STAT 410: Classroom Observation Assignment

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I. Big Picture & Interactions

The introductory statistics class we observed was STAT 217: Introduction to Statistical Concepts and Methods at Cal Poly. The course description for the class includes the following statistics concepts: sampling and experimentation, descriptive statistics, confidence intervals two-sample hypothesis tests for means and proportions, Chi-square tests, linear and multiple regression, and analysis of variance. The course description also states that there is substantial use of statistical software. We observed a section of STAT 217 on February 15, 2024.

In the class we observed, the teaching approach was highly interactive, seamlessly integrating lecture with active student participation. The session commenced with a welcoming introduction, where the professor outlined course logistics, emphasizing the importance of office hours and peer tutoring. Transitioning to the heart of the lesson, the professor adeptly combined lecture with hands-on problem-solving, employing a whiteboard to work through an example problem that laid the foundation for the day's focus on confidence intervals and hypothesis testing.

As the class progressed, the professor facilitated group work, dividing students into pairs or small groups, which fostered an environment of collaborative learning. These groups were assigned by the professor, and students were assigned to new groups every week. In these groups, the students worked on a new example, reinforcing the concepts the professor just reviewed in the example worked through at the beginning of class on the whiteboard. This method not only encouraged students to engage with the material and each other but also allowed for personalized interaction as the professor moved between groups, offering guidance and answering questions. The class ended in a collective review of the problem the students just worked on in their groups, reinforcing the session's key concepts and ensuring a cohesive understanding among students.

Echoing the sentiments of Rossman, Chance, and Medina's article on the distinction between statistics and mathematics, the professor placed a strong emphasis on the interpretation of statistical conclusions over mere calculations. While in the example that the students worked on in groups included some calculations, the professor emphasized that while he wants them to do calculations, they should focus on interpretations. Furthermore, after working on the example for a bit, the professor stated that if they had not finished the calculations yet, to move on to the interpretations and wrote the solutions to the calculations on the board for the students who did not finish yet, so they could focus on interpreting. This approach highlighted the critical role of context in understanding statistical concepts, a theme that was consistently woven through the lesson's narrative. The handout, which served as the primary teaching tool, featured examples rich in context previously discussed, underscoring the importance of applying statistical knowledge in real-world scenarios. The handout also highlighted the lack of definitive inclusions in statistics, which is a crucial concept in an elementary level statistics course. For example, the handout was on confidence intervals, and the professor emphasized what they mean and what we can conclude based on them. There was also an emphasis on students being able to communicate statistical knowledge by interpreting statistical values and being able to come to conclusions based on their calculations.

The classroom environment was conducive to interaction, with the physical setup encouraging dialogue among students. The layout of the classroom was multiple tables with two chairs each. During the class we observed, nineteen students were present, fourteen of whom sat together (seven pairs), and five students sat alone. Before the class started, there was minimal interaction between students. Students interacted with each other primarily during the handout activity, working in pairs or small groups. This collaboration was encouraged by the professor, who assigned partners and facilitated group discussions. During this group work time, most groups are talking and working with each other, although two groups had minimal interaction, and appeared to be mostly working individually. One group seemed particularly close, as they were chatting during most of the group time instead of working on the handout, talking about their personal lives, taking selfies together, and talking about the Chick-Fil-A line on campus.

Despite a varied level of engagement initially, the professor's method of rotating partners weekly seemed to foster a dynamic learning atmosphere. This, coupled with the professor's efforts to relate material to familiar concepts and inject humor, contributed to a comfortable and engaging class atmosphere conducive to learning. The structure of the class is also consistent, so students know what to expect each day they come to the classroom. The structure appeared to blend lectures with hands-on activities, indicated by the use of handouts and group discussions. This seemed how the class was usually taught. There are no asynchronous meetings, however there is a questions discussion available on Canvas for the students to ask questions to the professor and see the questions other students are asking. In addition to the handouts they work on in class, the other assignments as part of the course are applications (where they apply the concepts learned in class) and a portfolio.

The professor actively engaged with students, asking open-ended questions, facilitating discussions, and providing individual feedback during group work. This approach prompted students to share their thoughts and questions, fostering a dynamic learning environment. The professor also circulated the room when the students were working in groups, answering questions and providing guidance. This approach allowed for direct interaction with students, offering personalized feedback and fostering a supportive learning environment. The professor also attempted to make some jokes and make the atmosphere more light-hearted, connecting with the students on a more personal level. Examples of this included telling a Valentine's day joke at the beginning of class, mentions Taylor Swift and Travis Kelce, and compared an example to Steph Curry shooting a free throw. This shows the professor is trying to relate concepts and examples to something students are familiar with. Additionally, during the lecture portion, every time a student volunteered to answer a question or ask a question, it was almost always a different student everytime, so a good portion of the students were participating, not just a small number of the same students participating. Also, after class was over, two students went up to ask him questions. Thus, the professor seemed to have created an environment where students are not afraid to answer questions, because even if an answer was slightly wrong, the professor would sort of adjust or rephrase the question rather than say that the answer is incorrect.

Overall, students remained engaged through various activities, including discussions on statistical concepts and working through handout exercises. During the lecture, some students were off task, which was seen because they were on their phones or watching something off topic (like sports) on their laptops. During the lecture portion, there was a mix of note-taking strategies from the students. Most students were taking notes on their tablet, laptop, or on paper, while some just had the empty handout pulled up and did not take any notes. During the group collaboration time, most students were on task and working through the example in their groups. Some groups were off task, were on their phone or talking about their personal lives, while some students were also eating during class (lecture and group work time).

In summary, the class exemplified a balanced mix of traditional lecture and interactive, hands-on learning. Through the strategic use of handouts, group work, and direct engagement, the professor successfully cultivated an environment that not only emphasized the importance of statistical interpretation over computation but also encouraged active participation and collaboration among students. This approach, reflective of the principles discussed in class readings, effectively demonstrated the value of context and communication in statistical education, setting a benchmark for teaching methodologies in the field.

II. Content

The lesson navigated through the concepts of confidence intervals and hypothesis testing, leveraging real-world examples, such as the intriguing dataset on kissing couples and the behaviors of teenagers changing clothes and shoes while driving. These examples underscored the practical application of statistical inference in everyday life, providing students with a tangible connection to the abstract concepts discussed.

One potential area of confusion for students could stem from the nuanced relationship between the confidence level and the margin of error, particularly the trade-off between increased confidence and the width of the interval. Additionally, the intricacies of interpreting a 95% confidence interval, particularly the common misconception about what "95% confidence" conveys, also pose significant challenges. This underscores the delicate balance between statistical accuracy and the interpretive nuances required in understanding confidence intervals.

Reflecting on the GAISE report's nine learning goals, the professor adeptly covered several key objectives. These included critical evaluation of statistically based results in media, the application of the investigative process in statistics, and the interpretation of numerical summaries and graphical displays. The lesson also illuminated the central roles of variability and randomness in statistical analysis, provided foundational experiences with statistical models, and emphasized the principles of statistical inference through practical examples. The professor was able to relate the lesson to popular media by including an example that involved polling data, and how to interpret statistical results from analysis conducted on the polls. Students were introduced to the investigative process in statistics by working through examples that involved forming confidence intervals, and also identifying parameters and estimating them from sample data. Students were required to interpret numerical summaries by producing and interpreting statistical summaries in the context of the real-world example. The lesson directly addressed the central role of variability in the field of statistics through the construction and interpretation of confidence intervals. While specific to confidence intervals, the handout laid the groundwork for understanding statistical models by discussing parameter estimation. The entire handout is dedicated to teaching basic ideas of statistical inference, specifically through the use of confidence intervals for various real-life scenarios. Although the explicit discussion on ethical issues and statistical software output interpretation was less evident, the foundational concepts necessary for ethical practice and software output interpretation were implicitly woven throughout the lesson.

Addressing Jessica Utts' essential topics for an elementary statistics course, the lesson touched on several areas, including the differentiation between statistical and practical significance and the exploration of common sources of bias in surveys and experiments. The differentiation between statistical and practical significance was implicitly addressed through examples showing how confidence intervals can inform us about practical significance. A common source of bias in a study was addressed in an example in the handout involving a sample of teenagers taken from the Pacific Northwest region of the United States. The professor discussed the impacts of generalizing the conclusions to all teens in the United States. The professor also emphasized that the data uses the phrase "occasionally" when describing the frequency of teens changing their clothes and shoes while driving. However, what counts as occasionally? Did they specify what occasionally means? What counts as changing clothes and shoes while driving? The professor made sure to emphasize how the students need to be careful when seeing reports and data in the news like this, especially when using subjective language like "occasionally". However, opportunities to delve deeper into topics such as the distinction between causation and correlation, the nature of coincidences and improbable events, and the clarification of "confusion of the inverse" were not fully seized. These areas represent crucial aspects of statistical literacy that could enhance students' understanding of the material. The professor could have addressed the distinction between causation and correlation through the use of two different examples, one being a randomized experiment and another being an observational study. The professor also missed an opportunity to discuss the nature of coincidences with the topic of the lesson being confidence intervals, and the possibility of the true parameter falling outside of the confidence interval. However, the "confusion of the inverse" would have been a difficult topic to cover in the handout or lecture, since conditional probabilities were not discussed in the lesson.

In conclusion, while the lesson provided a solid foundation in confidence intervals and hypothesis testing, enriched by real-life examples, it also highlighted areas for deeper exploration. Addressing the nuances of statistical significance versus practical importance, and expanding on the ethical considerations and the interpretation of statistical software outputs, could further refine students' grasp of statistical concepts. This critical analysis, rooted in the curriculum and the insightful observations made during the class, underscores the continual opportunity for pedagogical enhancement in the teaching of statistics.

III. Assessment

During the class, the assessment of student understanding was notably interactive and centered around key concepts of confidence intervals and hypothesis testing. A particularly insightful moment occurred when a student inquired about the standard for confidence levels, sparking a comprehensive explanation from the professor about the inherent trade-off between confidence level and margin of error. The professor answered: "There's a tradeoff, more confidence means larger margin of error, so wider interval, more confident but less precise. 95% is the standard. If you want other confidence levels, use a different multiplier. More confident, bigger multiple, larger margin of error, wider interval, less precise. Does that answer the question?". The professor not only answered the student's question, but also made sure that the student understood and had their question fully answered before moving on. This exchange not only illuminated the concept of confidence intervals but also demonstrated the dynamic engagement between the professor and students, with the professor's clarification underscoring the balance between confidence and precision in statistical analysis.

Another notable statistical question that was asked during the lesson was "Can we conclude that more than half of kissing couples lean to the right when kissing based on the confidence interval that we calculated?". This question helps students think outside of the mathematical calculations, and more about what we can statistically infer based on the calculations, which reinforces the foundation of many statistical concepts.

The professor's method of embedding statistical questions within the handout activities further facilitated this engagement, challenging students to interpret specific statistics and hypothesize about population behaviors based on sample data. Such questions, especially regarding the directional leaning of couples in a kiss as inferred from confidence intervals, encouraged students to apply theoretical knowledge to practical scenarios, fostering a deeper understanding of statistical inference.

Observations of the class's active participation, the diversity of questions posed by students, and the accurate responses given to posed questions collectively suggested a solid grasp of the day's material by the students. This engagement indicates not only comprehension but also the ability to critically engage with statistical concepts, reflecting the effectiveness of the teaching and assessment strategies employed.

A statistical question that the professor could have asked the students is, "How does changing the confidence level from 95% to 99% affect the width of the confidence interval?". This embodies the essence of critical thinking and application of statistical principles. It prompts students to consider the implications of confidence levels on the precision of their estimations, thereby reinforcing the conceptual understanding of statistical inference and its practical applications in research and decision-making processes. This question would have furthered the students' ability to critically analyze statistical data and understand the balance between confidence and interval width, a key aspect of statistical literacy.

IV. Evaluation & Reflection

To optimize the learning experience in the statistics classroom, integrating diverse forms of student collaboration alongside technology can significantly enhance both student-student and student-professor interactions.

To improve student-student interaction, the professor can encourage more diverse forms of student collaboration, such as through online forums or mixed-group discussions, and could enhance peer interaction. The professor is already assigning new groups every week, but they could try to make an effort to make sure not to group together individuals that are already very chatty around each other. Additionally, implementing cooperative learning through having something turned in for the groups they are put in, like an exit ticket, so they can be held accountable for working on that activity and have a shared group goal. This makes sure that all individuals understand the concept because they know someone will be selected to share their answer. This would also make sure that they are working together and helping each other. This fosters a collaborative environment where students are accountable not only for their own understanding but also for their peers. This method ensures active engagement and mutual support, promoting a deeper comprehension of statistical concepts.

Further enriching the classroom dynamics involves engaging students more actively during lectures. During the beginning of class where the professor worked through the example on the white board, he mostly did the actual work and calculations alone, and only asked for student participation occasionally. Instead of the professor leading problem-solving efforts, inviting students to participate in real-time problem-solving encourages a more inclusive and engaging learning environment. This strategy not only enhances student-professor interactions but also deepens students' practical understanding of statistical concepts.

Another suggestion is to possibly further implement a flipped classroom approach, where the students first get exposed to new material outside the the classroom, so students come to class having already watched the lecture material, and then class time to devoted toward applied learning activities of the material they were already exposed to in an environment where the professor is there for questions and to correct misconceptions. The professor is already implementing ideas of a flipped classroom, since there was no formal lecture in class, since they were working through examples first in a more guided setting with the professor, and then split off into groups working on it more individually, with the professor still there to provide guidance. To implement this, the professor could formally prepare some lecture recordings for the students to watch before coming to class, and then to continue working on examples as a class, in groups, and individually during class time. In addition, the professor can assign a few more problems for the students to work on after class to really solidify their knowledge in the concepts covered previously.

Additionally, the professor could try implementing a constructivist approach in the classroom. To do this when teaching confidence intervals and hypothesis testing in an introductory statistics class, the professor could design activities where students explore these concepts through the analysis of real-world data sets, such as evaluating product reliability or political polling accuracy. By encouraging students to formulate hypotheses based on their prior knowledge and then test these hypotheses through data analysis, the professor facilitates a learning environment where students actively construct new understanding. This approach also includes promoting student-student and student-teacher interactions through discussions, where students can share their insights, challenge each other's reasoning, and collaboratively refine their understanding. Incorporating scenarios that require students to navigate ambiguity and apply statistical reasoning to draw conclusions can further enhance their learning experience, emphasizing the process over the mere attainment of the correct answer. Through these strategies, the professor can scaffold students' learning, guiding them from their current understanding to a deeper and more nuanced grasp of statistical concepts.

A student-centered approach can be further promoted by implementing data collection and analysis projects that allow students to explore statistical concepts through their own investigations. This hands-on experience encourages students to engage deeply with the material, fostering a personal connection to the subject matter.

Effective use of technology, such as integrating statistical software for data analysis exercises and minimizing distractions from mobile devices, can greatly enhance students' understanding and engagement. While technology was used to present the handout onto the white board and TVs around the room, further incorporation of statistical software for data analysis exercises could enhance understanding and engagement. In the handout (just not in the examples in the particular class we observed), it seems that there is a use of the Rossman Chance applet for simulation. A majority of students also used their phones as their calculator when working through the examples. Additionally, the professor has solutions of the handout projected onto board and TV (only scrolls to answer once completed on board) so students have his version and nicely typed out version to reference. By encouraging the use of dedicated calculators and further integrating technology thoughtfully, students can engage with the material in a focused and interactive manner.

Addressing weaker features of the class, such as distractions from mobile devices and passive learning during lectures, can significantly improve the learning environment. Students were using their phones for non-class activities, such as texting, taking selfies, and using social media. This distraction likely impacted their engagement and focus during the lesson. A suggestion to address this is to implement a policy that limits or manages phone use during class time. For instance, the professor could introduce phone-free periods during critical teaching segments or use technology integration, like polling apps, to keep students engaged with their devices in a productive manner. The professor could also tell students to bring a calculator to class, rather than calculate on their phone, which could lead to them being distracted. Additionally, while the professor was actively teaching and engaging with the material, there was a reliance on lecturing and individual work, with limited student interaction during these segments. Additionally, for the handout they were working on in class, they are not turning in the handouts and solutions might be on Canvas or at least some solutions projected onto the board, so there is little motivation to actually complete it and work on it. A suggestion to improve this is to incorporate more active learning strategies that require student participation, such as think-pair-share, where students first think about a question individually, then discuss their thoughts with a partner, and finally share with the class. This can enhance engagement and ensure that students are actively processing and applying the concepts being taught.

The class demonstrated a strong alignment with Garfield's Principles for Learning Statistics through active learning, real-world applications, encouragement of discussion and questioning, use of technology and visual aids, and a diversity in instructional strategies. The professor actively engaged students with exercises on confidence intervals, fostering an environment where students are not merely passive recipients of information. This approach aligns with the principle that students learn best through active involvement. Additionally, by using real-life examples, such as favorite sports among U.S. adults and scenarios involving kissing couples, the professor connected statistical concepts to real-world contexts. This method supports the principle that application of statistics to everyday problems enhances learning.

The professor's method of frequently pausing for questions and encouraging students to discuss their thoughts on statistical interpretations fosters a classroom environment that values critical thinking and inquiry, which is a core aspect of Garfield's principles. Also, the projection of handouts and solutions onto the board and TVs facilitated visual learning, catering to different learning styles as recommended by Garfield.The mix of lecturing, individual work, and group activities provided a varied learning experience that caters to different student needs and preferences, reflecting Garfield's emphasis on diverse teaching methodologies. This method not only facilitated a deeper understanding of statistical concepts but also made the learning experience more dynamic and inclusive.

Similarly, the session reflected the GAISE recommendations by teaching statistical thinking, focusing on conceptual understanding, integrating real data, fostering active learning, utilizing technology, and employing assessments. The professor taught statistical thinking since confidence intervals are a fundamental concept that supports statistical thinking by teaching students to estimate parameters and understand uncertainty in statistical conclusions. There was a focus on Conceptual Understanding through the exploration of confidence intervals which helps students grasp the underlying concepts of statistical inference without focusing solely on mathematical formulas. There was a use of real-world examples to explain confidence intervals integrating real data, showing its application and relevance. The professor fostered active learning, engaging students with hands-on activities related to confidence intervals encourages active participation and deeper understanding. Technology was used, demonstrating how statistical software calculates confidence intervals and integrates technology, allowing students to explore data more deeply. Finally, the use of assessments like the applications and portfolio the students submit evaluates the students' ability to calculate and interpret confidence intervals in various contexts and uses assessment to improve and evaluate learning.