Electronic Supplementary Material (ESI) for Chemistry Education Research and Practice.
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Appendices

Appendix 1. Dweck Mindset Instrument (DMI)

DWECK MINDSET INSTRUMENT (DMI)*

Please read each statement below and then indicate how much you agree with each sentence from 1 (strongly agree) to 6 (strongly disagree). There are no right or wrong answers.

1) You have a certain amount of intelligence in chemistry, and you really can't do much to change it.
2) Your intelligence in chemistry is something about you that you can't change very much.
3) No matter who you are, you can significantly change your intelligence level in chemistry.
4) To be honest, you can't really change how intelligent you are in chemistry.
5) You can always substantially change how intelligent you are in chemistry.
6) You can learn new things, but you can't really change your basic intelligence in chemistry.
7) This is a control question. Please select "Disagree, 5" as your response to this question.
8) No matter how much intelligence you have in chemistry, you can always change it quite a bit.
9) You can change even your basic intelligence level in chemistry considerably.

Items 1, 2, 4, 6 underlined are the "fixed" statements used to assess fixed mindset.
Items 3, 5, 8, 9 are the "growth" statements used to assess growth mindset.

*Modified version of DMI: In each statement, the word "chemistry" was added to specify that chemistry intelligence is what is being measured. In addition, a "control" statement was added.

Appendix 2. Chemistry Self-Efficacy (CSE) Instrument

CHEMISTRY SELF-EFFICACY INSTRUMENT

Please read each statement below and indicate how well you understand different areas of chemistry on a scale from 1 (very poorly) to 5 (very well).

1) To what extent can you explain chemical laws and theories?
2) How well can you choose an appropriate formula to solve a chemistry problem?
3) How well can you describe the properties of elements by using the periodic table?
4) How well can you read the formulas of elements and compounds?
5) How well can you interpret chemical equations?
6) How well can you interpret graphs/charts related to chemistry?

Appendix 3. Growth Mindset Modules Design Broken Down by Topics and Materials from Weeks 1 to 13

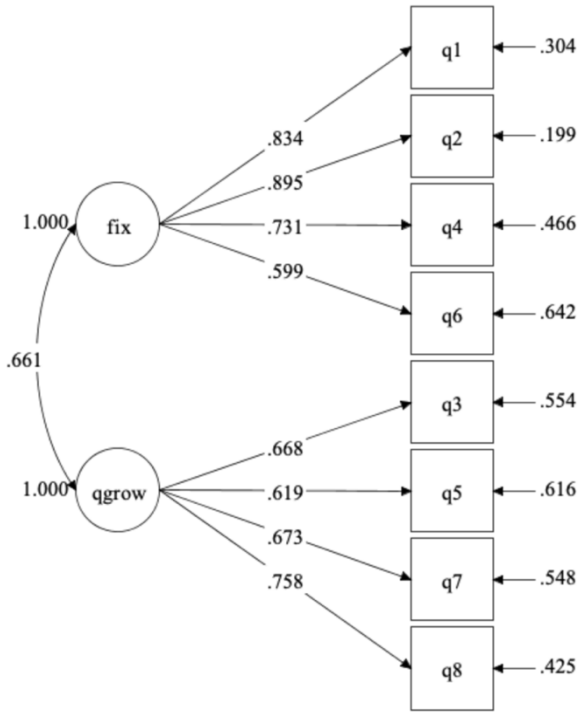
	Topics	Materials
Week 1	Neuroplasticity, learning and growth mindset	• DMI survey (pre) • Three videos ("Your Brain is Plastic," "The Working of the Adolescent Brain," "The Power of Belief") • Follow-up questions: o Briefly discuss your understanding of neurons. o Briefly discuss your understanding of synapses. o Briefly discuss your understanding of neuroplasticity. o Explain what the following statement means to you: "Learning is an active process." o How do you define intelligence? o Compare and contrast a growth vs. fixed mindset. o How do people with growth and fixed mindset view challenges and effort? o What do people with fixed mindset focus most on? What do people with growth mindset focus most on? • One reading passage ("Factors that Enhance Neuroplasticity") • Reflection questions o How does neuroplasticity connect to growth mindset? o How has your knowledge about growth and fixed mindsets changed your perception and motivation toward learning challenging topics in your major? o What was the most interesting or surprising part of the module, if any? Explain why it was interesting to you. o Do you plan on sharing your knowledge about neuroplasticity and growth mindsets with others? If so, how do you plan on sharing this knowledge?
Week 3	Learning from challenges –from failure to success	• Videos of interviews from CSUF faculty, alumni, graduate student, and undergraduate students from Department of Chemistry and Biochemistry sharing their experiences on how they overcame challenges in the context of teaching and learning chemistry. o The interviewees include one non-URM female, two URM males, and one non-URM male. o Sample Interview Questions: ▪ During the early stages of your career in chemistry, was there a particular time (or situation) you experienced set-backs or challenges? If so, when was this and what did you learn from this experience? How has this realization to grow (or improve) influence where you are currently in your job and life?

	▪ During your undergraduate career, was there a course in particular you struggled in? If so, what was this course and how did you overcome these challenges in this course? How did you feel while you were struggling? Did that feeling change as your success improved? • Follow-up questions: o Think back to a time when you were learning a challenging topic, skill, or task and answer the following questions. Briefly describe the learning challenge. What kind of strategies (or methods) did you use to help overcome this challenge? What were some lessons you learned about coping with challenges? • Reflection questions o After participating in Growth Mindset Modules (weeks 1, 3), how has your attitude and perception toward failure and challenge changed in this course? o After participating in Growth Mindset Modules (weeks 1, 3), what would you identify as some strengths in the modules? What improvements would you suggest for future Growth Mindset Modules? Please provide any additional comments or feedback. • DMI survey (post)
Week 13	• DMI survey (delayed post)

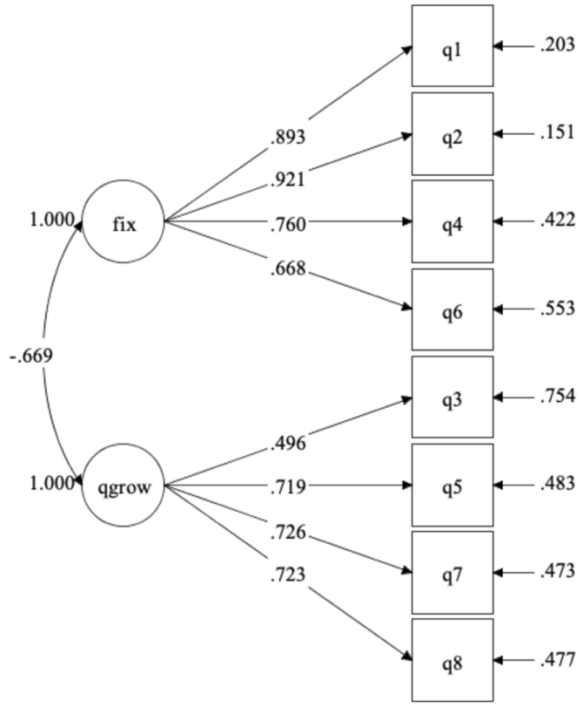
Appendix 4. Confirmatory Factor Analysis: Data Model Fit Indices for Dweck Mindset Instrument (DMI) and Chemistry Self-Efficacy (CSE)

		Final model		
Measure		**CFI**	**SRMR**	**RMSEA**
DMI	Week 1	0.888	0.053	0.108
	Week 3	0.908	0.047	0.090
	Week 13	0.915	0.052	0.092
CSE	Week 1	0.996	0.020	0.033
	Week 13	0.953	0.032	0.109

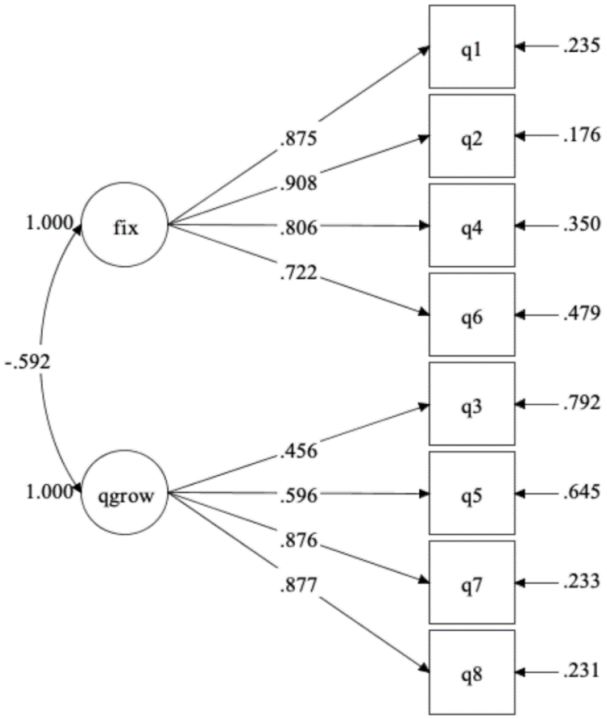
Appendix 5. Pre-DMI Model (Week 1)



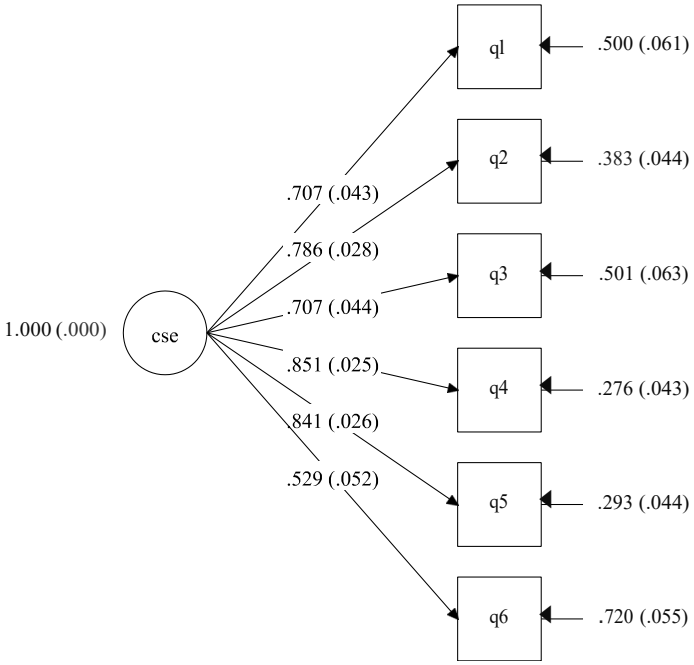
Appendix 6. Post-DMI Model (Week 3)



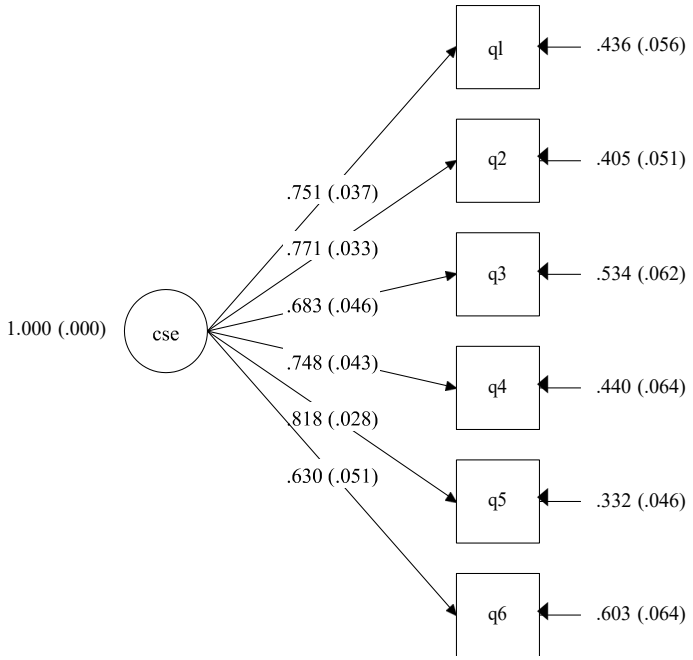
Appendix 7. Post-Delay DMI Model (Week 13)



Appendix 8. Pre-CSE Model (Week 1)



Appendix 9. Post-CSE Model (Week 13)



Appendix 10. Descriptive Statistics for Chemistry Self-Efficacy (CSE)

		CSE (Week 1)	CSE (Week 13)
GC1 (N = 107)	Mean	2.95	3.54
	SD	0.59	0.62
GC2 (N = 66)	Mean	3.34	3.54
	SD	0.57	0.6

Appendix 11. Paired Samples *t*-Test using Chemistry Self-Efficacy scores (CSE) between weeks 1 (pre) to 13 (post)

	Mean	*SD*	*T*	*df*	Cohen's *d*
GC1	0.59***	0.57	10.7	106	0.97
GC2	0.19**	0.47	3.3	65	0.34

**$p < 0.01$, ***$p < 0.001$

Cohen's d effect sizes: small (0.2), medium (0.5), large (0.8)

Appendix 12. Summary of themes from students' responses to their attitudes and perceptions towards failures and challenges (Week 3) for GC1 and GC2. Additional examples of student quotations for each theme that were not presented in results section.

Theme	Description
Acceptance	Indications of development of positive outlook/ mindset on failures and challenges (viewing them as opportunity or using them as motivation/ encouragement) Indications of accepting failures and challenges as part of learning and a willingness to persist and overcome challenges. *"I think failure and challenge as having a less negative connotation and necessary tools to learn* better". (*GC1)* *"I've become more positive about failure and challenges. Failure should not set me back, instead it should motivate me to work harder." (GC2)*
Essential Characteristics	Indications of students realizing the key characteristics needed to overcome challenges (e.g., having self-belief, determination, self-assurance, hard work, persistence, and strategic practice) *"I know I can power through challenges" (GC2)* *"I know I can do it" (GC1)*
Behavioral	Indications of planning/ implementing new approaches/ actions when encountering failures and challenges. *"I keep trying and asking for help when needed." (GC1)* *"I don't put as much pressure on myself to know the content right then and there, but challenge myself to figure out what I need to focus and study more about" (GC1)*
Neutral	Indications of unchanged perception/attitude *"My mindset has stayed the same" (GC2)* *"it didn't change but rather enhanced my understanding of failure and challenges" (GC2)*

Appendix 13. Summary of themes and subthemes from students' responses to feedback of GMMs (Week 3) for GC1 and GC2. Additional examples of student quotations for each theme and code that were not presented in results section.

Theme	Sub-theme	Description
Areas of Strengths	Resources	Students appreciate articles, videos, and outside resources provided. *"The strengths in these workshops were the videos that were provided" (GC1)* *"The TED talk was really useful and informative. I shared it with several people I know. It was also nice to see alumni and current masters students talk about their experiences"(GC1)*
	Development of new perspectives	Students gain positive experiences, perspectives, mindsets, and ideas *"It shows people [it's] possible and shows people that things get frustrating at times is normal and a thing everyone has to deal with" (GC2)* *"The strengths in these workshops are that it can really help someone not be afraid to face a challenge and to know you are always learning no matter what"(GC2)*
	Content	Students appreciate the type of information presented and the structure workshop *"Some strengths in these workshops would be the actual data that was pulled from real people and not just hypothesis" (GC2)* *"I would say the videos we watched from different students to see their experience and what*

		they think because they are within our age group so they experience similar things" (GC1)
Areas of Improvement	Interaction	Students request for more interactive activities. *"Improvements can be made by having more engaging tasks" (GC1).* *"Improvements can be made by having more interactive workshops or physical ones to attend" (GC1),*
	Modification	Students request for modifying content of workshops by adding more information about growth-mindset and/or specific assignments that help them practice growth mindset *"I think there needs to be more assignments that involves putting these ideas into practice" (GC2)* *"It would be nice to hear more stories of perseverance because it is very helpful to hear success stories" (GC1)*
Neutral		No suggestions or improvements needed *"No further comments or improvements" (GC1)* *"No improvement ideas at the moment" (GC1)*