Electronic Supplementary Material (ESI) for Chemistry Education Research and Practice.
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Appendix 1. Survey items for measuring six types of values

Intrinsic Value
1. I enjoy learning chemistry.
2. I find many topics in chemistry to be interesting.
3. Chemistry fascinates me.
4. I am interested in solving chemistry problems.

Social Value
1. Learning chemistry can help us make economic and social progress.
2. Learning chemistry can help humans keep healthy.
3. Learning chemistry can help us protect the environment and achieve sustainable development.
4. Learning chemistry can help improve our quality of life.
5. Learning chemistry can help provide us new materials and energy sources.

Utility Value
1. I need chemistry to learn other school subjects.
2. I think learning chemistry will help me get good grades in exams.
3. Learning chemistry will benefit my choice of university major in the future.
4. Learning chemistry will give me more job opportunities.
5. I think learning chemistry will help me solve problems in my daily life.

Epistemic Value
1. Learning chemistry help me think rigorously.
2. Learning chemistry can increase my safety awareness.
3. Learning chemistry can develop my creativity.
4. Learning chemistry can strengthen my scientific inquiry skills.
5. Learning chemistry help me make inferences informed by evidence.
6. Learning chemistry help me how to examine the scientific basis behind phenomena.
7. Learning chemistry help me treat thing critically.
8. Learning chemistry enable me to participate in the discussion and practice of related societal issues.
9. Learning chemistry enable me to solve problems through identifying patterns and applying principles.

Attainment Value
1. Getting high grades in chemistry is important to me.
2. Understanding the subject content of chemistry is important to me.
3. Doing well in chemistry can fulfill parents' expectations.
4. If I do well in chemistry, I can help my classmates with a sense of fulfilment.
5. It is worthwhile to spend effort in doing well in chemistry.

Aesthetic Value
1. When learning chemistry, I can feel the beauty of rationality.
2. When learning chemistry, I can feel the beauty of conservation.
3. When learning chemistry, I can feel the beauty of diverse phenomena.
4. When learning chemistry, I can feel the beauty of symmetry.

Note: Colors representing different types of values were matched with colors in MDS maps.

Appendix 2. Survey items for measuring cost

1. Doing well in chemistry requires more effort than I want to put into it.
2. I have to give up other activities that I like to do well in chemistry.
3. I have to sacrifice a lot of free time to be good at chemistry.
4. When learning chemistry, I loss more than I gain.
5. Chemistry exams scare me.
6. Studying chemistry makes me feel stress.
7. Teachers or parents would be disappointed in me if I performed poorly in chemistry.
8. Others would think I am incompetent if I get low grades in chemistry.

Appendix 3. Confirmatory factor analysis output for value items

Factors	Items	Standardized loading estimates	S.E.
Intrinsic Value (IV)	IV1	0.939	0.010
	IV2	0.911	0.012
	IV3	0.926	0.016
	IV4	0.876	0.017
Utility Value (UV)	UV1	0.694	0.056
	UV2	0.623	0.045
	UV3	0.863	0.045
	UV4	0.848	0.048
	UV5	0.621	0.063
Attainment Value (AtV)	AtV1	0.734	0.041
	AtV2	0.815	0.028
	AtV3	0.615	0.041
	AtV4	0.688	0.034
	AtV5	0.687	0.043
Aesthetic Value (AeV)	AeV1	0.855	0.032
	AeV2	0.821	0.034
	AeV3	0.944	0.013
	AeV4	0.870	0.027
Epistemic Value (EV)	EV1	0.877	0.016
	EV2	0.792	0.031
	EV3	0.823	0.029
	EV4	0.878	0.020
	EV5	0.860	0.023
	EV6	0.870	0.019
	EV7	0.833	0.026
	EV8	0.751	0.028
	EV9	0.810	0.026
Social Value (SV)	SV1	0.786	0.032
	SV2	0.839	0.032
	SV3	0.916	0.020
	SV4	0.904	0.034
	SV5	0.909	0.019

Appendix 4. Hierarchical multiple regression output for significant variables predicting chemistry achievement

Variable	B	SE	β	*p*
Step 1				
Age	.328	.086	.177	.000
Female	-.760	.126	-.283	.000
Step 2				
Age	.212	.078	.115	.007
Female	-.477	.115	-.177	.000
Intrinsic Value	.342	.046	.347	.000
Cost	-.259	.055	-.196	.000
Social Value	.121	.062	.087	.051
Step 3				
Age	.247	.078	.134	.002
Female	-.467	.114	-.174	.000
Intrinsic Value	.338	.045	.344	.000
Cost	-.250	.055	-.189	.000
Social Value	.267	.081	.191	.001
Social Value × Female	-.305	.109	-.155	.005

Note: $R^2 = 0.124$ for Step 1; $\Delta R^2 = 0.197$ for Step 2; $\Delta R^2 = 0.013$ for Step 3.