S1:

Hello everyone, I'm Sunayana Mitra. I am a graduate student at the University of Pittsburgh in the department of chemistry.

Today I'm going to take this opportunity and present my teaching and research project.

My teaching is research project involves training undergraduates to read and interpret scientific literature.

My mentor in this project is Dr. Eugene Wagner who kindly let me implement this course transformation in his honors general chemistry course and

my inspiration is my academic adviser Prof. Sean Garrett-Roe. This presentation will include only the first half of the project.

S2:

First let's look at who our students are. These are students who are taking advanced courses in high schools and as freshmen.

They constitute the top 5% of their matriculating year. Everyone of them are motivated to do some kind of research in the future.

Now, on your right inside you'll see the graph which shows a student prior understanding of

how original research impacts some walks of everyday life and how significant it is in education.

As you can also see, everyone of the students understand the importance of reading scientific literature so it is critical to teach them how to efficiently read scientific literature.

S3:

Therein lies my motivation in creating this intervention to try and help the students understand scientific literature efficiently.

Scientific literature trains us to best think critically.

In order to understand original research undergraduates can either go through an institutional course or it can be an individual effort.

There can be three kinds of ways in which an institutional course can instill an interpretation and critical thinking skill in undergraduates.

The first approach is where the course is designed so that it's a standalone course of teaching undergraduate how to how to pick apart primary literature.

The second approach is designing a writing course where the undergraduates learn academic writing along with evaluating scientific literature.

In a very popular approach of laboratory method undergraduates are given scientific literature

to conduct laboratory experiments and be able to design experiments from scientific literature.

All three approaches have one thing in common that being a course fully devoted to scientific literature understanding.

Now if the institution does not have such a course then the students miss out on gaining the skill of critical thinking

whereupon comes in the individual of effort. Do you do the huge complexity of scientific data it becomes

a large barrier to crush for a student by them self in understanding and evaluating scientific literature in a timely fashion.

Therefore, during the lack of a institutional course it's imperative that there should be some kind of intervention which teaches the students how to evaluate scientific literature.

S4:

The central hypothesis of this project is:

that when they read primary research along with their coursework their understanding of the coursework solidifies to form a stronger conceptual foundation based on research material.

The 5 main learning objectives that are addressed in the research are:

1.That original research is not equivalent to secondary research articles.

2.They learn that the hypothesis lead to the main goals of the primary article.

3.They also learn that in the end the introduction the methods and the conclusion all culminate to explain the main hypothesis.

4.Another learning objective is that central hypothesis and the main goals together make sense with the authors conclusion,

and 5. in a broader perspective they learn where their course materials come from and how these original research articles build on important concepts.

Now I'll show you a glimpse of what went on in this research.

S5:

Here is a example of all the broad topics that were chosen for this research endeavor which are

ice cream modeling nanoparticle biomolecules techniques like infrared spectroscopy mass spectrometry

and LCMS and concepts like carbon capture and environmental chemistry.

In general most of these topics have a high conceptual correlation with the coursework covered.

But as the assignments progress over the course the topics become incrementally difficult.

More importantly the intervention becomes more and more of a extrapolation of the class material over the course of class completion.

S6:

Now I will show you precisely how the intervention or the activity assignments were designed.

First a secondary article respect relating to the course material in this example it's ice cream.

It was also summer so we thought everybody would enjoy something about ice cream.

Not three primary articles were then preassigned with the secondary article.

The students first ranked ordered those three primary articles according to their connection to the assigned secondary paper.

After that they would choose the hypothesis and mean goals from two of the articles and go in depth in one of the pre-assigned primary research articles.

In that article they would find the method conclusion future direction along with the hypothesis and main goals.

They would eventually end assignment by finding the relationship between the authors conclusion and the author stated hypothesis plus me and goals.

Now I will show you a glimpse of how one such assignment looks like.

S7:

Here you see that the students not only pick out the passages from the paper they also pick

the relationship of the primary and secondary article. In every question they explain the goals of the original research in their own words.

The students also explain the hypothesis and mean girls in their own language. Finally, in the original paper where they go in depth,

they pick out the method the conclusion the future direction along with new terms that they learned through the process.

For every single one of these questions they produce evidence from the paper.

S8:

Here I am showing you our quantitative progress throughout the semester for the students also the favor assignments.

The maximum grade of each assignment was 25. The A1 through A5 are the five assignments.

The course broad topics of the assignments are written over the bar histograms.

The difficulty level of these assignments scale as the course progresses.

The student finds a lot of connections between the course and assignment A1, whereas in assignment A5 for CO2 capture

they would find the bare minimum conceptual connection with the course material.

Some of this difficulty would also arise from the content in the structure of the particular primary literature papers chosen.

In between these five courses two workshops for held. The first workshop dealt with talking about the frustrations

in picking out hypothesis and distinction between the secondary and primary literature.

The second workshop dealt with the students frustration with picking out the conclusion and the connection of the conclusion to the hypothesis.

As you can see in all of these assignments the students manage to score throughout the semester.

This points two words the fact that the students were motivated enough throughout the course to keep on performing

well even though the assignments were getting harder. Part of this motivation came from the lively

workshops in between the course and also the feedback that was given to the office hours answer keys.

S9:

Here I am showing you the student self-assessment on the improvement after the intervention.

As you can see in most of the areas the students think that due to this intervention, they have at least improved

by more than 10% from what they were before the semester started.

Undergraduates think they are better at understanding secondary literature primary literature the relationship between them.

The students feel that they can pick out hypothesis better than before, they can look up new words, main goals.

They are also confident on their ability to tell what kind of a paper the reading and what kind of conclusion and

future work the author is suggesting. Therefore, the undergraduates are clearly more competent in

tackling primary literature after this intervention according to their own opinions.

S10:

Here I am showing you some of the feedback that came out of the surveys in the workshops.

On the bright side the students realized that they were more capable and picking out hypothesis and main goals.

They could figure out which kind of information is located in which part of the scientific paper.

They were also better at evaluating new scientific terms. Finally, they got an idea of how academic research presentation structure looks like.

On the frustrating side they realize that there might be more than one approach to analyzing the data and research.

They were grappling to understand the concepts which are extremely difficult sometimes.

They were also befuddled with the fine connections between the hypothesis and the conclusions.

And some of them fortunately also realized that this is just the beginning to the road of getting better in understanding scientific literature.

On another note students enrolled in this course over the past 2 years who are attached to research labs in their undergraduate years have provided feedback.

They have informed me and Dr. Wagner the beneficial this research intervention was to the critical thinking capabilities.

How this course transformation has helped them gain clarity & efficiency in conducting research.

S11:

One of the first things that come to mind when designing such an integrated intervention embedded in a pre-existing course is:

how much of the workload is going to be feasible for both the student and for the instructor?

I am going to address the student workload first.

Historically the honors general chemistry laboratory had 13 lab practical's.

The students had to write full length lab reports for each of those 13 labs.

In order to accommodate the intervention and course transformation the practicals were reduced to 12 laboratories.

The students now have to write 6 full length reports and 6 worksheet style reports.

Some of the laboratories are 2 week investigations. First week is a worksheet report followed by full practical report on the second week.

Time was carved out from all of experiment and report-writing instances to execute the five worksheet assignments, the two workshops and peer feedback.

Thus, the student effectively spent time on task by working on those assignments.

They also spent time discussing the scientific papers with their peers and assignment partners, hence collaborating on the assignments.

Coming back to the workshops it helped the students develop their ideas and understanding much better than figuring the papers alone.

Some of this was qualitatively witnessed in the laboratory report.

The students were gradually seemed to be getting better at hypothesizing and stating a testable hypothesis.

Their data analysis and conclusion skills were imprescriptibly getting sharper.

Before talking about instructor observations more, I would like to talk a little bit about the instructor workload.

S12:

There are two demarcations in the slide the blues for the pre-semester and the green is for the time right after semester begins.

I'll talk about the blue region first. Originally the instructor first chooses five topics related to the course.

After that he or she first chooses the five secondary articles.

Then I picked the three primary articles related to each of the five-secondary article.

I need one common activity sheet format encompassing all of the learning objectives.

It took me a total of about 40 hours to prepare all the material before the intervention started.

Right after the semester starts, we designed a pre-semester survey which was handed right before the first assignment.

After that I designed workshop materials for the two workshops that were conducted between the first second and fourth third assignment.

The intervention started after 1 & 1/2 weeks of formal coursework start.

Hence the surveys and workshops could be designed as the semester started.

The grading began as soon as the student submitted the first assignment.

The grading rubric for each assignment was made in grade scope, where all of the course material was being graded.

If I add up all the work hours: the two workshops, two surveys along and all the grading of the five assignments

it took me approximately 40 hours to complete everything after the intervention started.

The main take-away from this slide is as long as the instructor has a plan in place

to have all the topics in the secondary journals along with the primary research ready

before the semester starts it should not take too much of an effort to execute this intervention.

The activity sheet as I will iterate later is highly transferable from course to course and from subject to subject.

S13:

This brings me near the end of the presentation where I want to point out the benefits of this intervention or course transformation.

We talked about the students understanding the significance of literature in their daily life now they are also equipped with complex research topics.

The students are now familiar with the whole academic presentation structure.

They have more confidence in their abilities after going through five such of assignments with varying levels of difficulty.

They also have an inkling that every research article is actually trying to tell a story.

As I mentioned before the worksheet that I made for this course transformation is completely transferable from subject to subject.

Now honestly, I should also discuss the roadblocks that can occur during the intervention.

The complexity of research data is not a new concept to people like us but to undergraduates who are just starting to fiddle with research data, it is a tremendous leap.

They also have difficulty in dealing with then on ideal writing styles of majority of scientific publications.

Even though we pride ourselves in writing good research but most times we do encounter research papers we do not have the

particular thought flow which would make understanding easier. The writing might become complex did a number of reasons.

It might be due to the complexity of the concepts, the complexity of the data, the confused writing, the broadness of the topic.

Watching all of this unfold was somewhat of a revelation for me as I understood that sometimes it is always challenging to

understand primary literature in the beginning. That is why I was also amazed that most of the students understood that this is just

the start of a long-winded road of practice. On an end note one of the challenges is the instructor readiness

which is suffice it to say that the instructor should have at least half the materials ready before the course starts.

S14:

This brings me to my concluding Slade where I would like to thank all of you for patiently listening to my research description.

As a teaser I would like to say that this fall semester I would present the second part of this research.

To you know more about the second half please join me in my fall ACS presentation. Please come and encourage me in the final dissemination of this project.

I would like to thank my mentor Dr. Eugene Wagner. I would also like to thank my academic advisor professor Sean Garrett-Roe for his encouragement.

I would definitely want to shower all my thanks to the students who went through this research,

the assignments and the workshops with me throughout the semesters in 2018 and 2019.

Lastly, I would like to thank my undergraduate TAs who also supported me throughout these course transformation implementations.

Thank you again for listening to me and being attentive. I hope you find this a valuable additional tool in your teaching skillsets.

Sunayana Mitra 2020.04.29