

## **No More Death by PowerPoint! Using an Alternative Presentation Model in a ChE Unit Operations Laboratory Course**

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## 1. Introduction

It is well-known that effective oral communication skills are critical to the success of chemical engineering (ChE) graduates in the modern workplace<sup>1-8</sup>. With this in mind it is important that ChE instructors provide their students with numerous opportunities to practice oral communication skills through in-class presentations. However, assigning several oral presentations across multiple sections and/or in large classes can be mentally exhausting for the course instructor, and students may similarly feel that they are simply “turning the crank” and feel bored or unchallenged when faced with the construction (or sit in the audience) of yet another bullet/sub-bullet technical presentation – these are symptoms of the so-called “Death by PowerPoint” (DBP) syndrome<sup>6,9</sup>.

Part of the reason DBP syndrome occurs is staid adherence to the classic bullet/sub-bullet structure espoused in much instruction on technical presentations, which can lead to presentations feeling formulaic and lacking in creativity<sup>6,9</sup>. In recent years new and exciting presentation paradigms have been developed and adapted for technical presentations. One of these modern presentation styles, the “assertion-evidence” (AE) model, requires a heavier reliance on visuals rather than text and is purported by many communication experts to be the most effective format for technical presentation slides<sup>6</sup>. Recent studies claim that presentations using the AE format lead to significantly better comprehension and recall of advanced concepts by both presenters<sup>10</sup> and audience members<sup>11</sup> compared to common presentation formats. From a personal perspective, the author has enjoyed viewing student presentations in the AE format if for no other reason than it is a welcome change from the traditional bullet/sub-bullet format the author has assigned and personally used for years. It is possible the students making up the audience appreciate this change as well. However, regardless of any increase in personal enjoyment it is important that assigning the AE format in an effort to liven up presentation sessions does not negatively impact students’ improvement in their presentation skills; the realistic possibility of a failed teaching experiment is a concern held by the author anytime when introducing new pedagogical method(s) to a course.

This work describes the incorporation of oral presentation assignments using the AE model into different sections of a senior ChE Unit Operation laboratory course. The objectives of this work are to: 1) determine if student presentation skills development is altered by assigning the AE model – in particular, if student performance is not negatively affected by using an alternative presentation format, then faculty can assign it as an enjoyable alternative without concern of harming student development/grades; and 2) identify student perspectives on using the AE model for their presentation assignments.

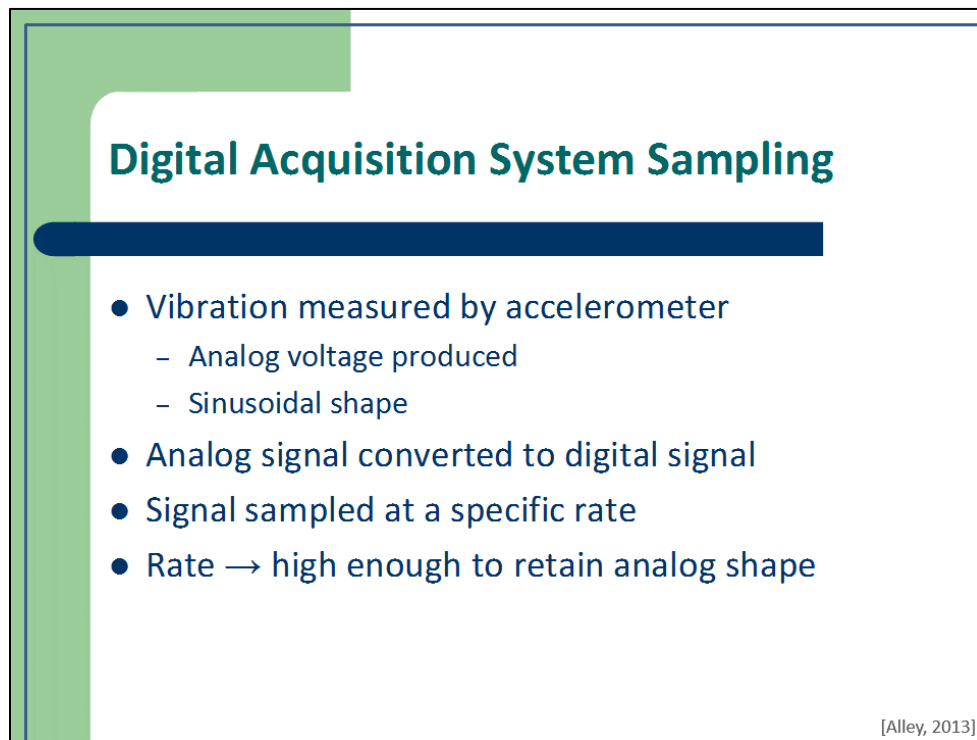
## 2. Differences between the “Death by Powerpoint” and Assertion-Evidence Formats

The benefits of using the AE model for technical presentations instead of the DBP model are discussed thoroughly in Michael Alley’s *The Craft of Scientific Presentations*<sup>6</sup>. This section of this paper intends to provide a brief high-level overview of the comparisons, analysis and suggestions Alley gives in his book to provide necessary background for this study to the reader; additional information is available in Alley’s book<sup>6</sup> as well as a website<sup>12</sup> containing instructional resources supporting the AE method.

The ubiquitous bulleted topic/subtopic structure described here as DBP derives from the default settings of the Microsoft PowerPoint slide master. This slide master was developed in 1986 by an opportunistic entrepreneur and a computer programmer, neither of whom based the bullet/sub-bullet structure upon communications research. Later studies have shown that the DBP format represents a poor choice for technical presentations if the goal of the speaker is audience understanding and retention<sup>13</sup>. An example of a technical slide prepared in the DBP format is shown in Figure 1.

Common problems associated with slides prepared in the DBP format include<sup>6</sup>:

- The header of each slide is often a vague word or phrase (e.g. “Results”) which provides little context for the specific content/goal of the slide or presentation.



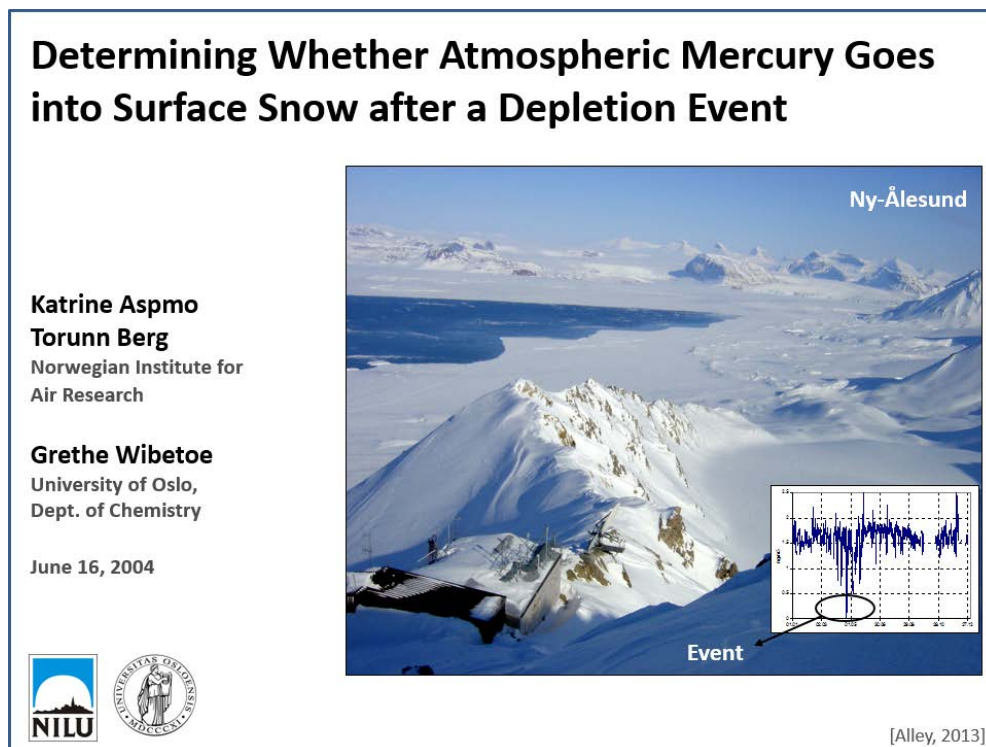
**Figure 1. Example of a slide prepared in the Death-by-PowerPoint format<sup>12</sup>.**

- The bullet/sub-bullet structure encourages the use of text, which can overwhelm or otherwise distract the audience from the speaker and data.
- Excessive use of bulleted lists reduces the amount of space available for images, which is problematic since graphics are central to the psychological principle of multimedia learning<sup>14</sup>.
- According to the psychological principle of coherence<sup>15</sup>, anything which distracts from the speaker’s message (e.g. excessive text, bullets, backgrounds, etc.) should be eliminated to maximize the presentation’s “signal-to-noise ratio”<sup>16</sup>.

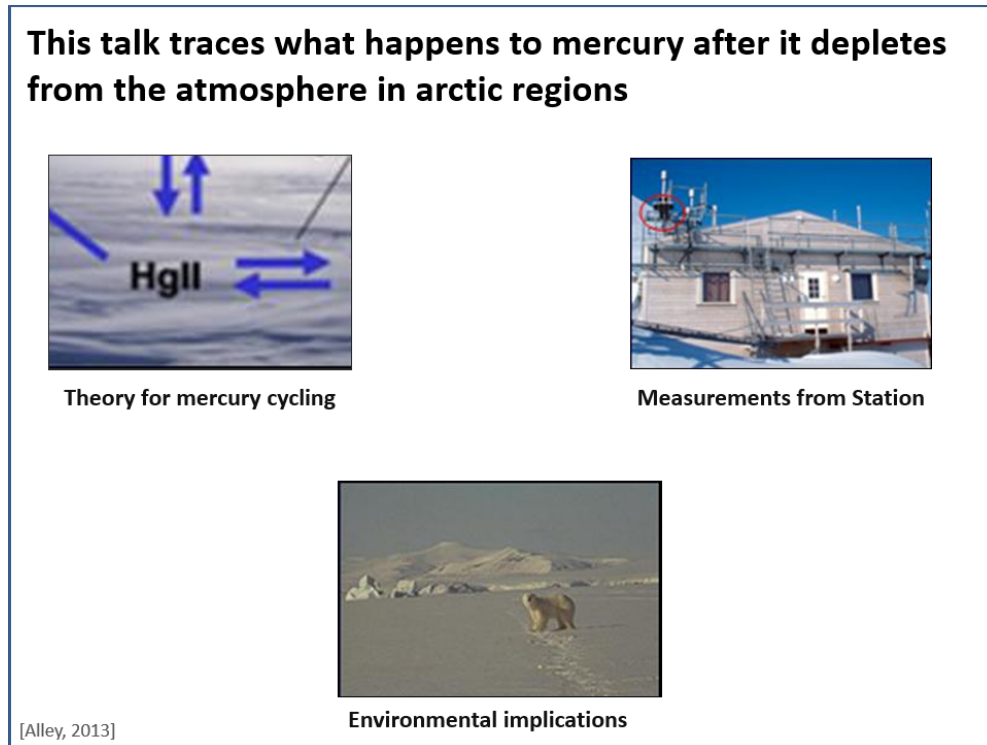
In contrast to the DBP format, the AE format was developed specifically to support oral presentations of engineering content, and borrows strategies from successful presentation formats emerging from private industry and national labs<sup>6</sup>. Examples of slides prepared in the AE format are shown in Figures 2 – 6.

The key tenets of the AE format are<sup>6</sup>:

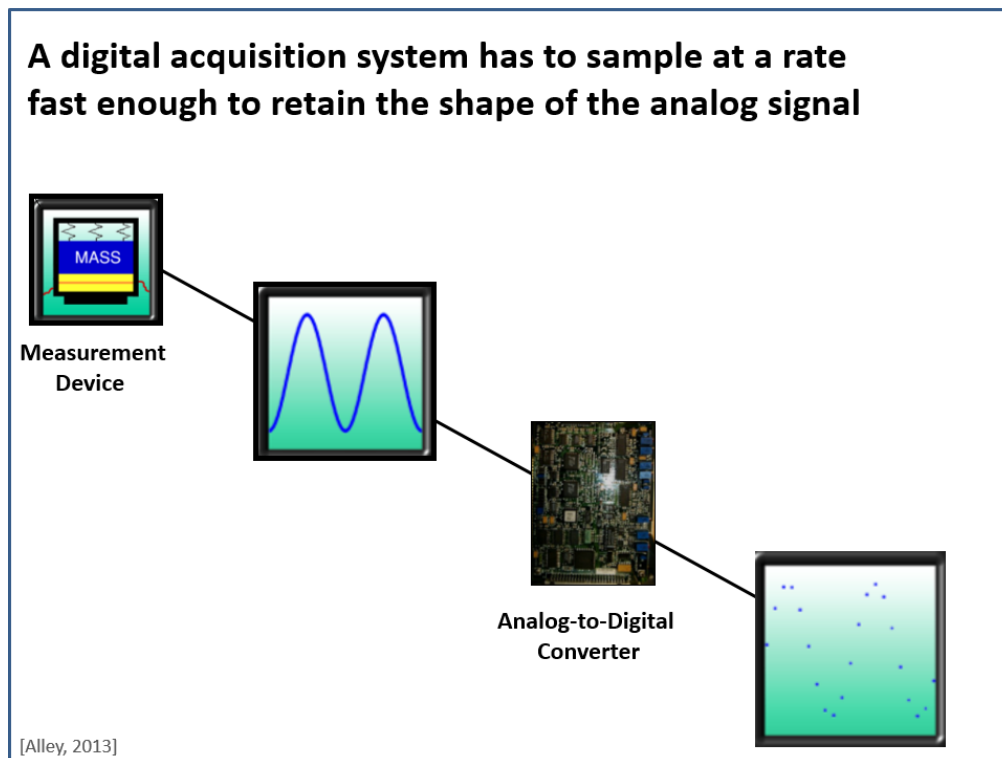
- A title slide providing a memorable graphic relevant to the study, as shown in Figure 2.
- A mapping slide such as that shown in Figure 3 which relies on images (rather than only words) to provide a memorable overview of the talk for the audience.



**Figure 2. Example title slide prepared in the assertion-evidence format<sup>12</sup>.**



**Figure 3. Example mapping slide prepared in the assertion-evidence format<sup>12</sup>.**



**Figure 4. Example presentation slide prepared in the assertion-evidence format<sup>12</sup>. Note the alternative presentation here for the same content of the DBP slide shown in Figure 1.**

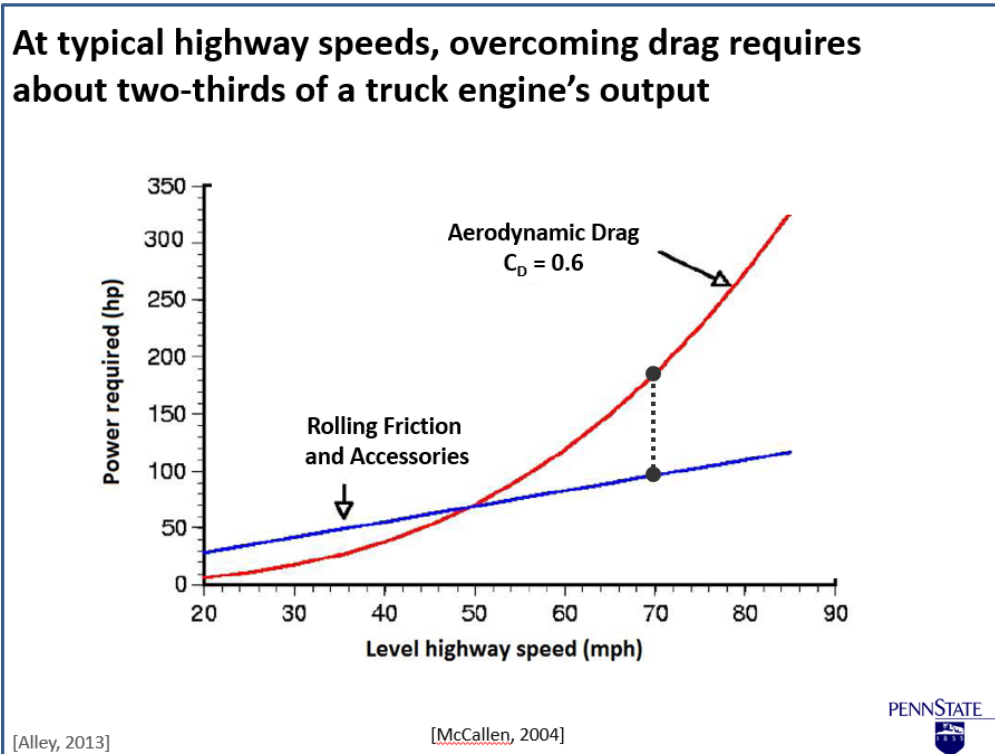


Figure 5. Example results slide prepared in the assertion-evidence format<sup>12</sup>.

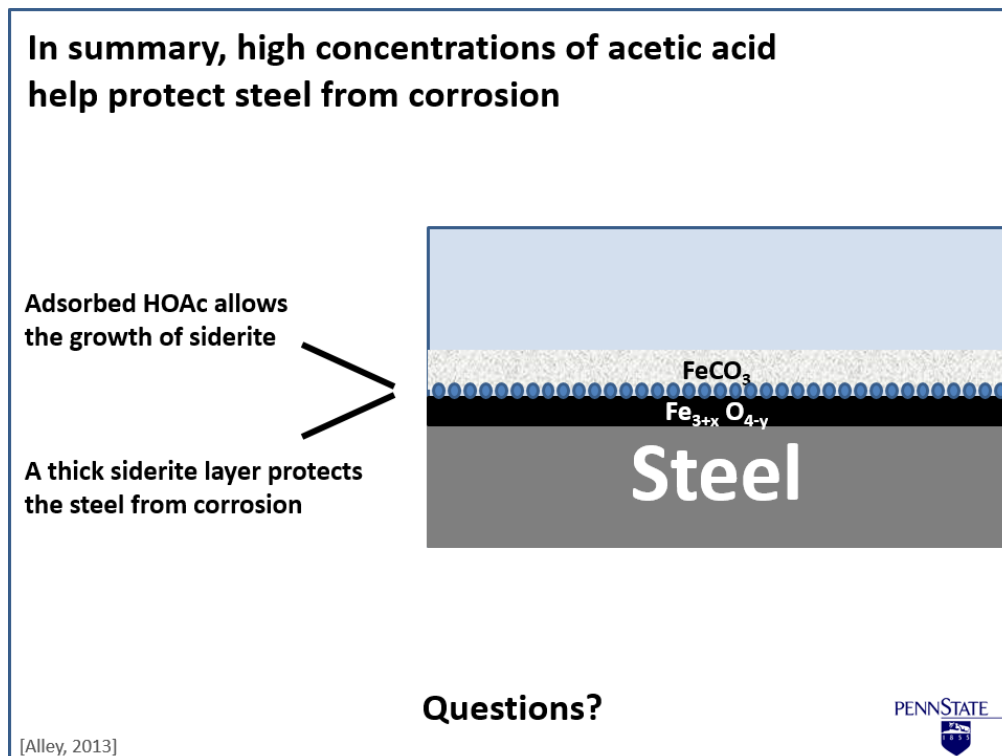


Figure 6. Example concluding slide prepared in the assertion-evidence format<sup>12</sup>.

- An assertion is provided as the header or title of each slide in the body of the presentation as demonstrated in Figures 4 and 5; the slide itself provides visual evidence supporting this assertion in as few words as possible.
- As shown in Figure 6, the concluding slide does not simply say “Questions” but instead includes an image which summarizes the study (similar to the graphical abstracts now required by many scientific journals).

From the presenter’s perspective, using slides in the AE format requires that the presenter provide their own discussion of the data rather than expecting the audience to read every slide, resulting in more dynamic presentations<sup>6</sup>. Speakers are also unable to read word-for-word from slides at length since there are few words on each slide.

It is the author’s opinion that successfully delivering a presentation with slides in the AE format requires a deeper technical understanding on the part of the presenter since the onus is on them to explain equipment, features in data, etc. The author also contends that assigning the AE format makes it easier for instructors to identify student understanding of content compared to the DBP format.

### **3. Description of Study**

The author’s ChE program offers two required unit operations laboratory courses to its students: a four credit hour junior unit operations course (CHE 330) requiring three technical oral presentations, as well as a two credit hour senior unit operations course (CHE 331) requiring three technical oral presentations. In both courses, student presentations are scheduled to last for 20 minutes (10-20 slides) followed by a 10 minute Q&A session with questions asked by the instructor and fellow students enrolled in the section. Students are required to attend all presentations by their fellow students in their section as well as ask a relevant question during the Q&A period of one of these presentations. Both courses are taught by the author.

Instruction on preparation of slides using the DBP format has been a fixture in CHE 330 since the author began teaching the course in Fall 2011, and through Fall 2015 this same DBP presentation structure was again assigned for presentations in the later CHE 331 course (for which CHE 330 is a prerequisite). In both courses students were informed they would be graded according to the rubric given in the appendix as Figures A1, A2 and A3 depending on whether they were responsible for presenting or answering questions. These Fall 2011 – Fall 2015 semesters (n = 340) of CHE 331 which specified the DBP format for all three presentations is treated as a control group in this study.

In Spring 2016 the author began assigning Alley’s textbook<sup>6</sup> which describes the AE slide format as a required text for the senior CHE 331 course. The author informed students at the beginning of the semester that the students’ first presentations would use the traditional DBP format, while

their second and third presentations later in the semester would be expected to have slides conforming to the AE format described in Alley's book<sup>6</sup>. This timing allowed students approximately seven weeks from the beginning of the semester to read the assigned textbook and ask any questions of the instructor before constructing presentation slides in the new format. Students were informed that they would be graded in these second and third presentations according to the rubrics given in Figures A1 and A2, but their slides would be graded according to a rubric specific for the AE method shown in Figure A4 (rather than the slide rubric for the DBP method in Figure A3). Similar instructions were given to students enrolled in CHE 331 in the later Fall 2016 semester. This two-semester sample of students from the Spring 2016 and Fall 2016 semesters (n = 87) using the AE format for their second and third presentations is treated as an experimental group in this study.

It would be expected that student performance and improvement (as evidenced by their overall presentation scores) would not be diminished by assigning the AE model; it may even be expected that exposing students to a different presentation format would only strengthen their performance. In any event, if student performance and improvement using the AE format is not lower than when using the DBP format, then it can be determined that assigning the AE model (which in the author's opinion is more enjoyable as an audience member) is a reasonable alternative to DBP that does not harm student performance or growth.

Open-ended student comments from end-of-semester course evaluations were also collected to investigate student views on using the AE format for their oral presentations and identify factors not originally considered in the study.

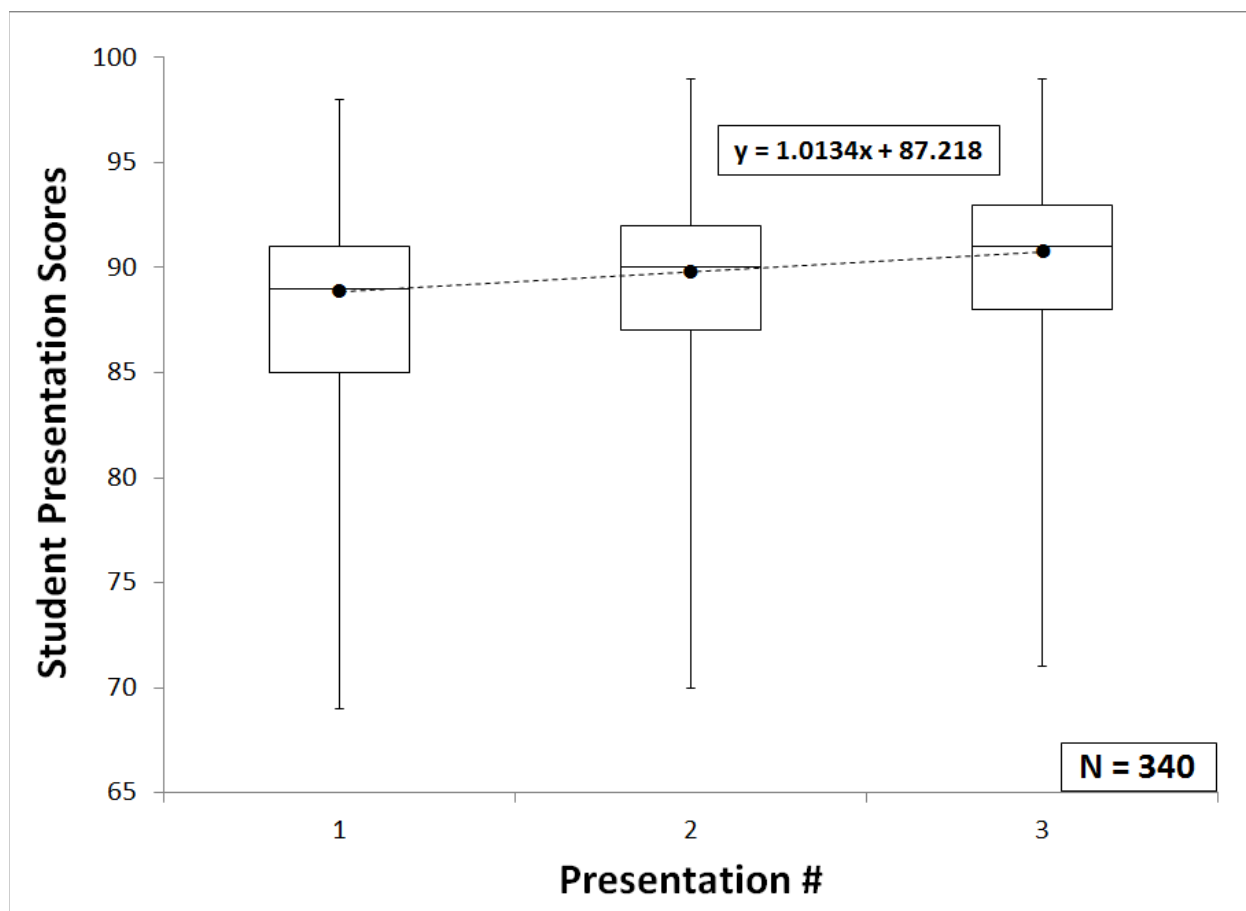
## **4. Results and Discussion**

### **4.1. Comparison of student performance using Death-by-PowerPoint and Assertion-Evidence models**

Student performance in each oral presentation was calculated according to the rubrics given in the appendix as Figures A1 – A4 (note that scores are normalized to a 0-100% scale rather than the 0-150 scale shown in the rubrics). Resulting performance data for the first, second and third presentations are shown for the control group (which used the DBP model for all three presentations) in Figure 7, and for the experimental group (which used the DBP model for the first presentation and the AE model for the second and third presentations) in Figure 8.

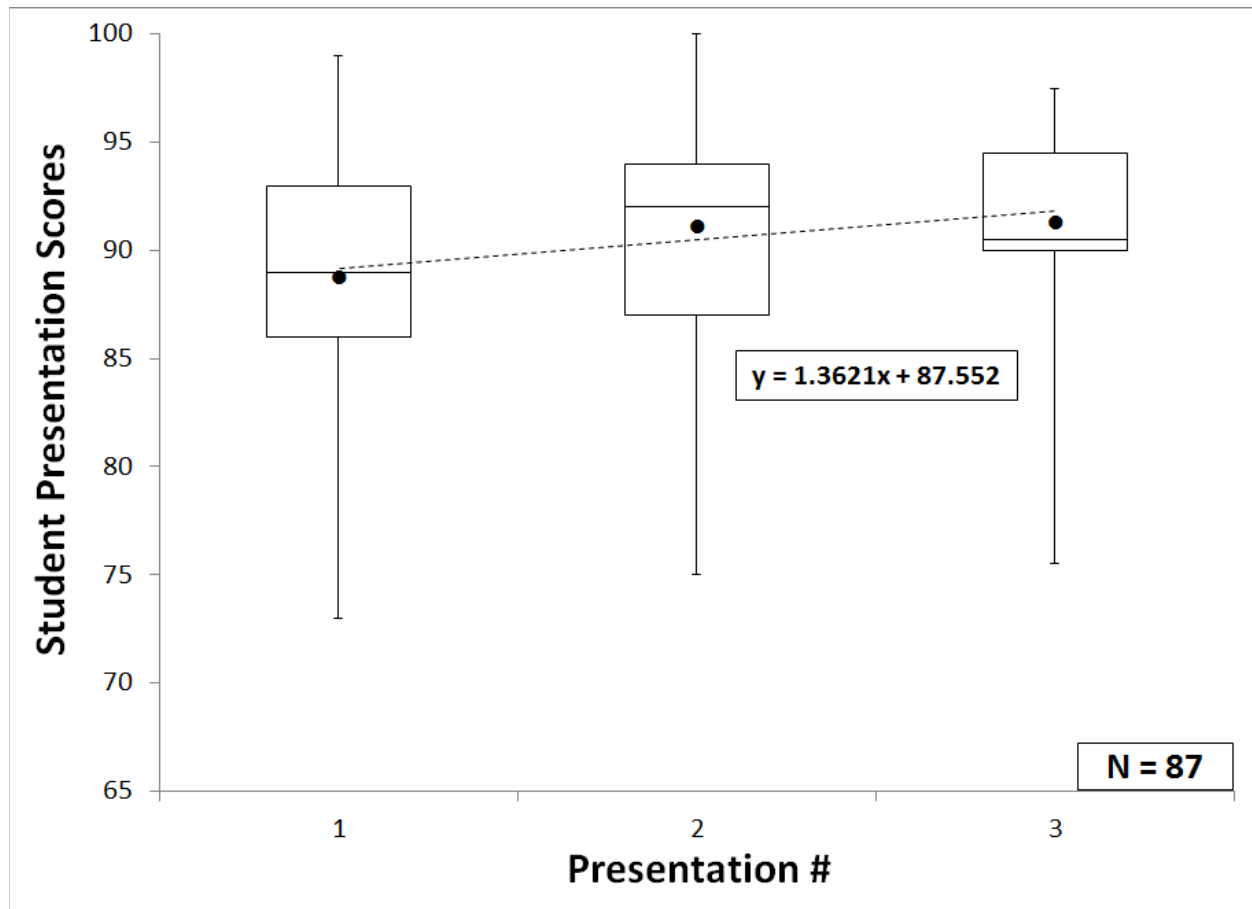
Presentation performance is shown to be quite high for both groups throughout the study, which is to be expected since both groups were comprised of senior students with prerequisite practice constructing slides and orally presenting technical material. As evidenced by the slopes larger than 1 for the plots in Figures 7 and 8, student performance is found to improve as the semester proceeds. This is likely due to additional practice leading to increased confidence as well as feedback from the instructor<sup>17,18</sup>.





**Figure 7. Presentation scores for students taking CHE 331 in the semesters in which the Death-by-PowerPoint presentation format was assigned (control group). The distributions of student scores are depicted through display of the maximum and minimum, first and third quartile, and median scores (high and low error bars, top and bottom of the box, and middle line of the box, respectively). Dots represent the average score of each presentation and are fit to a linear trend (dotted line).**

In order to determine if the experimental group is similar in initial character to the control group (i.e. to ensure an “apples-to-apples” comparison), student performance on their first presentations – for which both groups used the DBP model – were compared using hypothesis testing in a similar manner as for comparison of pre-test data. The groups are found to be similar from a statistical perspective ( $p = 0.38$ ), which implies that the groups are sampled from a similar population. This is expected since all students in the study were accepted into the author’s ChE program under similar criteria and had also received similar prerequisite instruction by the program to that point in their academic careers. Knowing that the groups are similar from the outset, a comparison can be drawn between the slopes of the regression lines (which indicate the improvement of student performance over time) shown in Figures 7 and 8. Although the larger slope for the experimental group compared to the control group (1.36 vs. 1.01) implies that



**Figure 8. Presentation scores for students taking CHE 331 in the semesters in which the Assertion-Evidence presentation format was assigned. The distributions of student scores are depicted through display of the maximum and minimum, first and third quartile, and median scores (high and low error bars, top and bottom of the box, and middle line of the box, respectively). Dots represent the average score of each presentation and are fit to a linear trend (dotted line).**

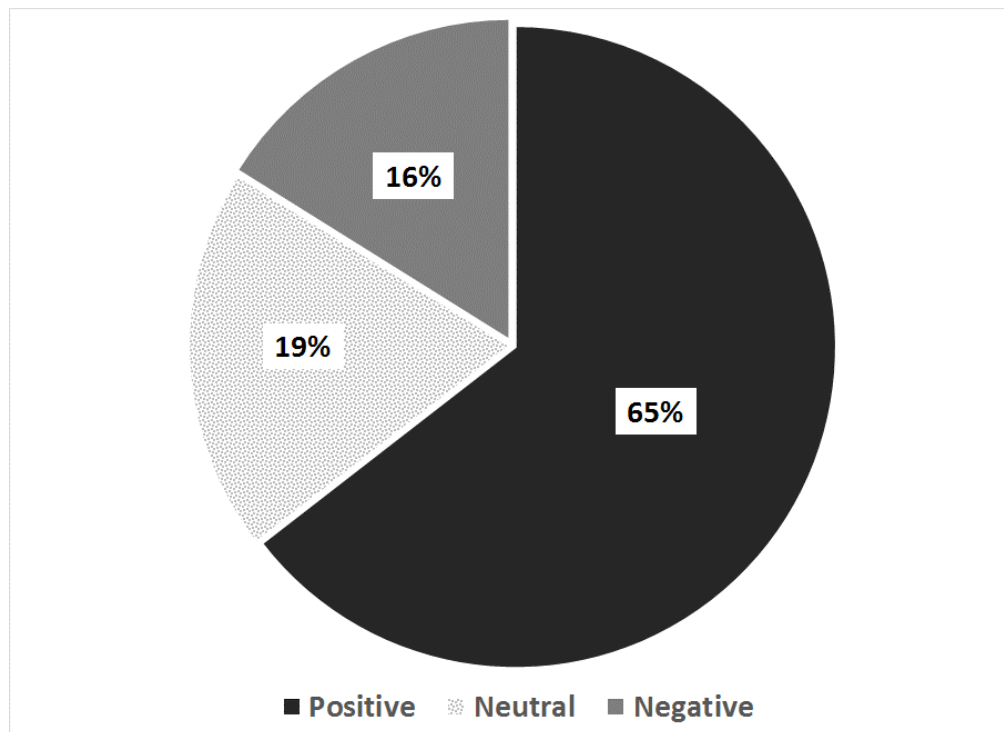
student improvement accelerated when using the AE format, hypothesis testing shows that there is not a strong statistical difference between the slopes of performance data ( $p = 0.12$ ) for the students who were assigned the AE presentation format compared to the DBP format. However, this finding indicates that student improvement in presentations is certainly not diminished by assigning the AE format – with this in mind, instructors should feel confident that assigning the AE method will not hamper student presentation skill development nor negatively affect student scores on oral presentation assignments. Though the collected data cannot strongly support that student performance significantly improved by assigning the AE method compared to DBP, this is in part due to the somewhat small sample size ( $n=87$ ) of the experimental group in the study. If the observed difference between the experimental and control groups persisted over a larger sample, this increase in performance could become statistically significant.

## 4.2. Student feedback

In order to probe student views on the efficacy and enjoyment of being assigned the AE format, end-of-semester course evaluations for the studied semesters included the question “This semester the second and third CHE 331 presentations required that students use the “assertion-evidence” presentation format. Did you think learning the new format was valuable? Why or why not? Would you have changed anything about its implementation in the course?” A total of 31 out of 87 students in the experimental group (36%) volunteered to answer this question.

A summary of the tone of student responses to this question is given in Figure 9. On the whole, comments from students indicate they generally had a positive attitude (65% of responses) toward being assigned the AE format:

- “The [AE format] helped the audience much more than the previous [DBP] format. With assertion-evidence, there was a clear purpose for the slide asserted at the top that was then addressed by the speaker. The images were easier to follow than text, and whether intentionally or not, I found that assertion-evidence format encouraged larger graphs that were much easier to read.”



**Figure 9. Tone of student comments on the value of being assigned the assertion-evidence format for presentations.**

- “[The AE] format seems to be valuable because it makes the students better understand the key takeaways from the lab before the presentation.”
- “I like the idea of providing more informative and interesting visuals to display information. I'll definitely think about that more moving forward with how to make my presentations better and more professional.”
- “Yes because it allowed students to focus less on reading or referencing the PowerPoint presentation. This [encouraged] knowledge of the experiment, its purpose, and the results.”
- “The assertion-evidence format certainly made the presentation sessions more interesting.”
- “[The AE format] helped engage the audience more, and I enjoyed watching people present in the new style.”
- “I now use this format in my co-op and I think it is the best format for most technical presentations. I am glad that we were taught how to use it.”

These comments indicate that students 1) appreciated the opportunity to learn a new presentation style; 2) felt the AE format helped to improve presenter and audience understanding of the experiment; 3) learned something they will, or already have, incorporated into their later presentations; and 4) enjoyed watching their fellow students present in the AE format as an audience member.

Neutral student comments (19% of responses) were also observed, such as:

- “Meh. No real difference in learning.”

A minority of students (16% of responses) provided constructively critical or otherwise negative comments regarding the AE method:

- “I liked the [AE] presentation format, but I think it's kind of limited. Some things are really not able to be conveyed through just pictures/graphics, and it is very difficult to put together a conclusion slide that summarizes your main points if you have more than one or two main points.”
- “I feel like [the AE format] stifles creativity. I get bored by seeing just graphs on white backgrounds. It's almost like getting the textbook read to you.”
- “As an audience member it's harder for me to follow such presentations because I have to rely on the words of the presenter, and if I miss something or something is not spoken clearly, it's easy to get lost.”

- “It did make it much more difficult to follow along [in the audience] if you got confused since there wasn't any text to refer back to the main points said.”

Student comments also provided food for thought regarding improvements to implementation of the AE format in the classroom, which will be discussed in Section 4.3:

- “It might be worth it to create a third presentation style and have us do a different presentation style for each lab.”
- “The implementation of the new format at the second lab is ideal in my opinion, because it gives one lab presentation for students to acclimate to the class before changing something as vital as presentation formatting.”
- “It would have been helpful to learn the presentation style from something other than the book, such as a video or presentation.”
- “I would try to avoid reading a book. Personally I did everything else I could instead i.e. videos and Google explanations.”
- “I think a screencast would be sufficient... instead of having to buy and read a book.”
- “An example of [the instructor] applying the assertion-evidence model [themselves] would have been a great learning aid.”

#### **4.3. Lessons learned and tips for faculty assigning the AE format for student presentations:**

- *Students appear to demonstrate the same fatigue regarding DBP syndrome as faculty and expressed appreciation over learning a new presentation style. One student suggested assigning a third presentation style to get additional practice with multiple formats. If you find yourself becoming exhausted with DBP syndrome as a faculty member, consider assigning the AE format in your course instead (the author has provided a scoring rubric in the Appendix of this article for your reference). This study indicates that student performance will be largely unchanged or perhaps even improve, and the majority of students will appreciate the change both as presenters and audience members.*
- *A number of students expressed that it was helpful to complete their first presentation of the semester in the traditional DBP method to ease the stress associated with classes at the beginning of the semester. This schedule also allows students time to learn about the new method before attempting it for a grade.*
- *Students did not seem to like being assigned a book to read, with many students suggesting to provide instruction in the form of screencasts, videos or lectures instead of assigned reading. One student even said they searched out these resources online on their own rather than read a book. Keep this Millennial generation aversion to reading books<sup>19</sup> in mind and consider alternative forms of communicating information on the AE method.*

## 5. Conclusions

The DBP slide format often results in formulaic presentations which can be mind-numbing to instructors (and students) who complete multiple oral presentation assignments in their courses. In an effort to enhance student learning while providing a welcome change of pace for both students and instructors, the author assigned oral presentations requiring the AE format in a senior unit operations course. The AE format has been specifically designed for technical presentations as a way to encourage dynamic, enjoyable presentations while improving understanding and retention for both the speaker and audience. In order to determine if assigning the AE format impacted students' improvement in oral presentations, student performance for a cohort using the AE format was compared against a similar historic student cohort that completed oral presentations using the DBP format. It was found that student improvement in presentations was not hampered by assigning the AE format, and there was no negative impact on student grades. With this in mind, instructors should feel confident that assigning the more enjoyable AE method will not hamper student presentation skill improvement nor negatively affect their scores in the course. The majority of student comments on being assigned the AE method were positive, with students stating they enjoyed the challenge and change of pace using the AE format both as speakers and audience members. Suggestions for instructors who would like to assign the AE format in their courses were provided. Ideas for future work include studying whether use of the AE format effectively improves the presenter's and/or audience's eventual technical understanding of the presentation material relevant to chemical engineering; it is suggested that this could perhaps be accomplished by giving a pre- and post-test on the presentation topic before and after the presentation.

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## Appendix

Rubrics used by the author during this study are given in Figures A1 – A4.

CHE 330 / 331 Oral Presentation Grade Sheet				
<b>Experiment:</b>				
<b>Date:</b>				
<b>Presentation</b>	<b>1 (Poor)</b>	<b>2 (Satisfactory)</b>	<b>3 (Excellent)</b>	<b>Weight</b>
<b>Technical Accuracy</b>	Numerous technical errors / omissions	Very few technical errors / omissions	No technical errors / omissions	4
<b>Technical Depth</b>	Little or no technical depth in discussion	Omits parts of conceptual discussion	Explains all underlying phenomena clearly	4
<b>Delivery</b>	Inaudible and/or poor pace	Acceptable clarity, interest, pace, eye contact	Very clear, dynamic, good pace	5
<b>Professionalism</b>	Lacking in more than one of dress / language / style	Lacking professionalism in one of dress / language / style	Presenter professional in dress, language and style	4
<b>Poor Habits</b>	More than 5 "uhs"; multiple distracting habits or hesitations	Less than than 5 "uhs." Very few distracting habits.	No hesitations or "uhs." No distracting habits	3
<b>Question</b>	No / duplicate / unprofessional question (-3)	Satisfactory question (-0)		--
			<b>Total (60 maximum):</b>	
<b>Comments:</b>				

**Figure A1. Instructor grading rubric for individual student (as oral presenter).**



CHE 330 / 331 Oral Q&A Grade Sheet				
<b>Experiment:</b>				
<b>Date:</b>				
<b>Q&amp;A</b>	<b>1 (Poor)</b>	<b>2 (Satisfactory)</b>	<b>3 (Excellent)</b>	<b>Weight</b>
<b>Readiness to Answer Questions</b>	Does not voluntarily participate in Q&A session	Provides few answers or dominates Q&A session at expense of others	Readily answers questions while allowing others to participate	8
<b>Technical Accuracy</b>	Multiple mistakes / egregious errors	Minor errors	No errors	3
<b>Clarity of Responses</b>	Rambling or off-topic responses	Minor clarity issues	Clear responses	3
<b>Sufficiency</b>	No depth of explanation in answers	Moderate depth in explanation, but missing key points	Explanation shows depth of understanding	3
<b>Brevity</b>	Very long answers or short answers lacking explanation	Responses moderately too short or long	Appropriate brevity	3
<b>Question</b>	No / duplicate / unprofessional question (-3)	Satisfactory question (-0)		--
			<b>Total (60 maximum):</b>	
<b>Comments:</b>				

**Figure A2. Instructor grading rubric for individual student (as question answerer).**

CHE 330 / 331 Oral Presentation Grade Sheet - Presentation Slides				
Experiment:			Date:	
Group	1 (Poor)	2 (Satisfactory)	3 (Excellent)	Weight
Technical Accuracy (Slides)	Numerous serious errors / omissions	A few minor errors / omissions	Very few or no errors / omissions	5
Technical Depth	Much missing discussion	Modest room for more technical depth	Thorough technical depth	3
Error Analysis	No error analysis presented	Uncertainties missing from some values	Uncertainty explicitly presented	3
Clarity	Unclear message	Minor clarity issues	Easy-to-understand presentation	5
Visual aids / graphics	Poor or no graphics	Graphics that moderately support presentation	Attractive graphics that support slides	3
Presentation Aesthetic	Difficult to read, distracting color scheme	Fonts, margins, etc. are not consistent (and other small distractions)	Pleasing colors, consistent fonts, legible	3
Timing	Longer than 20 minutes	Presentation too short	Completed within 20 minutes but not exceptionally short	2
Question Handling	One person dominates Q&A session	One or two Q&A people answered most questions	All Q&A people readily participated	1
Hard copy	No hard copy provided	Hard copy doesn't match presentation	Hard copy provided	2
Citations	Multiple missing citations	One missing citation	All citations present	3
<b>Total (90 maximum):</b>				

**Figure A3. Instructor grading rubric for group presentation slides (DBP format).**

CHE 330 / 331 Oral Presentation Grade Sheet - Presentation Slides				
Experiment:			Date:	
Group	1 (Poor)	2 (Satisfactory)	3 (Excellent)	Weight
Technical Accuracy and Depth	Numerous serious errors / omissions	A few minor errors / omissions or room for more technical depth	Thorough with very few or no errors / omissions	5
Error Analysis	No error analysis presented	Uncertainties missing from some values	Uncertainty explicitly presented	2
Clarity	Unclear message	Minor clarity issues	Easy-to-understand presentation	4
<i>Title Slide (pg. 73)</i>	Text on blank background	Missing one or more of "Excellent" criteria	Attractive slide with image providing entry point to work	2
<i>Mapping Slide (pg. 77 and 179)</i>	Anchored with bullets and no images	Anchored with bullets and images	Anchored with images rather than bullets	2
<i>Slide adherence to evidence-assertion format (pg. 105-184)</i>	More of a "typical" Powerpoint presentation	Inconsistently achieves "Excellent" criteria	Consistently avoids topic/subtopic structure, minimal text, heavy reliance on visual evidence	5
<i>Concluding Slide (pg. 183)</i>	Essentially a blank slide with "Questions?"	Either does not effectively emphasize key takeaway or no/poor image	Slides emphasizes main takeaway with supporting image	2
Timing	Longer than 20 minutes	Presentation too short	Completed within 20 minutes but not exceptionally short	2
Question Handling	One person dominates Q&A session	One or two Q&A people answered most questions	All Q&A people readily participated	1
Hard copy	No hard copy provided	Hard copy doesn't match presentation	Hard copy provided	2
Citations	Multiple missing citations	One missing citation	All citations present	3
<b>Total (90 maximum):</b>				

**Figure A4. Instructor grading rubric for group presentation slides (AE format), showing page numbers accompanying Alley's Craft of Scientific Presentations<sup>6</sup>.**