Critical Thinking About Critical Thinking

FLC 2023-24
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In the Beginning. . .

We wrestled with overall questions such as:

***What is Thinking v. Critical Thinking?**

***Clearly indicated in syllabi and assignment instruction?**

***What do students think critical thinking is?**

***How are we assessing it?**

***Evidence-based, effective ways to teach critical thinking?**

Discussions

***Rubrics in the literature vs. our own**

***What is a "good" question to stimulate students' critical thinking?**

***Effective vocabulary to frame open-ended discussions & written work**

***Models of inquisitive, critical thinking behavior**

Digging in. . .

In-depth presentations by each member on their specific assignments and classroom exercises around critical thinking to prep for and practice skills of critical thinking in discussion and written work.

Caveat:

Students' expectations that they can please instructor with one "correct" answer

Bindu Abraham

DEPARTMENT OF CHEMISTRY AND BIOCHEMISTRY
CHEM 102L
FRESHMAN, SOPHOMORE MIX
(>350 STUDENTS FALL, >160 STUDENTS SPRING)

ABOUT THE COURSE

The laboratory course intends to acquaint students with common laboratory practices for investigating chemical systems. You will observe the chemical phenomena described in the General Chemistry Classes (CHEM 101 and CHEM 102) firsthand.

LEARNING OBJECTIVES OF THE LAB COURSE

Purpose of the steps and procedures in the experiments, both practically and in how the procedure relates to theory.

Background theory of reaction equations, stoichiometric, kinetic, and thermodynamic calculations.

Safety awareness of toxic and corrosive properties of chemicals used.

Names and formulas of compounds used in the experiments.

Grading Rubric that initiates the process

Points	Excellent - 5 points	3 points	2 points	1 point	0
Introduction (5 points)	Name, Date, and Lab Partner Name. Title is clearly written. (This experiment is in the handout posted on blackboard (not in lab manual) Objectives are clearly stated.	One of the excellent conditions is not met	Two of the excellent conditions are not met	Three of the excellent conditions are not met	
Procedure (5 points)	A clear and legible step-by-step description written out in own words. Steps 1-10 from Procedure (in Handout) must be clearly written on the left side of the page.(Steps 11 and 12 can be done on MS Excel, I will provide more information in lecture presentation) Prelab Exercise (in the procedure) must be complete (except the Dye concentration. Dye concentration will be provided to you in the lab (written in the bottle). (Prelab and Post lab questions are not required).	One of the excellent conditions is not met	Two of the excellent conditions are not met	Three of the excellent conditions are not met	
Data Tables (5points)	Should be created from the Report Sheet in Handout. Data Table should be replicated in Lab Notebook (Use 510 nm instead of 520 nm) The data table should be completed. Before leaving make a rough graph by hand with Instructor's approval. Your TA should provide you with the actual value of the unknown. You will use that to calculate percent error.	One of the excellent conditions is not met	Two of the excellent conditions are not met	Three of the excellent conditions are not met	

Grading Rubric that initiates the process

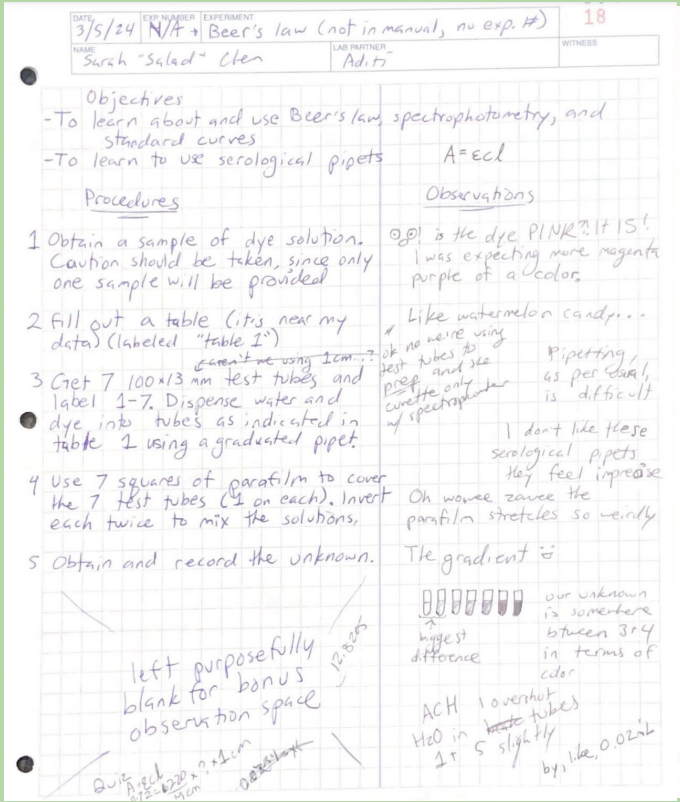
Points	Excellent - 5 points	3 points	2 points	1 point	0
Observations 5 points (Original sheet uploaded)	Observations on the right side of the procedure showing careful observations during the experiment. Prelab Exercise should be all complete.	One of the excellent conditions is not met	Two of the excellent conditions are not met	Three of the excellent conditions are not met	
Points	**Excellent - 10 points**	**7 points**	**3 points**	**1 point**	**0**
Data Tables 10 points (Original sheet uploaded)	A graph should be plotted in Excel (with Trendline – as shown in Lecture Presentation). Attach this to your submission. Show recorded Unknown Absorbance Value Deduce Unknown Concentration from graph (rough graph made in lab notebook. Show calculations. Using the actual value of the unknown (provided by your TA) to calculate percent error: |actual value – Exp value|/Exp value x 100=% error	One of the excellent conditions is not met	Two of the excellent conditions are not met	Three of the excellent conditions are not met	

Discussion
5 points

1. Discuss the equation that was used to create the standard curve/calibration plot. What is the y and the x axis and how do they correspond with the equation? What does the slope signify (what is the term called)?
2. Discuss the R^2 value? Does your R^2 value indicate a "good fit"? If it does indicate a good fit, discuss what happened in the experiment? If it does not indicate a good fit, discuss how it relates to what happened in the experiment. (think: were the dilutions done correctly using a serological pipette)?
3. Based on the standard curve/calibration plot, how confident are you about the accuracy of your unknown concentration.
4. Once you obtain the correct concentration of the unknown (from your TA), what is the percent error? Discuss how the R^2 value of the standard curve corelates with this result.

Example 1: Rubric initiated student response

Clear observations were made



DATE 3/5/24 | EXP NUMBER N/A → | EXPERIMENT Beer's law (not in manual, no exp. #) | 18
NAME Sarah "Salad" Chen | LAB PARTNER Aditi | WITNESS

Objectives
- To learn about and use Beer's law, spectrophotometry, and standard curves
- To learn to use serological pipets

Procedures

1 Obtain a sample of dye solution. Caution should be taken, since only one sample will be provided

2 Fill out a table (it is near my data) (labeled "table 1")

3 Get 7 100x13 mm test tubes and label 1-7. Dispense water and dye into tubes as indicated in table 1 using a graduated pipet

4 Use 7 squares of parafilm to cover the 7 test tubes (1 on each). Invert each twice to mix the solutions.

5 Obtain and record the unknown.

left purposefully blank for bonus observation space

$A = \varepsilon c l$

Observations

:O! is the dye PINK?! It IS! I was expecting more magenta purple of a color.

Like watermelon candy...

ok no we're using test tubes to prep and the cuvette only w/ spectrophotometer

Pipetting as per usual, is difficult

I don't like these serological pipets they feel imprecise

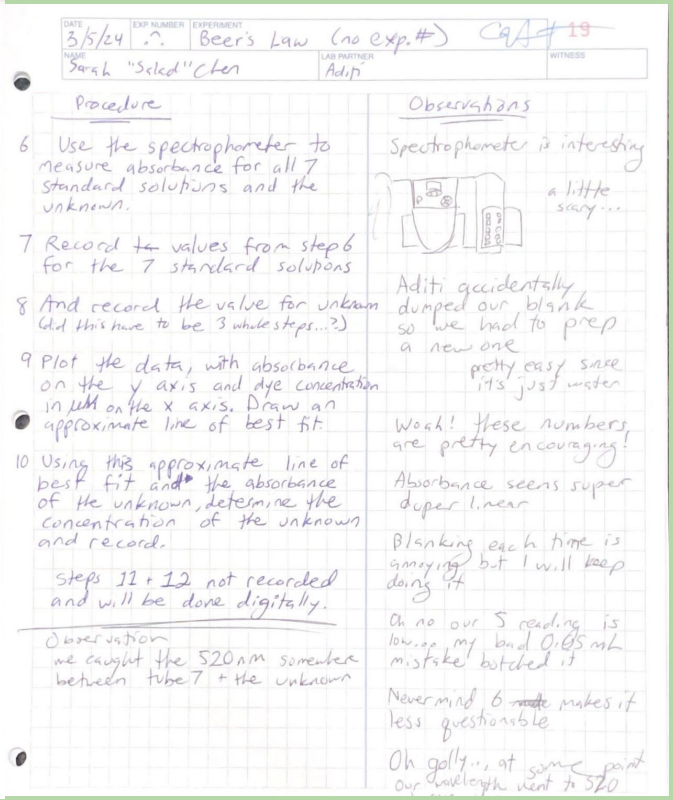
Oh woweee zaweee the parafilm stretches so weirdly

The gradient :)

biggest difference

our unknown is somewhere btween 3+4 in terms of color

ACH I overshot H2O in 1+5 slightly tubes by, like, 0.02mL



DATE 3/5/24 | EXP NUMBER .^. | EXPERIMENT Beer's Law (no exp. #) | ~~19~~
NAME Sarah "Salad" Chen | LAB PARTNER Aditi | WITNESS

Procedure

6 Use the spectrophometer to measure absorbance for all 7 standard solutions and the unknown.

7 Record the values from step 6 for the 7 standard solutions

8 And record the value for unknown (did this have to be 3 whole steps...?:)

9 Plot the data, with absorbance on the y axis and dye concentration in μM on the x axis. Draw an approximate line of best fit.

10 Using this approximate line of best fit and the absorbance of the unknown, determine the concentration of the unknown and record.

steps 11 + 12 not recorded and will be done digitally.

Observation
we caught the 520nm somewhere between tube 7 + the unknown

Observations

Spectrophometer is interesting

a little scary...

Aditi accidentally dumped our blank so we had to prep a new one

pretty easy since it's just water

Woah! These numbers are pretty encouraging!

Absorbance seems super duper linear

Blanking each time is annoying but I will keep doing it

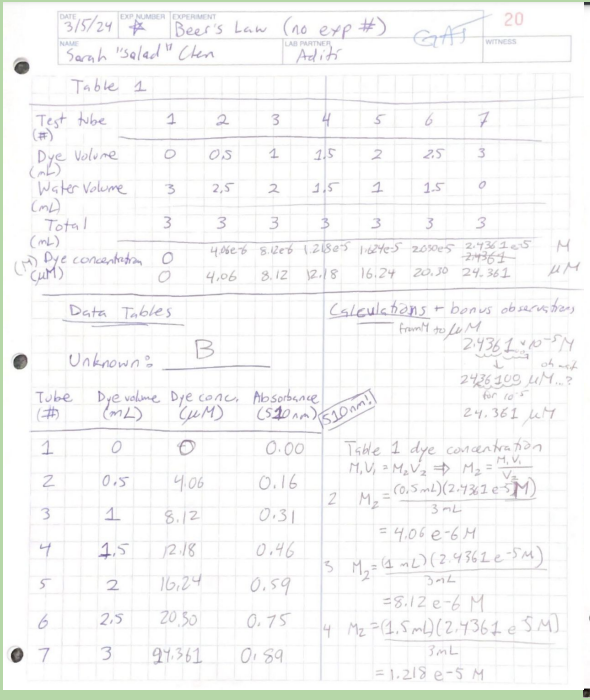
Oh no our 5 reading is low... my bad 0.05 mL mistake botched it

Nevermind 6 ~~made~~ makes it less questionable

Oh golly.., at some point our wavelength went to 520

Example 1: Rubric initiated student response

Effort made to present data and discuss the data



Beer's Law (no exp #)

Sarah "Salad" Chen

Table 1

Test tube (#)	1	2	3	4	5	6	7
Dye Volume (mL)	0	0.5	1	1.5	2	2.5	3
Water Volume (mL)	3	2.5	2	1.5	1	1.5	0
Total (mL)	3	3	3	3	3	3	3
Dye concentration (μM)	0	4.06	8.12	12.18	16.24	20.30	24.361

Data Tables

Unknown: B

Tube (#)	Dye volume (mL)	Dye conc. (μM)	Absorbance (510nm)
1	0	0	0.00
2	0.5	4.06	0.16
3	1	8.12	0.31
4	1.5	12.18	0.46
5	2	16.24	0.59
6	2.5	20.30	0.75
7	3	24.361	0.89

Calculations + bonus observations

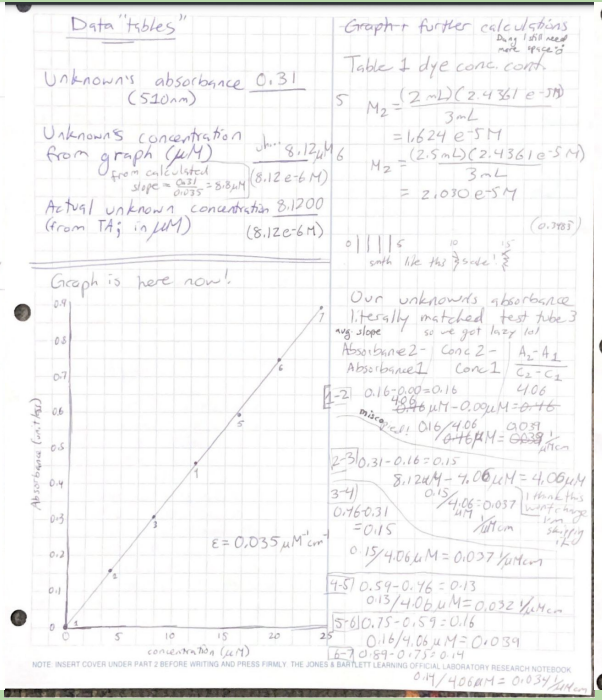
Table 1 dye concentration

$M_1V_1 = M_2V_2 \Rightarrow M_2 = \frac{M_1V_1}{V_2}$

2. $M_2 = \frac{(0.5\,mL)(2.4361e\text{-}5\,M)}{3\,mL} = 4.06e\text{-}6\,M$

3. $M_2 = \frac{(1\,mL)(2.4361e\text{-}5\,M)}{3\,mL} = 8.12e\text{-}6\,M$

4. $M_2 = \frac{(1.5\,mL)(2.4361e\text{-}5\,M)}{3\,mL} = 1.218e\text{-}5\,M$



Data "Tables"

Unknown's absorbance 0.31 (510nm)

Unknown's concentration from graph (μM) 8.12μM (8.12e-6M)

Actual unknown concentration (from TA; in μM) 8.1200 (8.12e-6M)

Graph is here now!

$\varepsilon = 0.035\,\mu M^{-1}cm^{-1}$

Absorbance (unitless) vs concentration (μM)

Graph further calculations

Table 1 dye conc. cont.

5. $M_2 = \frac{(2\,mL)(2.4361e\text{-}5M)}{3mL} = 1.624e\text{-}5M$

6. $M_2 = \frac{(2.5mL)(2.4361e\text{-}5M)}{3mL} = 2.030e\text{-}5M$

Our unknown's absorbance literally matched test tube 3 so we got lazy lol

avg slope: Absorbance 2 − Absorbance 1 / Conc 2 − Conc 1 = $\frac{A_2 - A_1}{C_2 - C_1}$

2-1: 0.16 − 0.00 = 0.16; 4.06 μM − 0.00 μM = 4.06 μM; 0.16/4.06 μM = 0.039 1/μMcm

2-3: 0.31 − 0.16 = 0.15; 8.12 μM − 4.06 μM = 4.06 μM; 0.15/4.06 μM = 0.037 1/μMcm

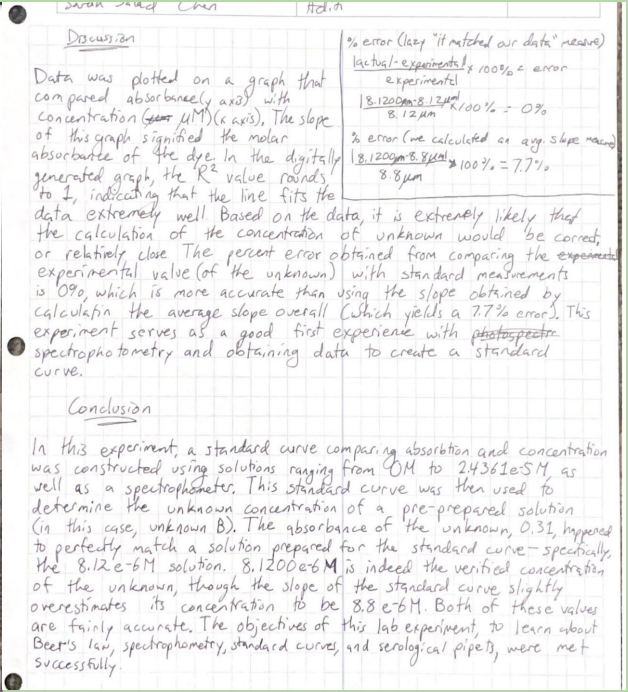
3-4: 0.46 − 0.31 = 0.15

4-5: 0.59 − 0.46 = 0.13; 0.13/4.06 μM = 0.032 1/μMcm

5-6: 0.75 − 0.59 = 0.16; 0.16/4.06 μM = 0.039

6-7: 0.89 − 0.73 = 0.14; 0.14/4.06 μM = 0.034 1/μMcm

NOTE: INSERT COVER UNDER PART 2 BEFORE WRITING AND PRESS FIRMLY. THE JONES & BARTLETT LEARNING OFFICIAL LABORATORY RESEARCH NOTEBOOK



Discussion

Data was plotted on a graph that compared absorbance (y axis) with concentration (μM) (x axis). The slope of this graph signified the molar absorbance of the dye. In the digitally generated graph, the R^2 value rounds to 1, indicating that the line fits the data extremely well. Based on the data, it is extremely likely that the calculation of the concentration of unknown would be correct, or relatively close. The percent error obtained from comparing the experimental value (of the unknown) with standard measurements is 0%, which is more accurate than using the slope obtained by calculating the average slope overall (which yields a 7.7% error). This experiment serves as a good first experience with spectrophotometry and obtaining data to create a standard curve.

% error (lazy "it matched our data" measure)

$\frac{|\text{actual} - \text{experimental}|}{\text{experimental}} \times 100\% = \text{error}$

$\frac{|8.1200\mu m - 8.12\mu m|}{8.12\mu m} \times 100\% = 0\%$

% error (we calculated an avg. slope meaning)

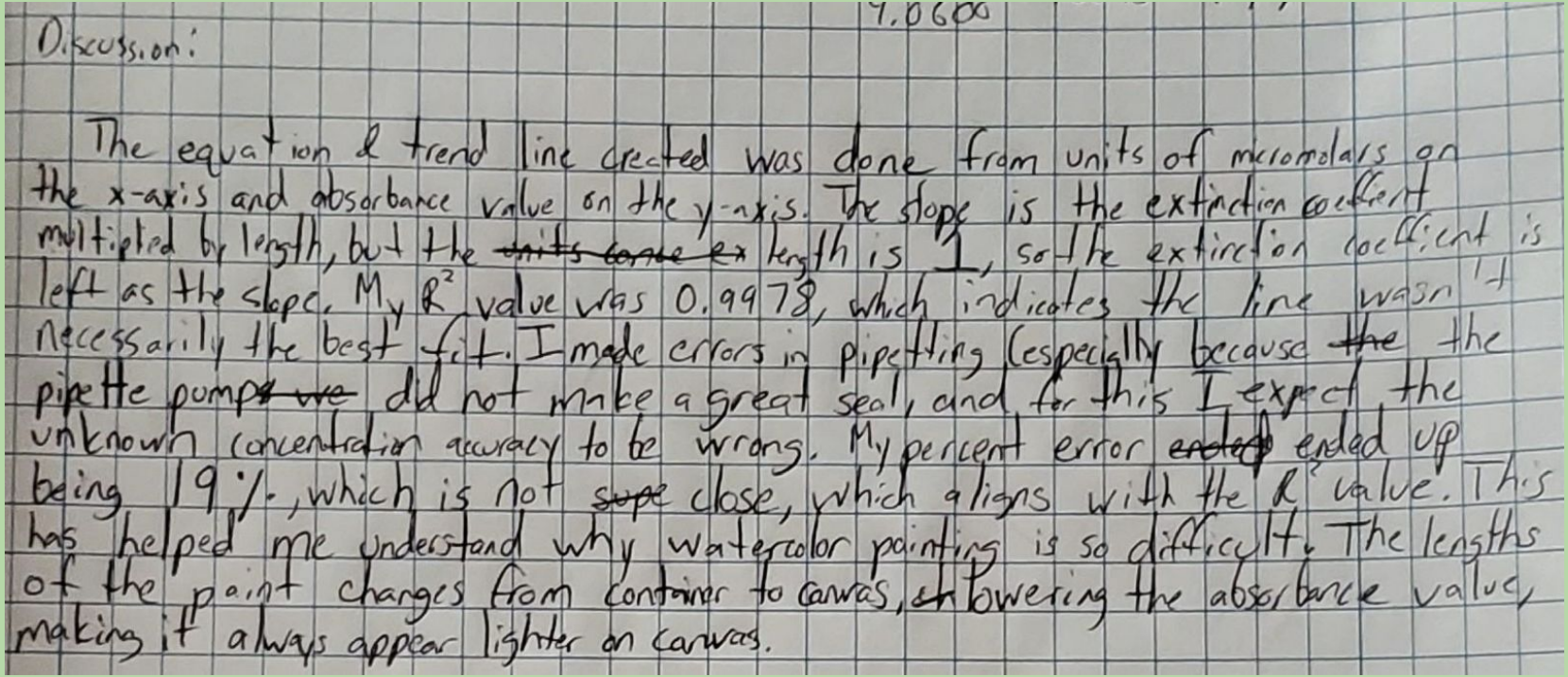
$\frac{|8.1200\mu m - 8.8\mu m|}{8.8\mu m} \times 100\% = 7.7\%$

Conclusion

In this experiment, a standard curve comparing absorbtion and concentration was constructed using solutions ranging from 0M to 2.4361e-5M, as well as a spectrophometer. This standard curve was then used to determine the unknown concentration of a pre-prepared solution (in this case, unknown B). The absorbance of the unknown, 0.31, happened to perfectly match a solution prepared for the standard curve - specifically, the 8.12e-6M solution. 8.1200e-6M is indeed the verified concentration of the unknown, though the slope of the standard curve slightly overestimates its concentration to be 8.8e-6M. Both of these values are fairly accurate. The objectives of this lab experiment, to learn about Beer's law, spectrophometry, standard curves, and serological pipets, were met successfully.

Example 2: Rubric initiated student response

Critically thought about the big picture application
(produced an appropriate example not discussed in class)

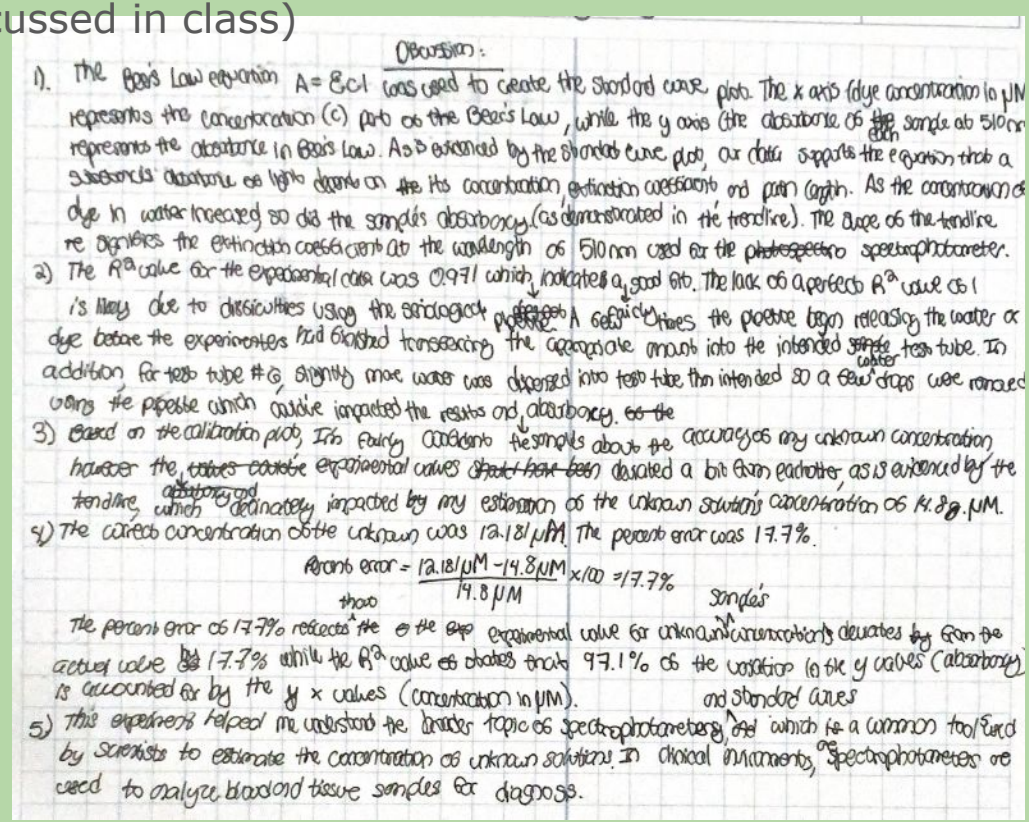


Discussion:

The equation & trend line created was done from units of micromolars on the x-axis and absorbance value on the y-axis. The slope is the extinction coefficient multiplied by length, but the ~~units cancel ex~~ length is 1, so the extinction coefficient is left as the slope. My R^2 value was 0.9978, which indicates the line wasn't necessarily the best fit. I made errors in pipetting (especially because ~~the~~ the pipette pumps ~~we~~ did not make a great seal, and for this I expect the unknown concentration accuracy to be wrong. My percent error ~~ended~~ ended up being 19%, which is not ~~supe~~ close, which aligns with the R^2 value. This has helped me understand why watercolor painting is so difficult. The lengths of the paint changes from container to canvas, ~~sh~~ lowering the absorbance value, making it always appear lighter on canvas.

Example 3: Rubric initiated student response

Effort made to present data and connect the experiment to an apt big picture example (not discussed in class)



Discussion:

1). The Beer's Law equation A = εcl was used to create the standard curve plot. The x axis (dye concentration in μM) represents the concentration (c) part of the Beer's Law, while the y axis (the absorbance of the sample at 510 nm) represents the absorbance in Beer's Law. As is evidenced by the standard curve plot, our data supports the equation that a substance's absorbance or light depends on the its concentration, extinction coefficient and path length. As the concentration of dye in water increased, so did the sample's absorbance (as demonstrated in the trendline). The slope of the trendline represents the extinction coefficient at the wavelength of 510 nm used for the spectrophotometer.

2) The R^2 value for the experimental data was 0.971 which indicates a good fit. The lack of a perfect R^2 value of 1 is likely due to difficulties using the serological pipette. A few times the pipette began releasing the water or dye before the experimenter had finished transferring the appropriate amount into the intended test tube. In addition, for test tube #6, slightly more water was dispensed into test tube than intended so a few drops were removed using the pipette which could've impacted the results and absorbancy.

3) Based on the calibration plot, I'm fairly confident the samples about the accuracy of my unknown concentration however the values could've experimental values should have been deviated a bit from each other, as is evidenced by the trendline, which significantly impacted by my estimation of the unknown solution's concentration of 14.8 μM.

4) The correct concentration of the unknown was 12.18 μM. The percent error was 17.7%.

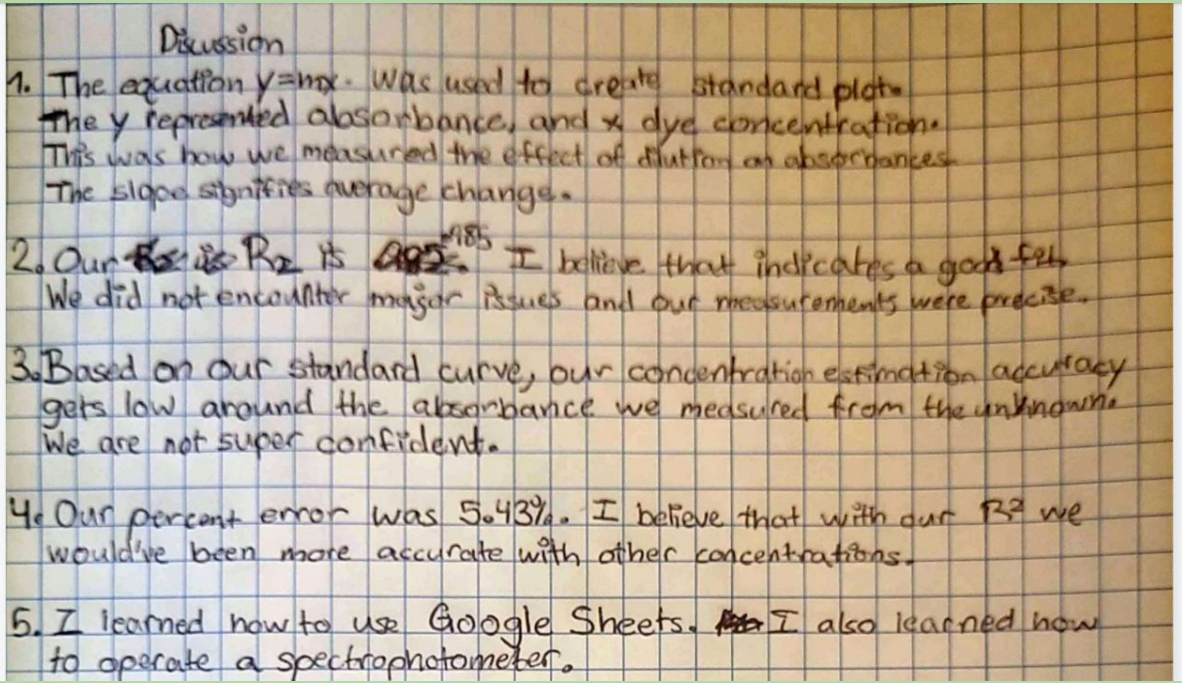
$$\text{Percent error} = \frac{12.18\,\mu M - 14.8\,\mu M}{14.8\,\mu M} \times 100 = 17.7\%$$

The percent error of 17.7% reflects the experimental value for unknown concentrations deviates by from the actual value by 17.7% while the R^2 value of shows that 97.1% of the variation in the y values (absorbancy) is accounted for by the x values (concentration in μM).

5) This experiment helped me understand the broader topic of spectrophotometery, and which is a common tool used by scientists to estimate the concentration of unknown solutions. In clinical environments, spectrophotometers are used to analyze blood and tissue samples for diagnosis.

Example 4: Rubric initiated student response

Feedback provided where appropriate responses were not produced.



Discussion

1. The equation $y=mx$ was used to create standard plot. The y represented absorbance, and x dye concentration. This was how we measured the effect of dilution on absorbances. The slope signifies average change.

2. Our R_2 is .985. I believe that indicates a good fit. We did not encounter major issues and our measurements were precise.

3. Based on our standard curve, our concentration estimation accuracy gets low around the absorbance we measured from the unknown. We are not super confident.

4. Our percent error was 5.43%. I believe that with our R^2 we would've been more accurate with other concentrations.

5. I learned how to use Google Sheets. I also learned how to operate a spectrophotometer.

observations should be more like measuring lower miniscus, color changes and what u observed -1
slope signifies extinction coefficient -1
R^2 shows how good your line of best fit it, not necessarily accuracy of results. so other conc would show similar results. be more precise in discusion reasonings -2

conclusion is vague should quote result in numbers, how it was done pipetting etc -3

Results

MODIFICATIONS TRIED THIS SEMESTER

1) **Clearer Grading Rubric that prompts the process of critical thinking.**
2) **Prompts for open ended discussion questions that critical thinking about the experiment.**
3) **Prompts for open ended big picture questions to connect to a larger topic (light waves, spectrometry to solar energy, etc)**

RESULTS OBTAINED

1) **Students got the hang of the rubric in a few weeks and the open ended discussion questions initiated precision in the responses.**
2) **Prompts for big picture questions connecting to a larger topic did not produce the results desired. Some students did show a penchant to connect (light absorbances to water color paintings, nucleic acid and protein detection, blood and tissue diagnostics). Majority of them stuck to the experiment and its results.**
3) **In the next iteration, incorporate plan to ask a better question for the big picture question. Incorporate How questions.**
4) **Plan on providing feedback to guide students towards the path of critical thinking.**

Nicki Belfiore
social work

- **SOWK 360: Social Welfare, Social Policy, and Social Work II**
- **Juniors and seniors**
- **15-25 students**
- **Students are expected to find a state or federal bill in progress and write an analysis from a social work perspective. This is a writing intensive course.**
- **Critical thinking is identified as one of the four overall skills needed in writing assignment (along with clear written communication, following directions, and scholarship)**

Changes made to teach critical thinking:

More practice in class

- **Discuss parameters of existing law, for example Americans with Disabilities Act**
- **Identify strength/weakness/unintended consequence (ie specific aspects) of the law**
- **Explain why strength ie what impact does this specific aspect of the bill have on the target population and/or the social issue**
- **Identify and explain the social work value, mission, goal, or perspective reflected in this strength.**

Formula to demonstrate critical thinking:

1. **Use term strength, weakness, unintended consequence**
2. **Identify specific aspect of the bill**
3. **Explain impact of specific aspect of the bill**
4. **Align with social work values, goals, mission, or strengths perspective**

Critical thinking skills

- **Making connections**
- **Applying concepts to content**
- **Considering implications on specific populations/issues**
- **Applying values to implications**

David Mitch, Department of Economics

Courses taught using critical thinking skills

-Asian Economic History: 300 level course, intro Econ preq, is a WI course.

Mix of sophomores, juniors and seniors with at least two-thirds being Econ or FIEC majors. Enrollment is 35 to 40

-Capstone course for M.A. in Economic Policy Analysis: 600 level course. Final semester for students Enrollment 3 to 5 students.

Asian Economic History: Content and Expectations

-Course examines how economic factors interact with cultural, social and political dimensions to influence economic performance from antiquity to the present. Lectures and exams focus on China, India and Japan. Student choose Asian countries other than these for their term papers.

-Critical thinking takes the form of being able to construct and evaluate organized arguments on the above topic. Students construct organized arguments during in-class essay exams, in a 10-20 page term paper and in group presentations. Students evaluate organized arguments in peer review of other term papers and other group presentations.

Asian Econ History: How term paper is constructed–steps and components

1. **Identify country and research question**
2. **Prepare 5-item bibliography**
3. **Read and review 1 item on bibliography**
4. **Provide chronology of key dates. Justify beginning and end points**
5. **Write outline of paper focusing on argument not just topics**
6. **Write 200-word abstract of your paper**
7. **Write rough draft**
8. **Write final draft**

Asian Economic History; How the final term paper is evaluated–each component of equal weight

1. **Is a clear research question formulated?**
2. **Is justification provided for the significance of the research question?**
3. **Is a clear line of argument developed supported by evidence and documentation?**
4. **Is the text clear, well-organized and does it engage the reader's interest?**
5. **Is the final draft substantially improved over the rough draft?**

Master’s Capstone project: Expectations

A 20 to 40-page paper that demonstrates the ability to do independent research on economic policy using both theoretical and empirical tools of economics.

Master's Capstone Paper; Evaluation Rubric evaluated on a scale of 1 to 5

***Do explanations in the paper exhibit mastery of the economic framework and econometric tools employed?**

***Does the literature survey convey grasp of previous research strategies and significance of key previous findings?**

***Does empirical analysis display understanding of the data employed and its strengths and limitations?**

***Does the paper explain how results address the research question?**

***Is the paper written in a clear, coherent and engaging manner?**

Issues encountered and next steps in Asian Economic History term papers

How to provide meaningful feedback on 35 to 40 individual term papers?

***Have approached this with grading rubrics–but students often want feedback beyond rubric scores.**

***Recently have emphasized and required peer feedback on rubric components.**

***Previously, in choosing term paper topics, focus has been on choice of country. In the future, more emphasis could be put on choosing a focused research question that engages the student.**

Issues in Assessing Capstone papers

***Defining and measuring learning outcomes has been much more straightforward for the Econ MA program than for its undergraduate degree programs. This is because the MA program has a clear final deliverable in the form of its capstone paper.**

***Furthermore the capstone paper is a deliverable that can be evaluated by "third party" faculty not involved in advising the students who wrote the paper.**

***Having defined critical evaluation elements in the rubric has facilitated a)assessment, b) "closing the loop" and c) "double looping"**

M.A. capstone papers: faculty assessments

Overall, students appear better at mastering techniques than at interpreting and explaining the results.

Three faculty reviewers mentioned tables and figures in the capstone papers are often confusing and incomplete. To quote one, "students should have impressed upon them more forcefully the importance of complete and thorough labelling of tables and figures."

Six of ten papers received unacceptable scores along one of the two dimensions that relate to whether the paper as a whole is well-written, specifically whether the paper is written in a clear, engaging and cogent manner and whether the results are explained clearly and completely.

Next steps for M.A. Capstone papers

1. **Students should be encouraged (or even required) to have someone copy edit their proposals and papers.**

2. **A reader should be able to look at a table or figure and, from its title, caption and other labelling be able to understand, at least to some degree, what it conveys. The importance of this can be emphasized to students. Both good and bad examples of table and figure construction can be drawn from past capstone projects.**

3. **In teaching the core courses more emphasis should be placed on interpreting how theoretical models and regression results translate into policy analysis in an intuitive way in order to improve explanation and interpretation of results.**

Keyimu Kalibinuer
Department of Economics, Adjunct Faculty

Microeconomics 101: mainly freshmen, sophomore and some juniors. Enrollment is 105~110.

Macroeconomics 102: mainly freshmen and sophomore Enrollment is 60~70.

ABOUT THE MICRO 101 COURSE

·Nature of economics in dealing with the issues of scarcity and opportunity cost.
·Evaluate factors affecting firm behaviors, such as production and costs.

·Concepts of supply and demand as main tools of microeconomic analysis used for both theoretical and applied economics.

·Be able use Excel to plug demand and supply functions into coordinate system by completing a group project (practice makes perfect)

·Be able to analysis the power of "Equilibrium" to find solutions for the unknown factors.
·Why elasticity is preferable to achieve market efficiency, a strategic aspect of a gross price elasticity.

·Develop critical thinking and reasoning skills through examination of often-unintended consequences of *economic decisions* and policies.

·Learn short-run and long-run cost functions, be able to translate economic concepts to assess real-world entrepreneurial practices.

·Identify and evaluate controversial social problems and commercial policies by using economic analysis on tax policy, monopoly, and international trade. The law of unintended consequences

ABOUT THE MACRO 102 COURSE

·**Use Excel to plug demand and supply functions into coordinate system by completing 1st group project.**

·**Be able to translate supply-demand concepts to assess real-world entrepreneurial practices.**
·**Understand the nature of certain macroeconomic problems and institutions.**

·**Learn macroeconomic issues: national output, economic growth, unemployment, wages, inflation, interest rates, fiscal policy, and monetary policy.**

·**Master certain tools of macroeconomic analysis, such as GDP, tax & money multiplier to identify and evaluate controversial social problems and policies.**

·**Develop critical thinking and quantitative reasoning skills through examination of often-unintended consequences of economic decisions and policies.**

·**Understand the Fed's money supply rule and functional relationship between inflation & interest rate in 2nd group project.**

Critical thinking (CT) in undergraduate teaching

- **Bloom's taxonomy can be used to achieve CT skills step by step.**
- **Very bottom line (category) is "practice makes perfect"**
- **Link textbook theories with practical market data (Apply concepts to content).**
- **Make a triangle connection between students and teacher.**

Common Teaching methods

●More math practice in classroom.

●Incorporate Excel into my teaching:
If I use Excel, multiplier concepts and their effects will be understood effectively. Better than verbal explanation of their exponential effects.

● Classroom discussion, always emphasize post hoc, ergo propter hoc and unintended consequences of the econ theory. Tax & subsidy policies, monopoly, etc.

Group Project Purpose: practice makes perfect a stepping stone project

- **Foster students mastering techniques, foster CT skills.**
- **Practice makes perfect (after Midterm, supply $ demand again: usefulness)**
- **Link textbook theories with practical market data (Apply concepts to content).**
- **Particularly practice calculations and linear equations.**
- **Learn Excel (at the beginning, 10~20 % students).**
- **Dynamic understanding the power of "Economic Equilibrium" in the process of finding solutions for problems.**
- **Try to get as many information as possible from the explicit and implicit factors when make a conclusion.**

Evaluation rubric for Micro 101

Evaluated on a scale of 1 to 5

- **Practice Excel to plug given data set**
- **Finding equilibrium price and quantity**
- **Explain slopes**
- **Elasticities calculations**
- **Related products and shifts in the equilibrium**
- **Cross price elasticities by employing economic assumption**
- **3 peer review questions**

Macro 102
First project: practice makes perfect

Evaluated on a scale of 1 to 5

- **Practice Excel to plug given data set**
- **Finding equilibrium price and quantity**
- **Explain properties of linear equations**
- **Calculate slopes and define their functions.**
- **3 peer review questions**

Macro 102
Second project: Busts and Booms

Evaluated on a scale of 1 to 5

·How the fiscal policy worked during a particular economic crisis (government spending and tax policy)

·How the monetary policy worked in this recession (define a functional relationship between inflation and interest rate and the Fed's money supply rule)

·3 peer review questions

Feedback from students: how CT helped them to finish their work

An individual project feedback

A student is good at Excel and math and confidently worked on the project alone. His numerical findings are correct. However, when it came to defining substitutions along with income effects, he was confused. After 3 peer review questions, he realized that group analysis would bring better accuracy into analysis of how elasticities interact with factors such as substitutes, complements and income in different ways. Interpreting and explaining the resulties.

Group project feedbacks

·applied the CT into economic assumptions when they calculated cross price elasticity of video games.

·the group project enhanced their CT skills by maximizing possible information collections along with evaluating their arguments. If they worked alone, they cannot finish the project productively in a month (reduce time as cost reduction).

Upcoming efforts to enhance CT skills

Directly measuring CT effects are difficult.

Improvement in scores, discussions and student feedbacks.

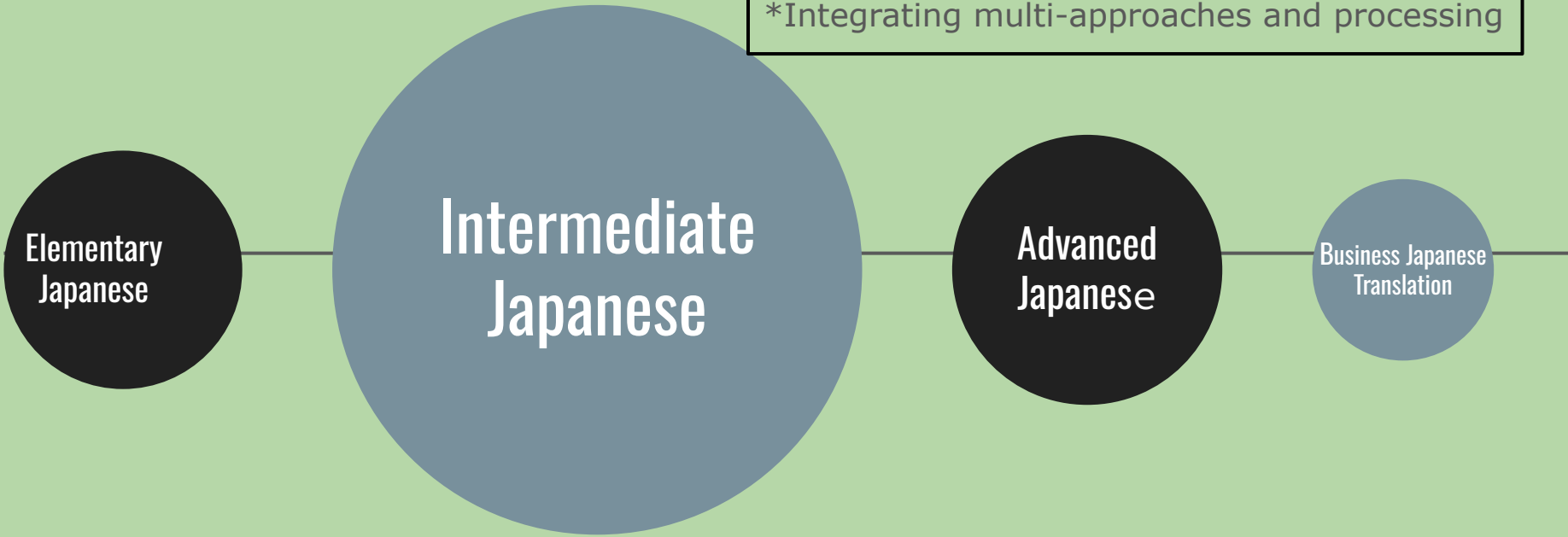
More emphasize responsibility to enhance academic integrity and professional courtesy.

Mina Seat

MLLI
Intermediate Japanese I and II
Freshmen to Seniors, mostly Sophomore and Juniors
JPNS 201 75-85 students (four sections)
JPNS 202 25-35 students (two sections)

Content of the Course

Critical thinking:
*Understanding and accepting different perspectives
*Problem Solving
*Integrating multi-approaches and processing



Students' critical thinking is encouraged to understand Japanese culture and society deeply by introducing authentic materials on specific topics.

Japanese Courses – Department of Modern Languages, Linguistics & Intercultural Communication – UMBC

Group project

Questionnaire Survey

- **Learning new or different perspectives**
- **Working as a group while encountering issues and seeking solutions to challenges**
- **Interviewing others (mainly Japanese speaking individuals) to compare, analyze, and organize ideas and thoughts.**

Spreadsheet to keep track of communication and processes

チーム名	A	B	C	D	E	F	G	H	I	J
チームリーダー	ティミ	エリオット	ブリン	ジャスティン・アダムズ	アハマド	ヘザー	サラ・フィリップス	シスクン	ヴァネッサ	マーカス
チームメンバー	今村	メイリン	アデオラ	ジャネル・クレボーン	ジョー	ショーン	メリッサ・ヒューソルトン	アマラ	サラス・セバスチャン	ジャスティン
チームメンバー	ジェイク	エイジア・のどか	ダニエル	チャールズ・ボーレイ	テイラー・カプチンスキー	クロエ	ウィリアム・リー	サバナ	マシュー	ルビ
チームメンバー	カール	オックスフォード				マイクル		シャーロット	アレックス	
タイトル（英語）	how does american and japanese college life compare	Pets	Gacha-pon & Gambling	How do you get around?	Comparison off American & Japanes	Thought/opinions on American cult	International Travel: Leisure vs Study Abroad	Seasons and Related Topics	Holidays	College campus life
タイトル（日本語）	日本とアメリカの大学生活はどう違いますか	ペット	ガチャと賭け	どうやっていろいろなところに行きます		アメリカのぶんかについてかんがえる		季節や密接なトピック	休日	大学生活
質問表ドラフト提出（3/29）	√	√	√	√	√	√	√	√	√	√
質問表ドラフト校正（3/11）	√	√	√	√	√	√	√	√	√	√
質問表最終版（3/13）	√							√	√	
インタビュー人数	8人(紹介必要はありません)√	8（4 人一先生の紹介）	8人（8 人一先生の紹介）√	7 人（4 人一先生の紹介）√	No from Mina Seat	8大学生（5人一先生の紹介）	10人（10人一先生の紹介）7 recommended	8人（7人一先生の √	10人（8人一先生の紹介）√	6人（4人一先生の紹介）√
回答者連絡先送付										
インタビュー終了										
レポートドラフト提出（4/28）										
レポートドラフト校正										
レポート最終版（5/7）										
プレゼン発表（5/19）										

Group project reflection (1st month)

Dear JPNS 202 students,

You will be asked to fill out a reflection form three times during the group project. You will fill out the first reflection by the middle of March, the second reflection by the middle of April, and the final reflection by the middle of May.

Please reflect on how you worked as a team member and/or a leader and how you collaborated with others. honest with your reflection.

Analyzing and reflection

Working as a team

What Changes were Incorporated

1. **From one-time students' evaluation of each other's presentation or team work > Three-layer teamwork evaluation**

2. **Changes made to highlight critical thinking**

   - **Observing the workflow and responsibilities**
   - **Assessing the of undertaking the project as a team**
   - **Analyzing and solving issues and challenges**
   - **Coming to consensus incorporating a variety of perspectives**

3. **Through specific project work, students have engaged in critical thinking while reflecting on their own work and making adjustments for the best outcome possible.**

Efforts to be continued….

Dann Malihom

Adjunct professor
Sociology, Anthropology and Public Health

SOCY310 - Social Stratification and Inequality
~35 students - Sophomores, Juniors, and Seniors
SOCY345 - Sociology of Education
~40 students - Sophomores, Juniors, and Seniors

SOCY345 - Sociology of Education

Course Objectives include:

- **Demonstrate how relationships, content, and external social pressures impact education**
- **Brainstorm how education could change in the future**

The midterm exam was focused on open-ended questions, requiring the student to think critically, take a stance, and then justify their argument with references to lectures, readings, or external articles.

Example Midterm Question

“What do you think is the biggest issue plaguing the American education system at this time? Why is it more concerning than other issues? What could different tiers of the education system (Department of Education, State School Board, Teachers, etc.) do to address the issue?”

Open-Ended Grading Criteria

- **Does the student take a clear and specific stance?**
- **Do they utilize the course material (lecture notes, readings, videos) to support their argument for prioritization?**
- **Do they contrast it with other issues or dilemmas, providing a valuation to indicate why it is of a higher priority?**
- **Do they brainstorm ideas/initiatives/policies that various tiers of the education hierarchy could implement, synthesizing knowledge of the roles and responsibilities of these tiers with their criteria for importance and impact?**

Assessment more focused on the process and connections, rather than specific answers or responses

Tomoko Hoogenboom

Department of Modern Languages, Linguistics and Intercultural Communication

Course focused on critical thinking;
MLL 316 Japanese Language in Society
MLL 333 Japanese Food Culture

Other courses with implementation of critical thinking
JPNS 301 Advanced Japanese I
JPNS 302 Advanced Japanese II
JPNS 309 Business Japanese

My definition of critical thinking = think '**why**'

MLL 333 Japanese Food Culture Spring 2024

Discussion based course:

Students sign up for a discussion leader

1) **Create two reading questions**
2) **Conduct class discussion**

The questions should enhance other students' critical thinking

= questions should be **open ended questions** rather than one correct answer questions

= questions preferably include '**why**' questions

Rubric for Creating questions

Discussion leader will receive feedback from classmates using a rubric

Discussion leader rubric includes

1) ***Reading questions***
2) **Responding to students during class discussion**
3) **Closure**
4) **Atmosphere**
5) **Comments**

<u>Reading questions rubric items</u>

1) **Were the questions *clear* to you?**
2) **Did they make you *think* about the reading material *critically*?**
3) **Did they include *open-ended questions*?**

Focus on the courses

Information available online vs Students' opinions not available online

Students should be able to express their opinions about the topic

- **Based on their own experience**
- **Based on academic sources**
- ***Why* they think the way they do**

Students should be able to explain considering cultural differences/similarities

- ***Why* things are the way they are**
- ***Why* people behave the way they do**

Janet Gross English 100

- **3-4 Sections per semester, 22 students per section**
- **Primarily freshmen; a few upperclassmen**
- **Challenge: Promoting critical thinking about course readings and research sources. In other words, effectively evaluating using questions to stimulate critical thinking of outside sources.**
- **Student arrive with minimal instruction in identifying authors or organizations behind a source or explaining what makes one source "better" than another**

Classroom Strategies

- **Slow students down to wrestle in small groups with MLA citations.**
- **Must identify author/sponsor and website. Not always obvious!**
- **Discussion questions:**
- **Who is this person/organization?**
- **What authority, expertise or credentials do they have?**
- **How do you find that information?**

Reinforcement of Critical Thinking skill

- **Quizzes. Notes given in class for open note quiz at home**
- **Includes questions to ask about any source**
- **Look for bias (sometimes want this)**
- **What about statistics: who does study include, how large a sample, etc.**
- **Practice skills in each unit**
- **Use of quote sandwiches to identify source and authority**
- **Research unit includes annotated bibliography**
- **Annotations combine all the practiced skills including an uncited source and explanation**

Student Reflections

- **I learned to adopt active reading strategies such as annotating, summarizing, and critically questioning the text. This shift in approach significantly improved my understanding and allowed me to engage in thoughtful discussions and written analyses.**
-
- **This semester, my most significant achievement was the development of my critical thinking skills. I entered this course with limited experience in critically evaluating texts and constructing coherent arguments. However, consistent practice and engagement with the course material have significantly enhanced my ability to dissect complex ideas, identify underlying assumptions, and present persuasive arguments. I now approach information and discussions with a more discerning and thoughtful mindset**

Conclusions

1. We could not come to a unified definition of Critical Thinking because it is an abstract, slippery term that is a reification.
2. Often easier to recognize Critical Thinking in the classroom or in student work than to measure it.
3. Useful to have uniform steps or process to guide students' CT skills in lower level classes.
4. Realistic, relatable problems and tasks are valuable in teaching Critical Thinking because students are more engaged.

Conclusions

- **Instructors need to model behaviors of uncertainty, vulnerability, and scientific skepticism**
- **Emphasize to students that often, there is no one "correct" answer**
- **Reward the process**
- **Expose students to discipline-specific examples of analytical work and use of evidence to support a proposal/direction/conclusion, etc.**
- **"Critical thinking" is difficult to measure; goals of learning are operational and observable, while critical thinking is abstract.**