Appendix

Analysis of students' self-efficacy, interest, and effort beliefs in general chemistry

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Scales and Demographic Items

Initial Interest Scale

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
A	B	C	D	E

II 1. I am fascinated by chemistry.   A   B   C   D   E

II 2. I chose to take general chemistry because I'm really
     interested in the topic.   A   B   C   D   E

II 3. I am really excited about taking this class   A   B   C   D   E

II 4. I am really looking forward to learning more about chemistry.   A   B   C   D   E

II 5. I think the field of chemistry is an important discipline.   A   B   C   D   E

II 6. I think that what we will study in General Chemistry will be
     important for me to know.   A   B   C   D   E

II 7. I think that what we will study in General Chemistry will be
     worthwhile for me to know.   A   B   C   D   E

Maintained Interest Scale

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
A	B	C	D	E

MI 1. What we are learning in chemistry class this semester is fascinating to me.   A   B   C   D   E

MI 2. This semester, I really enjoy the chemistry material we cover in class.   A   B   C   D   E

MI 3. I am excited about what we are learning in chemistry class this semester.   A   B   C   D   E

MI R4. To be honest, I don't find the chemistry material we cover in class interesting.   A   B   C   D   E

MI 5. What we are studying in chemistry class is useful for me to know.   A   B   C   D   E

MI 6. The things we are studying in chemistry this semester are important to me.   A   B   C   D   E

MI 7. What we are learning in chemistry this semester is important for my future goals.   A   B   C   D   E

MI 8. What we are learning in chemistry this semester can be applied to real life.   A   B   C   D   E

Self-Efficacy Scale

Very Poorly	Poorly	Average	Well	Very Well
A	B	C	D	E

SE 1. To what extent can you explain chemical laws and theories?   A   B   C   D   E

SE 2. How well can you choose an appropriate formula to solve a
    chemistry problem?   A   B   C   D   E

SE 3. How well can you describe the structure of an atom?   A   B   C   D   E

SE 4. How well can you describe the properties of elements by
    using the periodic table?   A   B   C   D   E

SE 5. How well can you read the formulas of elements and compounds?   A   B   C   D   E

SE 6. How well can you interpret chemical equations?   A   B   C   D   E

SE 7. How well can you interpret graphs/charts related to chemistry?   A   B   C   D   E

SE 8. How well can you solve chemistry problems?   A   B   C   D   E

Effort Beliefs Scale

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
A	B	C	D	E

EB 1R*. To tell the truth, when I work hard at chemistry, it makes me
    feel like I'm not very smart   A   B   C   D   E

EB 2R*. It doesn't matter how hard you work if you're not smart in
    chemistry, you won't do well in it.   A   B   C   D   E

EB 3R*. If you're not good at chemistry, working hard won't make you good at it.   A   B   C   D   E

EB 4R*. If chemistry is hard for someone, it means that he or she probably won't
    be able to do really well at it.   A   B   C   D   E

EB 5R*. If you're not doing well at chemistry, it's better to try something easier.   A   B   C   D   E

EB 6. When chemistry is hard, it just makes me want to work more on it, not less.   A   B   C   D   E

EB 7. If you don't work hard at chemistry and put in a lot of effort,
    you probably won't do well.   A   B   C   D   E

EB 8. The harder you work at chemistry, the better you will be at it.   A   B   C   D   E

EB 9. If a chemistry assignment is hard, it means I'll probably learn a lot doing it.   A   B   C   D   E

*R indicates item must be reverse-coded prior to analysis

Demographics

D1. Gender :   **A**- Male   **B** - Female

D2. Age : **A** - <18   **B** – 18-20   **C** – 21-23   **D** – 24-25   **E** - >25

D3. How many years have you been in college?

   A – This is my first semester   **B** – 1 yr.   **C** – 2 yrs.   **D** – 3 yrs.   **E** - >3 yrs.

D4. Is this your first chemistry class in college?   **A** - Yes   **B** - No

D5. How long ago did you take high school chemistry?

   A – I did not take chemistry in high school

   B – 1 yr. ago   **C** – 2 yrs. ago   **D** – 3 yrs. ago   **E** - > 3 yrs. ago

D6. What is your declared major?

   A – Chemistry (including Forensics, Biochemistry, Teaching, or Pre-Health)

   B – Other Science (Biology, Physics, or Mathematics)

   C – Other (including Sports & Exercise Science, Nursing, Earth Science, Statistics)

   D – Undeclared

D7. Would you be willing to participate in a 30-minute interview regarding your interest, effort beliefs, and self-efficacy about chemistry? These interviews help us to further understand your responses and how the items make sense to you so we can make improvements to the questionnaire.

A - YES   B - NO

Table 1. Time 1 item-level descriptive statistics for initial sample ($n = 373$)

Item	Mean	Std. Dev.	Skew	Kurtosis
II1	3.59	0.95	-0.31	-0.33
II2	3.09	1.07	0.06	-0.68
II3	3.40	0.94	-0.10	-0.23
II4	3.81	0.86	-0.67	0.46
II5	3.97	0.79	-0.73	1.14
II6	4.11	0.88	-1.20	1.82
II7	4.09	0.81	-0.98	1.51
EB1R	3.21	1.15	-0.24	-0.77
EB2R	3.96	0.92	-0.86	0.45
EB3R	4.19	0.79	-1.15	2.07
EB4R	3.92	0.87	-0.90	0.76
EB5R	3.87	0.78	-0.44	-0.04
EB6	3.48	1.03	-0.52	-0.34
EB7	4.07	0.80	-1.10	1.98
EB8	4.22	0.76	-1.36	3.54
EB9	3.57	0.84	-0.25	-0.10
SE1	2.47	0.86	-0.04	-0.53
SE2	2.63	0.93	-0.04	-0.53
SE3	3.14	1.04	-0.01	-0.53
SE4	3.16	0.95	-0.15	-0.45
SE5	3.12	0.95	-0.04	-0.21
SE6	2.91	0.92	-0.08	-0.23
SE7	3.16	0.86	-0.14	0.16
SE8	2.94	0.89	-0.26	-0.14

II – Initial interest, EB – Effort beliefs, SE – Self-efficacy, R – indicates item has been reverse-coded

Table 2. Time 2 descriptive statistics for maintained interest items with initial sample ($n = 294$)

Item	Mean	Std. Dev.	Skew	Kurtosis
MI 1	3.32	.97	-.26	-.16
MI 2	3.23	.96	-.11	-.36
MI 3	3.15	.93	-.02	-.16
MI R4	3.20	1.15	-.24	-.96
MI 5	3.73	.96	-.50	-.23
MI 6	3.37	.97	-.18	-.29
MI 7	3.75	1.07	-.67	-.28
MI 8	3.56	.94	-.23	-.29

MFeel – Maintained interest (feeling), MVal – Maintained interest (value),
R – indicates item has been reverse-coded

Table 3. Mean scores and differences between chemistry majors and non-science majors on interest scales for the cross-validation study sub-sample

Scale	Chemistry majors $n = 23$ Mean score (SD)	Non-science majors $n = 109$ Mean score (SD)	Mean difference[a] (effect size[b])	*p*-value
Initial interest (feeling)	3.88 (0.75)	2.98 (0.83)	0.90 (0.70)	< 0.001
Initial interest (value)	4.50 (0.52)	3.67 (1.07)	0.83 (0.56)	<0.001
Maintained interest (feeling)	3.80 (0.85)	2.99 (0.92)	0.81 (0.56)	<0.001
Maintained interest (value)	3.85 (0.80)	3.30 (0.82)	0.55 (0.45)	0.004

[a]Based on planned contrasts [b]Effect size represented by *Cohen's d* – small (0.20), medium (0.50), large (0.80) (Cohen, 1992)

CFA model diagrams

The figures below show the revised models for each scale for each time point. In the following figures, indicators are represented with a boxed border and latent variables are represented with an oval border. Error terms are represented by arrows pointing toward the indicators. The factor loadings are the numbers between the latent variables and the indicators. Correlations between latent variables are indicated by the number next to the double arrows in between two factors.
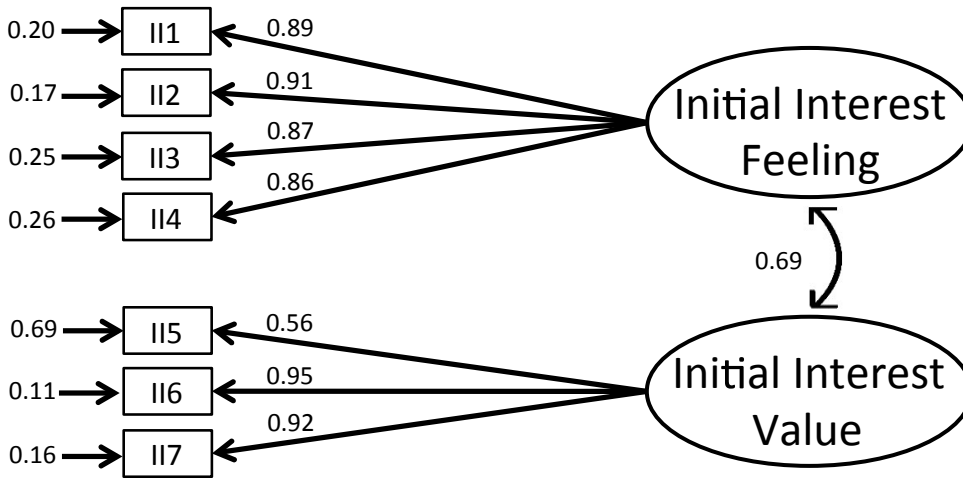
Figure 1. Time 1 initial interest CFA model for initial sample (n = 373)
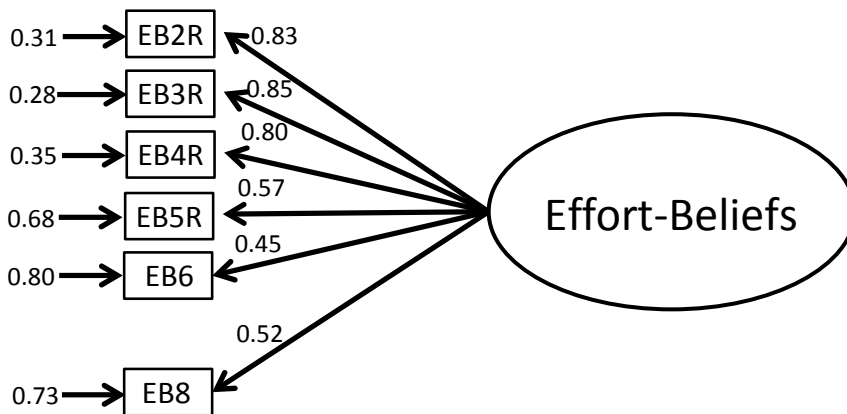
Figure 2. Time 1 effort beliefs CFA model for initial smaple (n = 373)
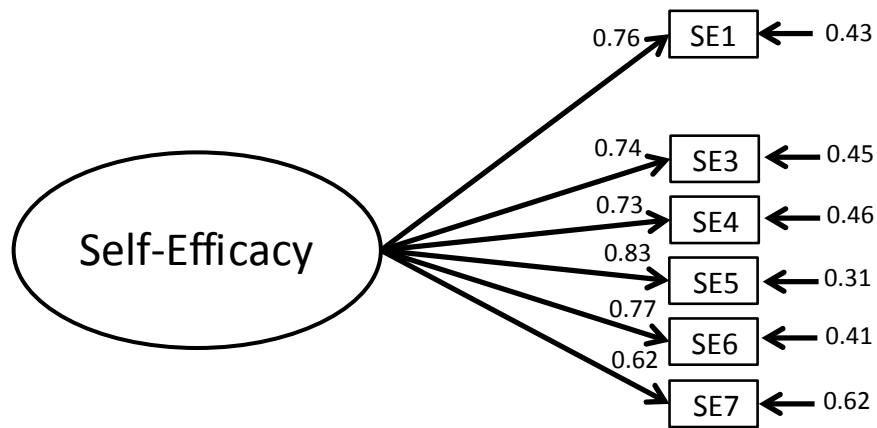
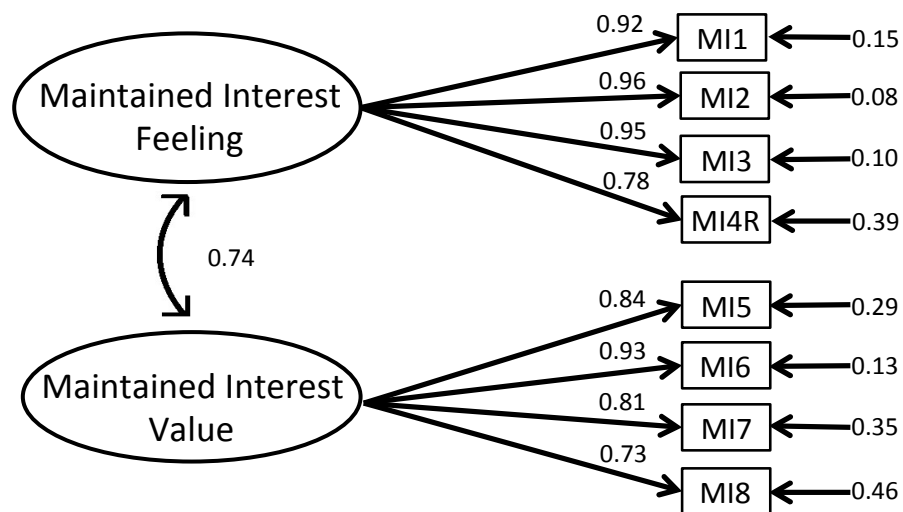**Figure 3.** Time 1 self-efficacy CFA model for initial sample (n = 373)

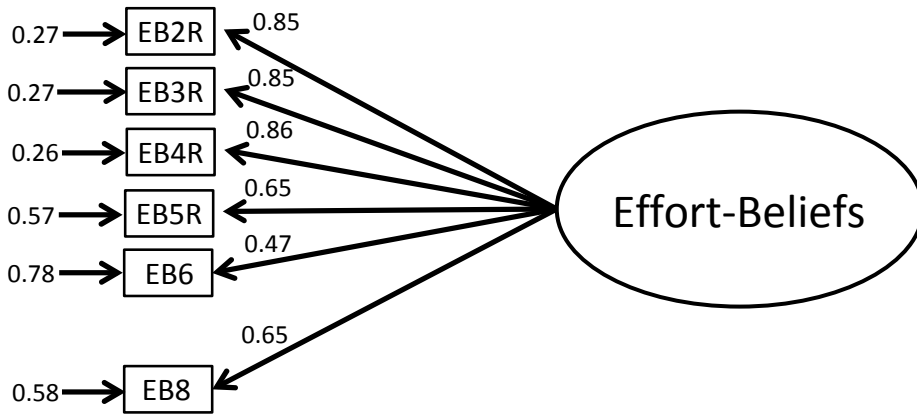**Figure 4.** Time 2 maintained interest CFA model for initial sample (n = 294)

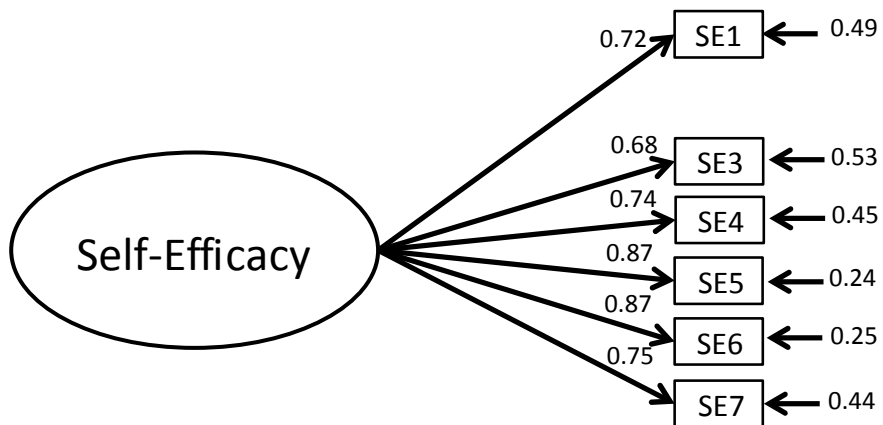**Figure 5.** Time 2 effort beliefs CFA model for initial sample (n = 294)

Figure 6. Time 2 self-efficacy CFA model for initial sample (n = 294)