

Electronic Supplementary Information (ESI)

for

**Exploring Factors within an Introductory Course that Influence
Students' Perception of Chemistry**

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Modified Attitudes Towards Science Inventory (mATSI) as distributed to students.

IRB Protocol #: **207611431**

C. Eugene Bennett Department of Chemistry

Dear Prospective Participant,

This letter is a request for you to participate in a research project geared towards determining students' perceptions of science fields. This project is being conducted by Oluwatobi Odeleye, PhD, in the Department of Chemistry at WVU.

If you decide to participate, you will be asked to complete the survey that follows, which asks about your perceptions of science fields. Your participation in this project will take approximately 5 -10 minutes. You must be 18 years of age or older to participate. You may receive extra credit points at the discretion of your instructor. Your participation in this project will be kept confidential, and your instructors will not access your responses until final grades have been submitted. Your participation is entirely voluntary. You may skip any question that you do not wish to answer, and you may discontinue at any time. As a student, your class standing, grades, student work status, or status on an athletic team, if applicable, will not be affected if you decide not to participate or withdraw.

The West Virginia University Institutional Review Board's review of this research project is on file with the WVU Office of Human Research Protections. If you have any questions about this research project, please feel free to contact me at oluwatobi.odeleye@mail.wvu.edu. If I am your instructor, then please contact Nghiem Tieu (nut00001@mix.wvu.edu) or the WVU Office of Human Research Protections at 304-293-7073. I hope that you will participate in this research project, as it could help us better understand your perceptions of science and the factors that influence them. This in turn can help us improve our general chemistry program here at WVU. Thank you for your time and consideration.

Sincerely,
Oluwatobi O. Odeleye

By answering the survey questions, I agree to participate in this research and provide a response to all questions asked. Please print this page for your records. Please select one of the choices below.

- I agree to participate
- I do not agree to participate

End of Block: Block 4

Start of Block: Default Question Block

Q13 What is your mixID number (e.g. 800XXXXXX)? This is for your extra credit, so please enter this correctly.

Q83 Please select your course:

- Fundamentals of Chemistry 1 (CHEM 115)
- Fundamentals of Chemistry 2 (CHEM 116)

Q27 How has your perception of **science** in general changed since you have been in your current chemistry class?

- It has not changed
- It has become more positive
- It has become more negative

Q28 After taking your general chemistry course this semester, which of the following has influenced your perception of **science** this semester?

- The course instructor
 - The lab TA/instructor
 - Other science courses you are taking this semester
 - Other science instructors
 - The course structure (including course content and exams)
 - Other (please provide a specific answer)
-
- My perception has stayed the same.

Q29 How has your perception of **chemistry** changed since you have been in your current chemistry class?

- It has not changed
 - It has become more positive
 - It has become more negative
-

Q30 After taking your general chemistry course this semester, which of the following has influenced your perception of **chemistry** this semester?

- The course instructor
 - The lab TA/instructor
 - Other science courses you are taking this semester
 - Other science instructors
 - The course structure (including the course content and exams)
 - Other (please provide a specific answer)
-
- My perception has stayed the same.

Q31 As a result of taking this course...

- I believe I can do well in science courses
- I believe I cannot do well in science courses
- This course has not influenced my belief in myself

Q32 As a result of taking this course...

- I am not interested in pursuing a career in science
 - I am interested in pursuing a career in science
 - This course has not influenced my desire to pursue a career in science
-

Q34 As a result of taking this course...

- I believe I can do well in other chemistry courses
 - I believe I cannot do well in other chemistry courses
 - This course has not influenced my belief in myself
-

Q35 As a result of taking this course...

- I am not interested in pursuing a career in chemistry
 - I am interested in pursuing a career in chemistry
 - This course has not influenced my desire to pursue a career in chemistry
-

Q36 Are there any other factors you believe have influenced your perception of science fields? If yes, please explain below.

Q37 Are there any other factors you believe have influenced your perception of the field of chemistry? If yes, please explain below.

Q41 For the following statements, select what best describes your feeling about the field of science.

Survey questions based on Modified Attitudes Towards Science Inventory

Q14 What is your year in school?

- Freshman
 - Sophomore
 - Junior
 - Senior
 - Other
-

Q27 Science is useful in helping to solve the problems of everyday life

- Strongly agree
 - Agree
 - Somewhat agree
 - Neither agree nor disagree
 - Somewhat disagree
 - Disagree
 - Strongly disagree
-

Q31 Science is helpful in understanding today's world

- Strongly agree
 - Agree
 - Somewhat agree
 - Neither agree nor disagree
 - Somewhat disagree
 - Disagree
 - Strongly disagree
-

Q35 Science is of great importance to a country's development.

- Strongly agree
 - Agree
 - Somewhat agree
 - Neither agree nor disagree
 - Somewhat disagree
 - Disagree
 - Strongly disagree
-

Q45 Most people should study some science

- Strongly agree
 - Agree
 - Somewhat agree
 - Neither agree nor disagree
 - Somewhat disagree
 - Disagree
 - Strongly disagree
-

Q46 It is important to know science in order to get a good job

- Strongly agree
 - Agree
 - Somewhat agree
 - Neither agree nor disagree
 - Somewhat disagree
 - Disagree
 - Strongly disagree
-

Q28 Science is something I enjoy very much

- Strongly agree
 - Agree
 - Somewhat agree
 - Neither agree nor disagree
 - Somewhat disagree
 - Disagree
 - Strongly disagree
-

Q47 I enjoy reading science content that has not been assigned to me, or is not a part of a course I am taking.

- Strongly agree
 - Agree
 - Somewhat agree
 - Neither agree nor disagree
 - Somewhat disagree
 - Disagree
 - Strongly disagree
-

Q52 Please select "somewhat disagree"

- Strongly agree
 - Agree
 - Somewhat agree
 - Neither agree nor disagree
 - Somewhat disagree
 - Disagree
 - Strongly disagree
-

Q37 I look forward to taking science classes

- Strongly agree
 - Agree
 - Somewhat agree
 - Neither agree nor disagree
 - Somewhat disagree
 - Disagree
 - Strongly disagree
-

Q48 I like the challenge of science assignments

- Strongly agree
 - Agree
 - Somewhat agree
 - Neither agree nor disagree
 - Somewhat disagree
 - Disagree
 - Strongly disagree
-

Q41 I have a real desire to learn science

- Strongly agree
 - Agree
 - Somewhat agree
 - Neither agree nor disagree
 - Somewhat disagree
 - Disagree
 - Strongly disagree
-

Q49 It is important to me to understand the work I do in my science classes

- Strongly agree
 - Agree
 - Somewhat agree
 - Neither agree nor disagree
 - Somewhat disagree
 - Disagree
 - Strongly disagree
-

Q29 When I hear the word "science", I have a feeling of dislike.

- Strongly agree
 - Agree
 - Somewhat agree
 - Neither agree nor disagree
 - Somewhat disagree
 - Disagree
 - Strongly disagree
-

Q53 Please select "neither agree nor disagree"

- Strongly agree
 - Agree
 - Somewhat agree
 - Neither agree nor disagree
 - Somewhat disagree
 - Disagree
 - Strongly disagree
-

Q34 I feel tense when someone talks to me about science

- Strongly agree
 - Agree
 - Somewhat agree
 - Neither agree nor disagree
 - Somewhat disagree
 - Disagree
 - Strongly disagree
-

Q38 It makes me nervous to even think about doing science

- Strongly agree
 - Agree
 - Somewhat agree
 - Neither agree nor disagree
 - Somewhat disagree
 - Disagree
 - Strongly disagree
-

Q39 It scares me to have to take a science class

- Strongly agree
 - Agree
 - Somewhat agree
 - Neither agree nor disagree
 - Somewhat disagree
 - Disagree
 - Strongly disagree
-

Q36 I have a good feeling towards science classes

- Strongly agree
 - Agree
 - Somewhat agree
 - Neither agree nor disagree
 - Somewhat disagree
 - Disagree
 - Strongly disagree
-

Q30 Science is easy for me

- Strongly agree
 - Agree
 - Somewhat agree
 - Neither agree nor disagree
 - Somewhat disagree
 - Disagree
 - Strongly disagree
-

Q42 I do not do very well in science classes

- Strongly agree
 - Agree
 - Somewhat agree
 - Neither agree nor disagree
 - Somewhat disagree
 - Disagree
 - Strongly disagree
-

Q50 I usually understand what we are talking about in my science classes

- Strongly agree
 - Agree
 - Somewhat agree
 - Neither agree nor disagree
 - Somewhat disagree
 - Disagree
 - Strongly disagree
-

Q32 No matter how hard I try, I cannot understand science

- Strongly agree
 - Agree
 - Somewhat agree
 - Neither agree nor disagree
 - Somewhat disagree
 - Disagree
 - Strongly disagree
-

Q51 I often think, "I cannot do this", when a science assignment seems hard.

- Strongly agree
 - Agree
 - Somewhat agree
 - Neither agree nor disagree
 - Somewhat disagree
 - Disagree
 - Strongly disagree
-

Q54 Science teachers make science courses interesting

- Strongly agree
 - Agree
 - Somewhat agree
 - Neither agree nor disagree
 - Somewhat disagree
 - Disagree
 - Strongly disagree
-

Q55 Science teachers typically present the course material in a clear and understandable way

- Strongly agree
 - Agree
 - Somewhat agree
 - Neither agree nor disagree
 - Somewhat disagree
 - Disagree
 - Strongly disagree
-

Q56 Science teachers are willing to give their students individual help

- Strongly agree
 - Agree
 - Somewhat agree
 - Neither agree nor disagree
 - Somewhat disagree
 - Disagree
 - Strongly disagree
-

Q15 What is your major?

- Pre-Professional (e.g. pre-med, pre-vet, etc.)
 - Engineering
 - Physical Science (e.g. chemistry, physics, mathematics, geology, astronomy)
 - Biological Science (including Biology)
 - Allied Health (e.g. nursing, PA, etc.)
 - Education
 - Other _____
-

Q9 What is your gender?

- Female
 - Male
 - Other _____
-

Q25 What is your ethnicity?

- Asian
- Black/African
- Caucasian
- Hispanic/Latinx
- Native American
- Pacific Islander
- Mixed Race

Prefer not to answer

CFA and EFA Analyses

Regarding the CFA we used goodness of fit indices to evaluate the model. Based on the literature, the CFI and TLI cut-off scores should be above 0.9. We got a CFI value of 0.930, and a TLI value of 0.916, which are indications of good fit indices for the internal validity.

The value of RMSEA is 0.072, and SRMR is 0.049, which is a little above the cut-of score of .05. All of the estimate coefficients loadings are significant and all variances have a positive sign which is good.

Latent Variables:

	Estimate	Std.Err	z-value	P(> z)
f1 (Desire) =~				
i_enjoy	1.000			
i_look	0.983	0.042	23.394	0.000
i_challeg	0.983	0.055	17.882	0.000
i_desire	0.990	0.047	21.266	0.000
i_good	1.003	0.044	22.671	0.000
f2 (Value) =~				
i_use	1.000			
i_help	0.766	0.055	13.916	0.000
i_import	0.616	0.050	12.401	0.000
f3 (Teacher)=~				
i_prsent	1.000			
i_will	0.582	0.059	9.871	0.000
i_intrest	0.887	0.069	12.840	0.000
f4 (Self-Efficacy) =~				
i_notwell	1.000			
i_try	0.991	0.061	16.149	0.000
i_easy	-1.020	0.065	-15.723	0.000
i_talk	-0.833	0.051	-16.223	0.000
i_hard	1.153	0.084	13.760	0.000
f5 (Anxiety) =~				
i_tense	1.000			
i_nerve	1.340	0.092	14.639	0.000
i_scare	1.420	0.101	14.052	0.000

Chi square value (X²) – 466.725, df=142, p-value = 0.000

F1 – Cronbach alpha – 0.908

F2 – 0.771

F3 – 0.724

F4 – 0.850

F5 – 0.811

DESIRE

Science is something I enjoy very much

I look forward to taking science classes

I like the challenge of science assignments

I have a real desire to learn science

I have a good feeling towards science classes

ANXIETY

I feel tense when someone talks to me about science
 It makes me nervous to even think about doing science
 It scares me to have to take a science class
SELF EFFICACY
 Science is easy for me
 I do not do very well in science classes
 I usually understand what we are talking about in my science classes
 No matter how hard I try, I cannot understand science
 I often think, "I cannot do this", when a science assignment seems hard.

Omega
 omega(m = CFA_pre_om, nfactors = 5)
 Alpha: 0.92
 G.6: 0.94
 Omega Hierarchical: 0.76
 Omega H asymptotic: 0.8
 Omega Total 0.95

With eigenvalues of:
 g F1* F2* F3* F4* F5*
 6.14 1.26 0.74 0.99 1.30 1.01

The degrees of freedom for the model is 86 and the fit was 0.48

The number of observations was 448 with Chi Square = 210.6 with prob < 0

The root mean square of the residuals is 0.04
 The df corrected root mean square of the residuals is 0.06

RMSEA and the 0.9 confidence intervals are 0.057 0.047 0.067
 BIC = -314.41 Explained Common Variance of the general factor = 0.54

Total, General and Subset omega for each subset
 g F1* F2* F3* F4* F5*
 Omega total for total scores and subscales 0.95 0.9 0.85 0.82 0.77 0.73
 Omega general for total scores and subscales 0.76 0.6 0.64 0.42 0.19 0.25
 Omega group for total scores and subscales 0.12 0.3 0.21 0.41 0.59 0.48