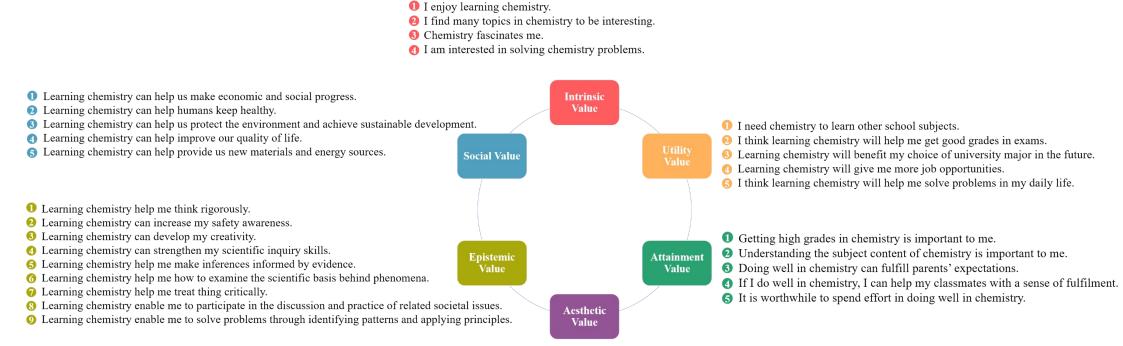
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Appendix 1. Survey items for measuring six types of values



When learning chemistry, I can feel the beauty of rationality.
When learning chemistry, I can feel the beauty of conservation.
When learning chemistry, I can feel the beauty of diverse phenomena.

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

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

Variable	В	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.