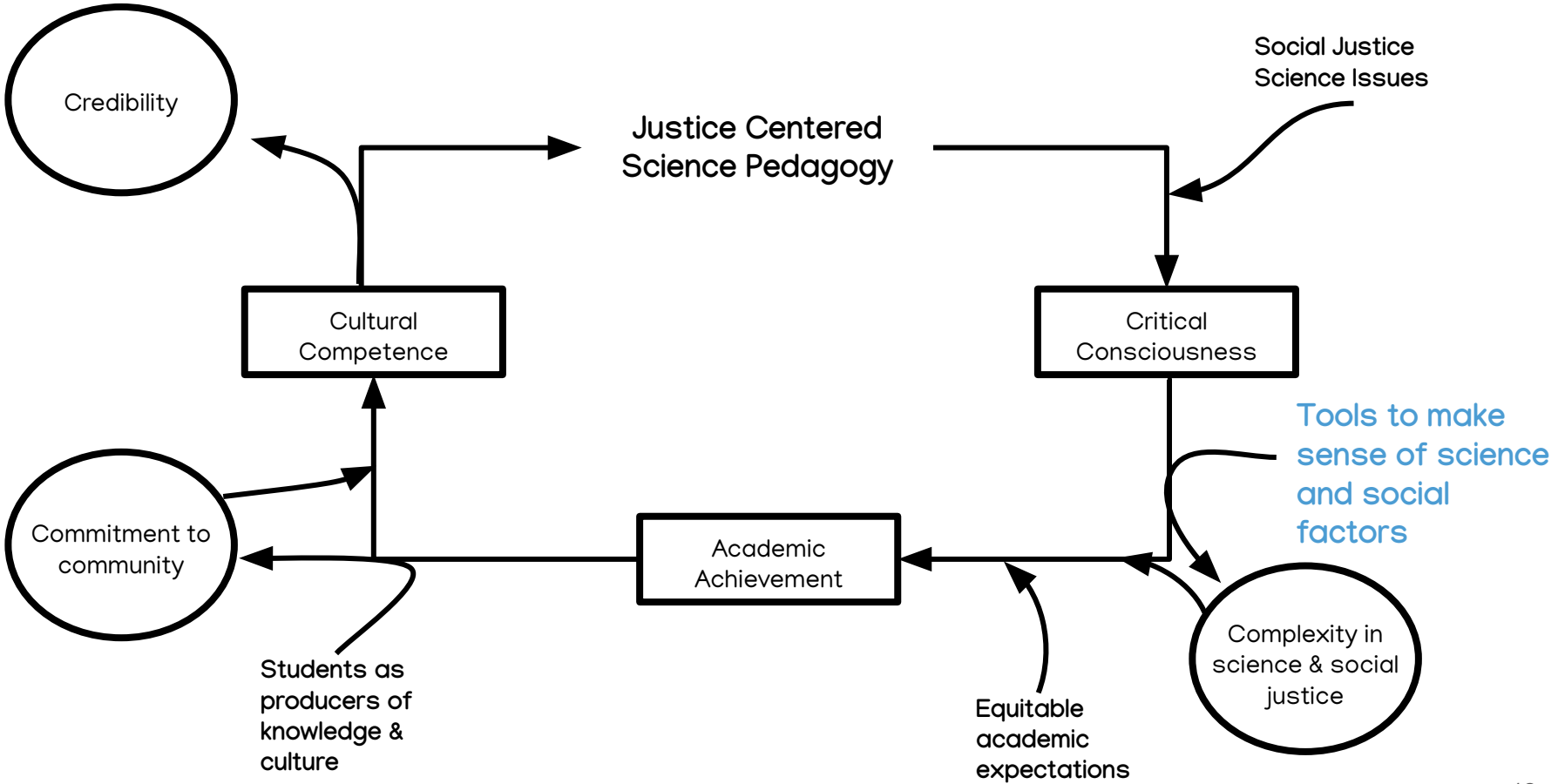
The challenge is that even teachers who embrace critical pedagogies struggle to incorporate social dimensions of science into their instruction (Bossér et al., 2015)

Teachers need discrete instructional strategies that introduce social dimensions of science

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How does systems modeling, a specific type of socioscientific modeling, support justice-centered science instruction?

We offer socioscientific models as an instructional strategy for attending to social dimensions of science in ways that align with JCSP

What are socioscientific models?

representations that incorporate social factors
alongside scientific factors
(Ke et al., 2021)

Socioscientific models can take on many forms,
here, our models are systems models

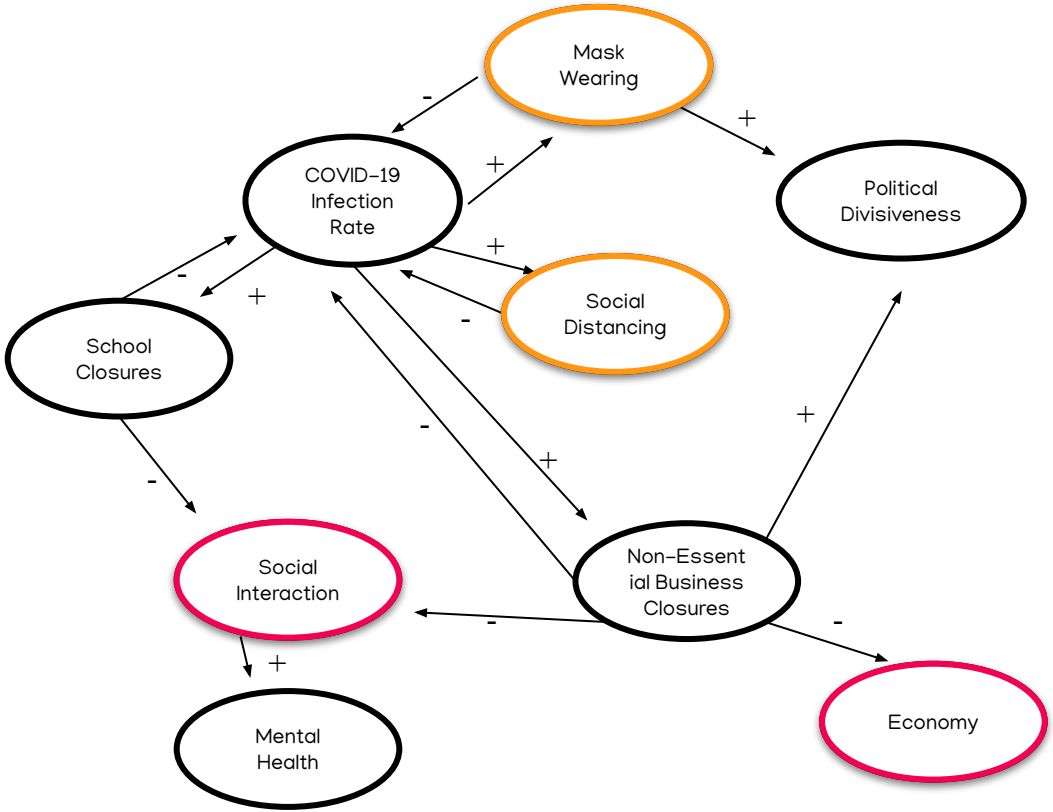
COVID-19 Infection Rate Systems Model Example

Scientific components:

Wearing Masks & Social Distancing

Social impacts:

Economic implications and limited social interaction



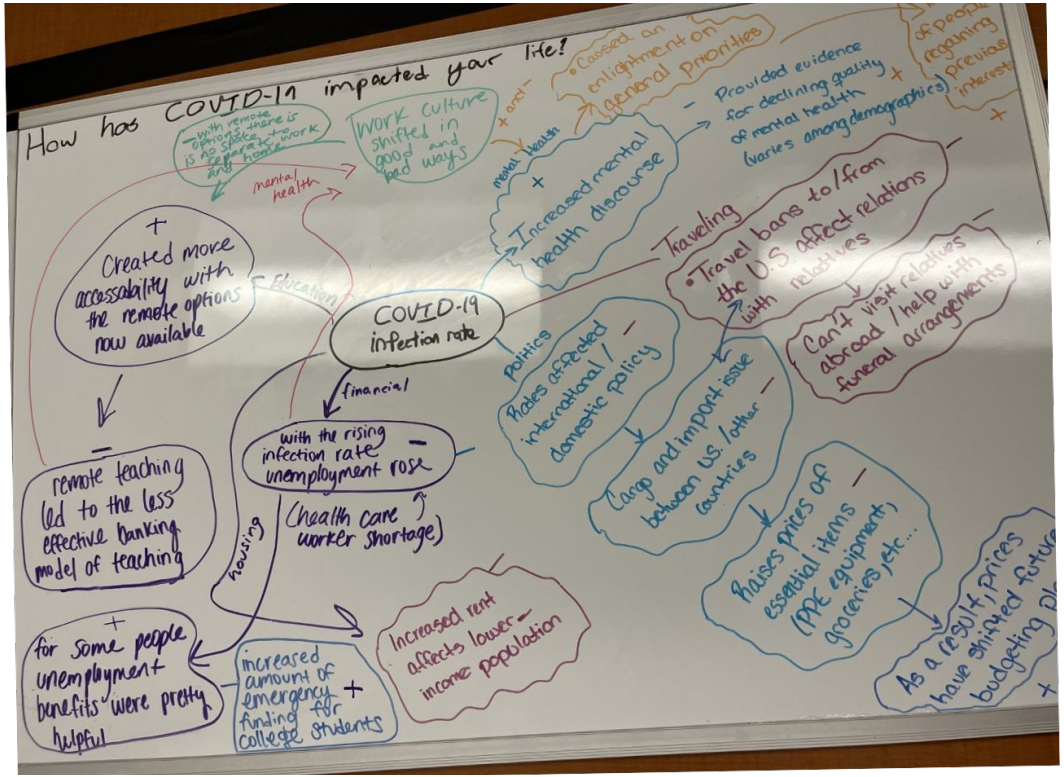
Participants

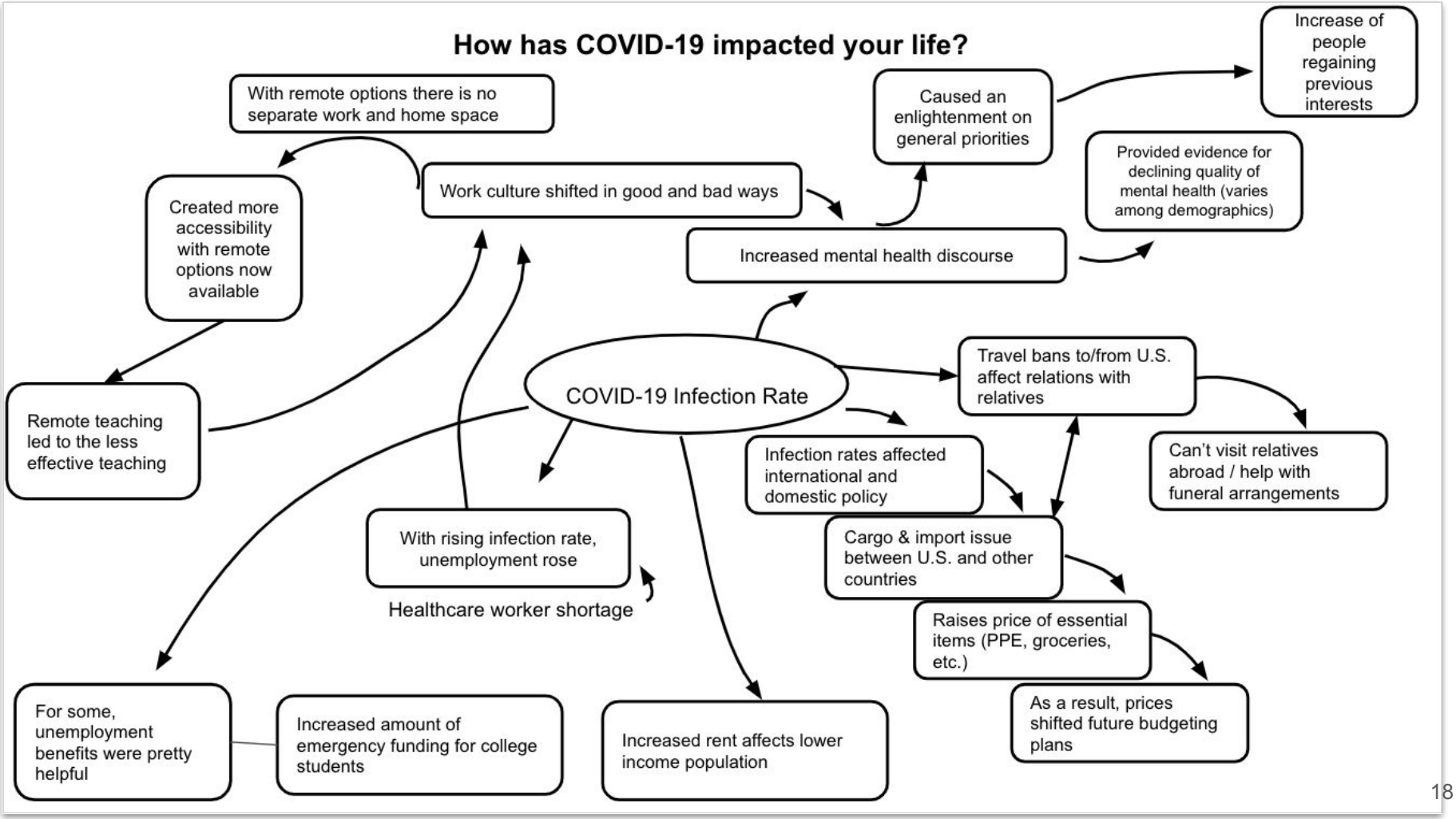
- 6 participants (all names are pseudonyms)
- 3 sessions of 2 participants each

Context

- Driving question: "How has COVID-19 impacted your life?"
- Video and audio recorded as they created the system model
- Interviewed following the exercise
- The first three authors met weekly to review the transcripts, watch the video if necessary, and discuss trends in the data.
- To ensure trustworthiness, track the development of ideas, and reflect on disagreements the authors kept personal analytic memos as well as running documentation of group meetings.

COVID-19 Infection Rate Systems Model Student Example
Francesca & Faith, Session 1




How has COVID-19 impacted your life?
With remote options there is no separate work and home space
Caused an enlightenment on general priorities
Increase of people regaining previous interests
Created more accessibility with remote options now available
Work culture shifted in good and bad ways
Provided evidence for declining quality of mental health (varies among demographics)
Increased mental health discourse
Remote teaching led to the less effective teaching
COVID-19 Infection Rate
Travel bans to/from U.S. affect relations with relatives
Infection rates affected international and domestic policy
Can't visit relatives abroad / help with funeral arrangements
With rising infection rate, unemployment rose
Cargo & import issue between U.S. and other countries
Healthcare worker shortage
Raises price of essential items (PPE, groceries, etc.)
For some, unemployment benefits were pretty helpful
Increased amount of emergency funding for college students
Increased rent affects lower income population
As a result, prices shifted future budgeting plans

COVID-19 Infection Rate Systems Model Student Example

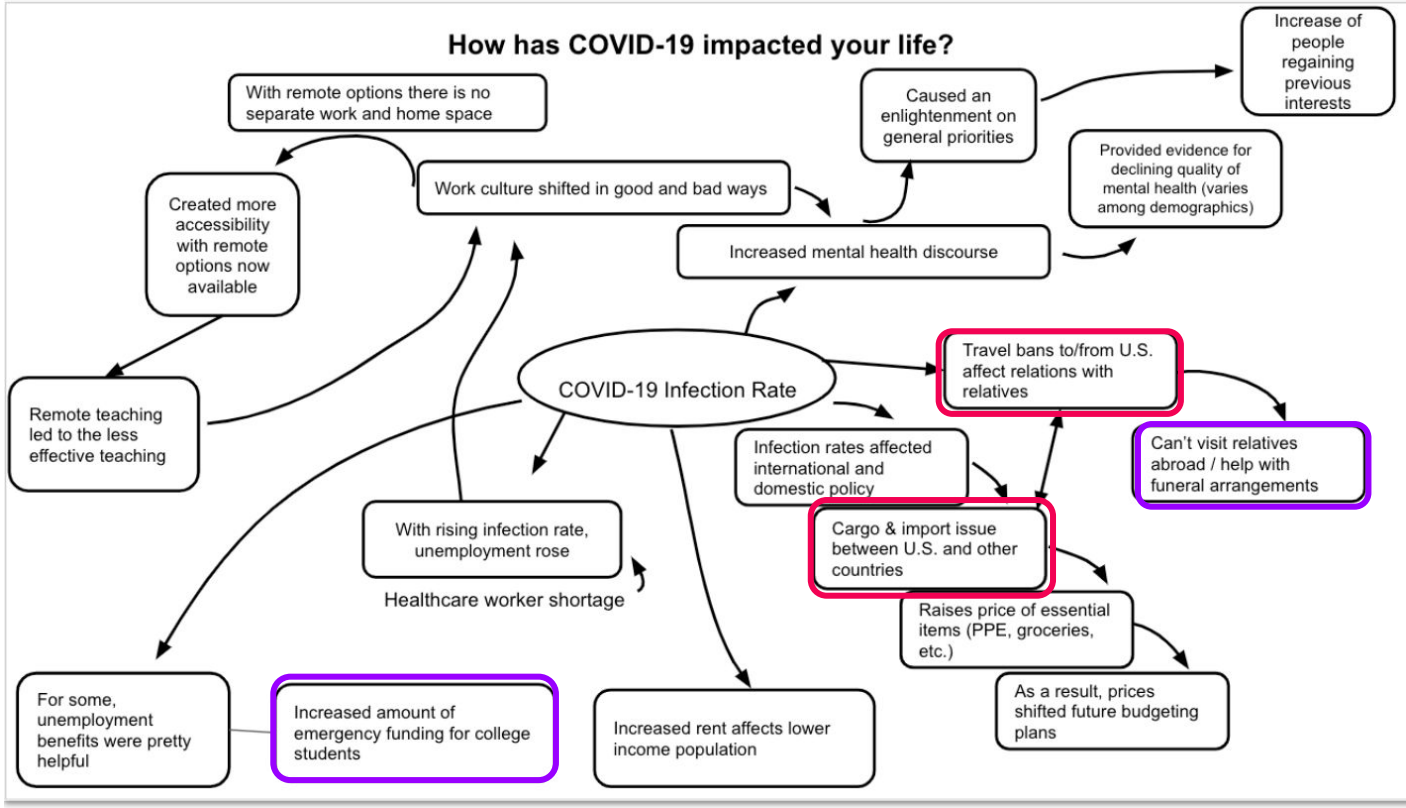
economics, politics, and history

+

knowledge from personal experiences

=

holistic understanding of complex SJSI



Socioscientific Modeling as a Justice-Centered Science Pedagogy

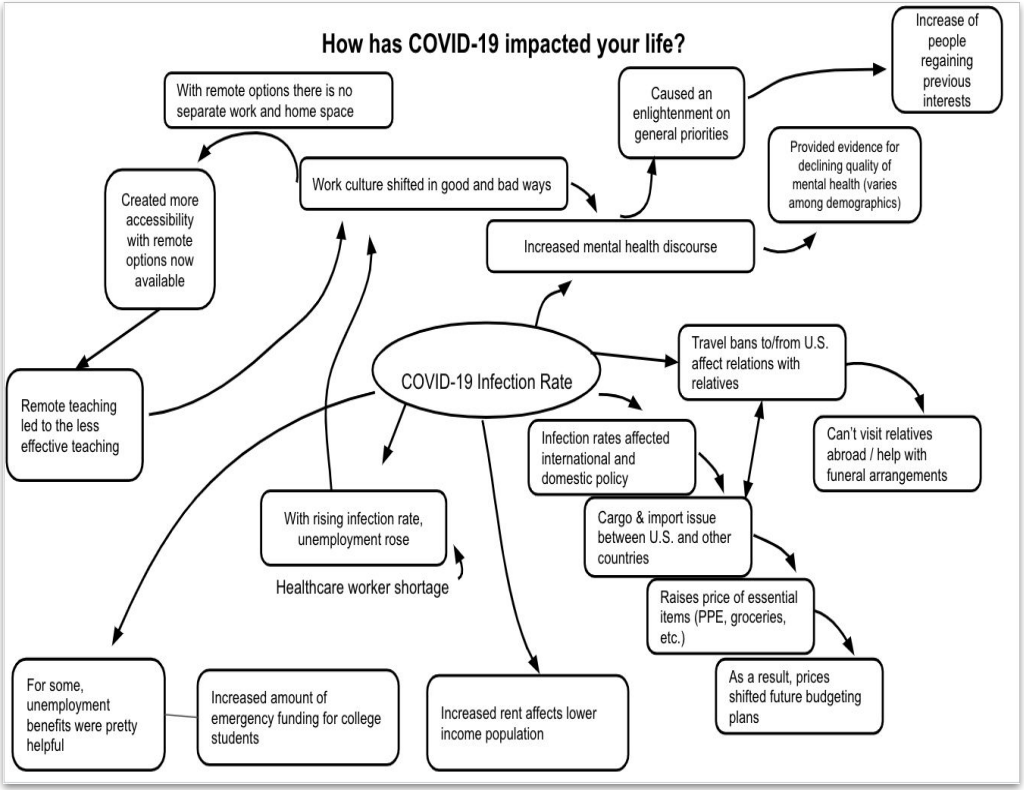
- Appreciating the complexity of SJSI
- Constructing understandings that are personally meaningful
- Conducive to academic learning

Appreciating the complexity of SJSI

Integrate information & evidence from different dimensions

Connecting science knowledge and social dimensions makes visible ways science & society intersect

Drawing from multiple types of evidence and seeing these factors connected on the model can lead to a more holistic, useful understanding

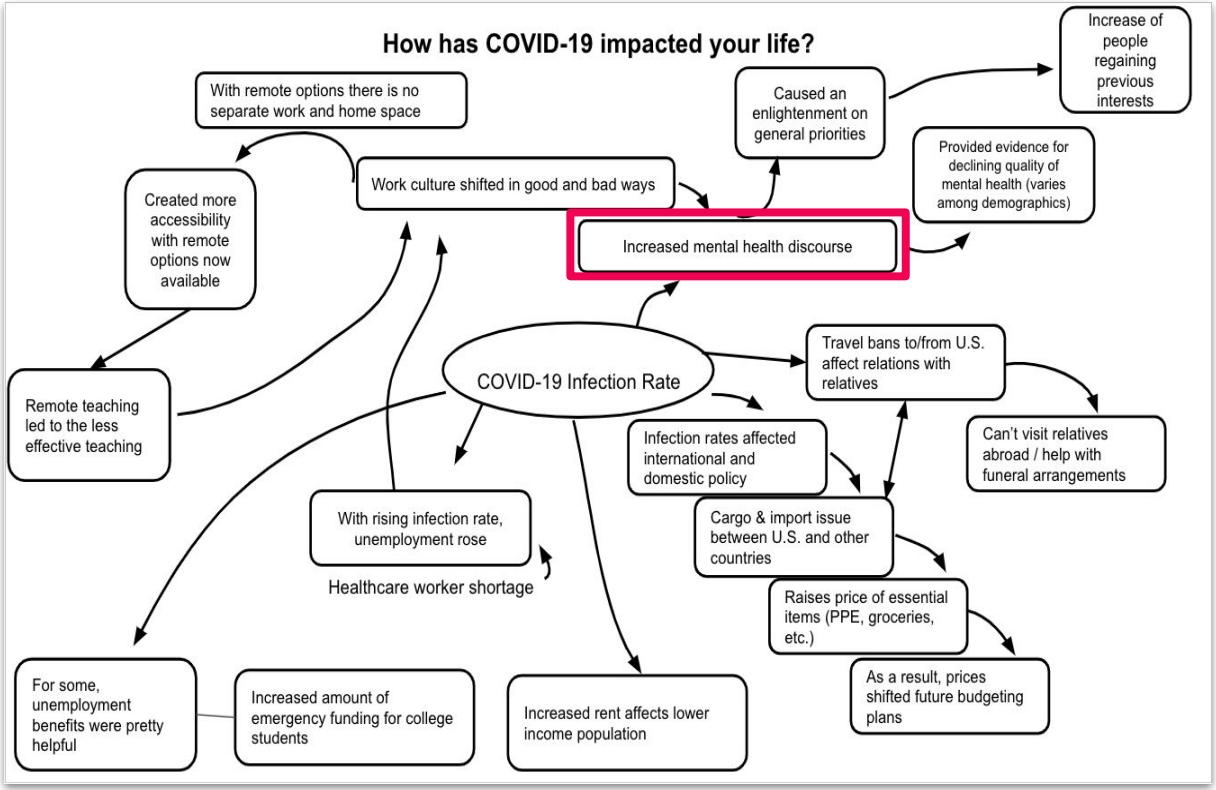


Appreciating the complexity of SJSI

Francesca:
I feel like this [education, unemployment rates, and working from home are] connected. I feel like it's all connected...

Faith:
They are all connected.

Francesca:
To mental health. I was going to say, this education issue, this issue with financial, it both ends up connecting to mental health.



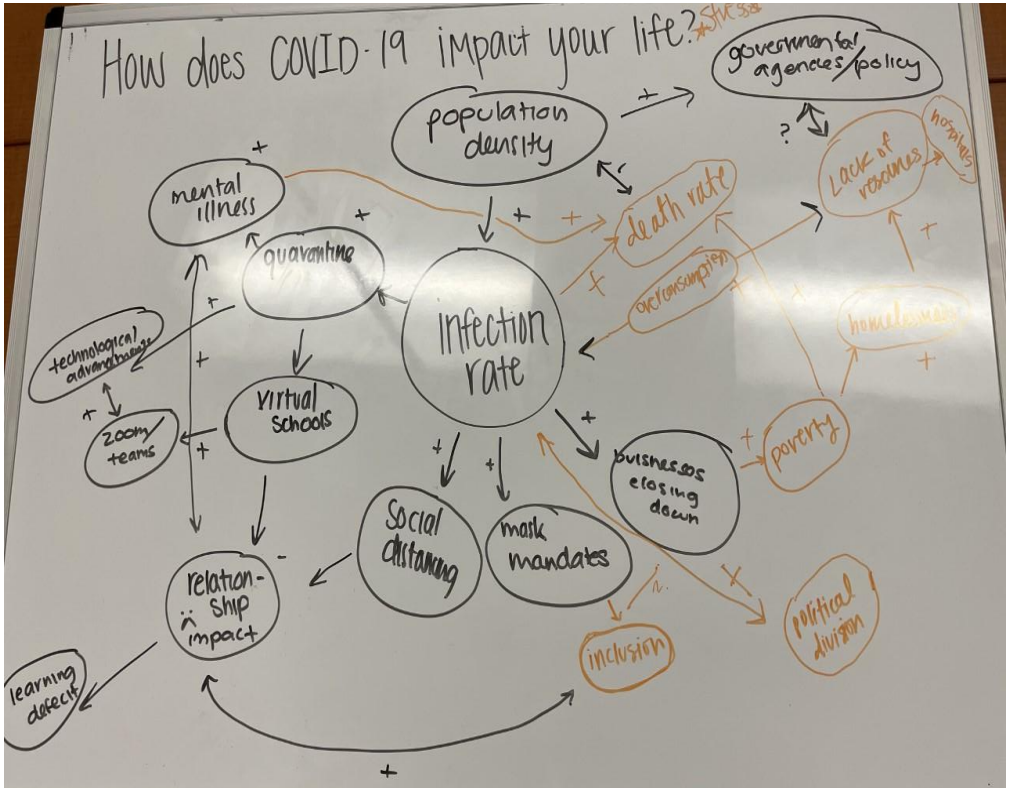
Appreciating the complexity of SJSI

In her interview, Francesca said,

First I started off like education and then we went into financial. And then whenever Faith was going over mental health, that's where – if I hadn't seen it all put together like this, I wouldn't have been able to make the connections where these two things are connected to mental health, and now it's visually here so, I can see that – it helped me make better connections.

Constructing understandings that are personally meaningful

Sam & Sadie, Session 2

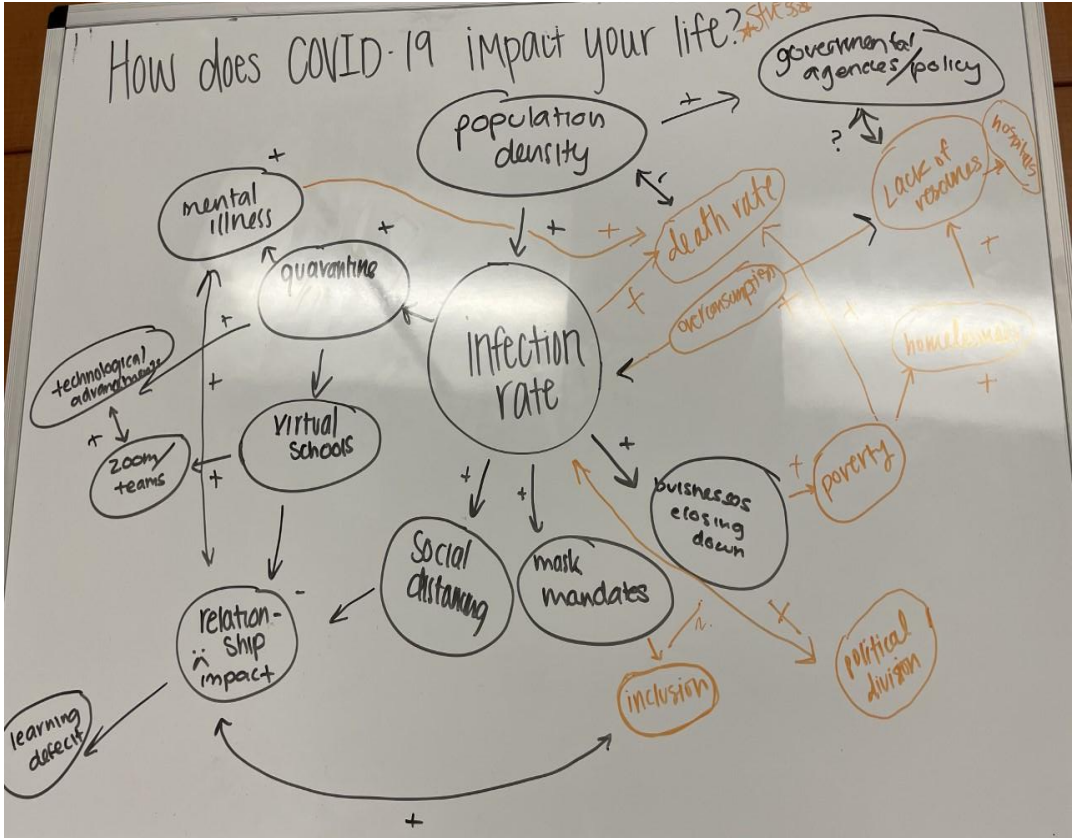


Constructing understandings that are personally meaningful

Pull from personal funds of knowledge to make sense of phenomena – broadens what is considered "valid" contribution

More ways to draw upon experiences, expertise, and interests to construct a model that meaningfully aligns with their goals and how they see themselves

Steeped in personal meaning that illustrates ways they can use their knowledge



Constructing understandings that are personally meaningful

Session 2, Sadie:

I mean, honestly, it just kind of goes into like all the details of COVID that like for – well, Sam and I, when we were thinking of all the ideas, I feel like we kind of we're pulling through our own experiences, so that kind of explains like personally how it impacted my life. We kind of just pulled a bunch of different details, so it kind of shows like – or I want to think that it shows the like whole picture of like what happened during COVID, um, and like not just like one aspect of it. I feel like it's kind of holistic.

Constructing understandings that are personally meaningful

Session 3, Trinity:

"I think it's [the model is] a personal thing that a lot of people could experience and yeah, I just recently had COVID, so the isolation was definitely a lot and kind of related to like the death like, like I have old family members and like that affected me personally. And the labor shortage, my dad owns a business so he's like been having trouble getting like consistent employees so that definitely affected my family."

Constructing understandings that are personally meaningful

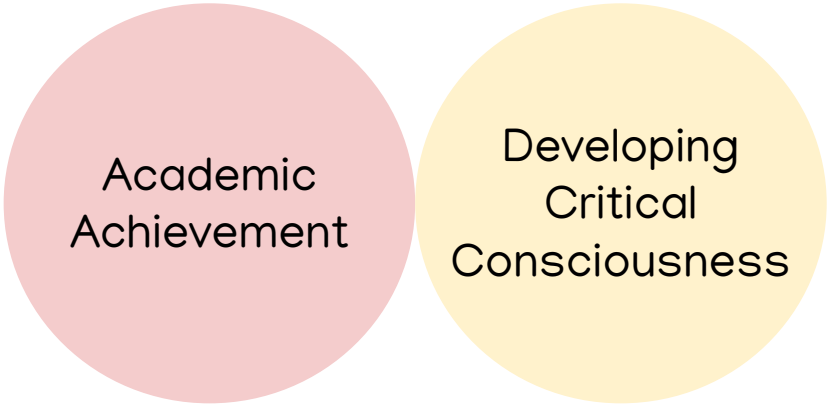
Honoring the social dimensions ordinarily omitted from scientific modeling helped students to meaningfully engage in the exercise and participate in ways they normally would not have.

Session 1, Francesca:
"just easier to read than having a bunch of scientific language that's just thrown at me"

Conducive to academic learning

Students having success with content and skills is necessary for youth to leverage their science education as a means to engage in transformative action

Academic achievement vs. students commitments to social change



Conducive to academic learning

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Sophisticated Reasoning Skills

Conducive to academic learning

Students having success with content and skills is necessary for youth to leverage their science education as a means to engage in transformative action

~~Academic achievement vs. students commitments to social change~~

Sophisticated Reasoning Skills

Conducive to academic learning

Students need to recognize the complexities and interdependencies of social and scientific issues through engaging in constructive dialogue with diverse perspectives.

Conducive to academic learning

Trinity Interview:

Um, I guess, um, like with labor shortage, um, [Tina] was kind of thinking of like quarantining and having, like, employees being sick. And I was kind of thinking of it more like, um, like a lot of places are hiring because they just don't have enough employees in general. So, I think there might have been like not disagreement, but we were just kind of thinking like from two different stances on that.

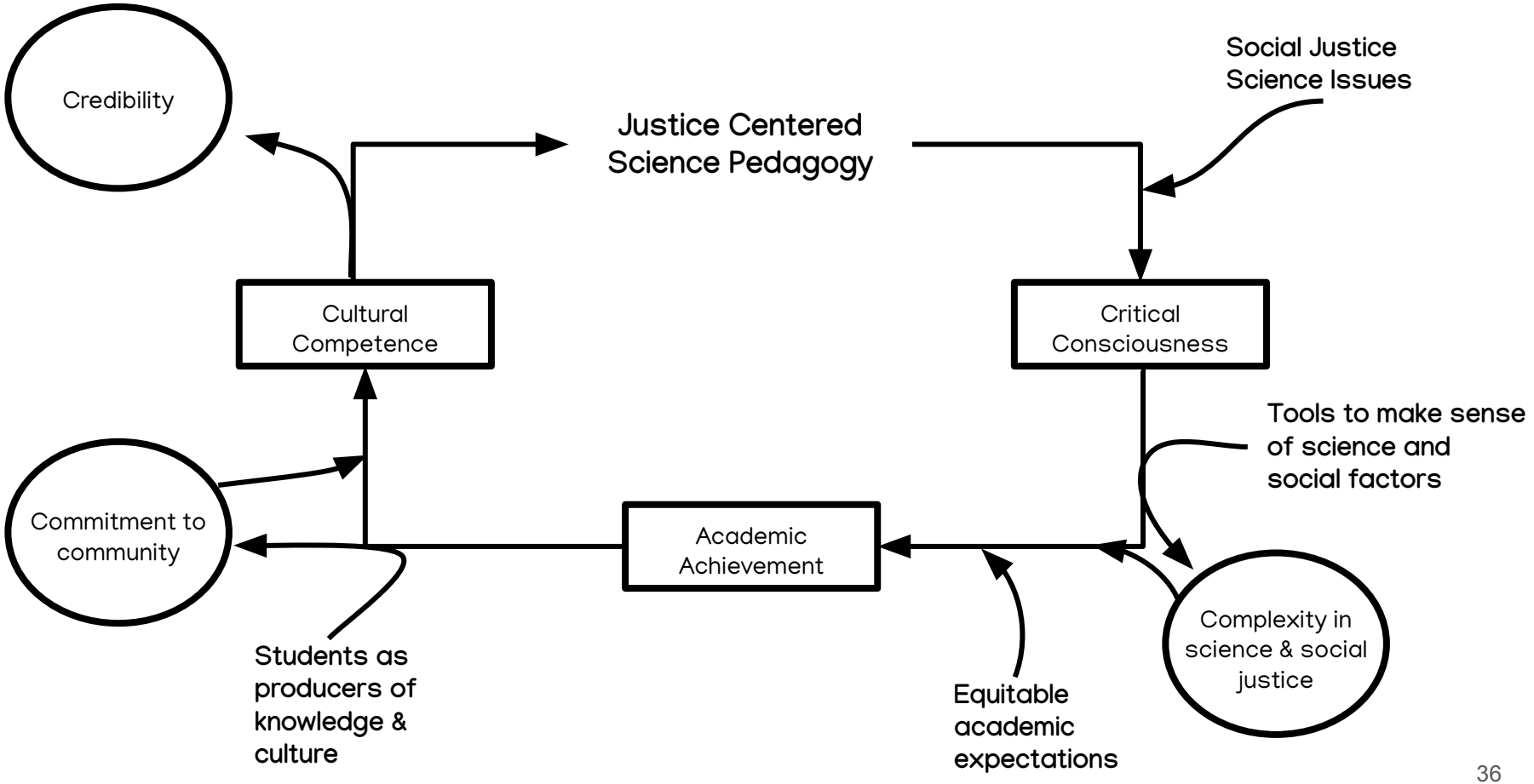
Um, we, um – I think we kind of more just looked at it from a, like, bigger lens, as opposed to like – like we kind of put labor shortage as just both of those things, instead of like narrowing it down to one.

Summary

Socioscientific Systems Modeling is one approach to broadening

- “Valid” contributions
- Ways students engage in modeling
- The goals of modeling experiences
- Allows students to see themselves in science content

- Appreciating the complexity of SJSI
- Constructing understandings that are personally meaningful
- Conducive to academic learning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Limitations

Small sample
Other intentional scaffolds such as engaging in discourse around equity-based content and uncovering power dynamics

Future Directions

By appreciating and drawing from the diverse resources students come to science classrooms with, educators can support students in ways that encourage them to take transformative action in ways that are personally meaningful.

Acknowledgments

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Paper & slides can be found at:
https://tarheels.live/seel/publications/conference-presentations/

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