An Exploration of Teaching Strategies for ELLs in Statistics Education

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There was a famous video on Chinese TikTok created by a Chinese English language learner (ELL). There was nothing beside a photo of her lecture room and a text in the left corner of the image, saying “Dear professor, you would feel that I am much smarter, kinder and funnier if I could speak my own language to you.” We may fail to pay enough attention to the ELLs in our classroom, as they do not come to seek help. Nevertheless, we still want to provide a safe and efficient classroom environment that allows ELLs to learn statistics properly. I will introduce the following teaching strategies that may be helpful in a lecture room to support ELLs. The following strategies have been organised by the effort likely required to implement them to take to implement.

Low-effort teaching strategies

Having Pauses in Sentences

When we start thinking about how to help ELLs understand better in a statistics lecture, the first thing that comes to our mind is likely to be slowing the speaking speed. In common sense, ELLs may understand each sentence better if the lecturer speaks more slowly. However, how to slow down one’s speaking speed is worth considering.

Speaking speed may not be the primary reason why ELLs struggle to grasp ideas in sentences. In Blau’s (1990) investigation, having a machine automatically adjust speed did not improve the understanding of ELLs. However, for the case when the speaker added a three-second pause at clause or phrase boundaries, ELLs’ understanding improved. Hence, rather than mechanically reducing speaking speed, which risks making the lecture boring, adding pauses creates better comprehension for ELLs.

Pauses will break the long sentence down, making the content more transparent and easier to understand. For example, the Chinese sentence structure differs significantly from English sentence structures (Zhou, 2018), and ELLs who have Chinese as their first language may find listening to a long sentence challenging. Similarly, ELLs may encounter this challenge at varying levels, depending on the degree of difference between their languages’ sentence structures and English. Lesser and Winsor (2009) also argued that it is essential to allocate a wait time for ELLs. This is because students need to transfer what they hear in English to their own language, think about it in their own language and even need to transfer

it back to English if they need to answer a question. Therefore, adding a pause can actually give ELLs a thinking time to reorganise the sentence into the order they are more familiar with in their brains. Pauses will be especially useful when the lecturer is reading out scenarios that require students to understand them.

Repeat the Key Idea Sentence

For my personal experience, I know my friends who are ELLs themselves found it extremely hard to pick out the key ideas that the lecturer was trying to convey among all the information they listened to in a one-hour lecture. It is also easy for ELLs to lose attention in class because they cannot understand and follow the lecturer. Therefore, purposely repeating the key idea sentence can draw the attention of ELLs and send them a hint that this is the part they should pay more attention to or note down.

Cervantes and Gainer (1992) have shown evidence that repetition facilitates comprehension. They also point out that lecturers do not use repetition due to concerns about the quality of their lectures. However, the strong evidence that repetition has a positive effect. Lecturers should be encouraged to use this strategy for important concepts that students need to understand.

Visualise the Key Ideas on Slides

In addition to the repetition of key ideas, such as definitions, it will be helpful if ELLs can visualise the sentence at the same time. In Flowerdew and Miller's (1992) study, ELL students stated that visual tools, such as pictures, diagrams, and written text, aided their comprehension of the material. They also mentioned that when lecturers wrote keywords on the board, it improved their understanding. For ELLs, having something to read while listening may facilitate comprehension. For example, having the definition of statistics on the screen while repeating this sentence will definitely draw students' attention and boost their understanding.

Lesser and Winsor (2009) argued that statistical vocabulary, such as "mean", can be misunderstood by students. It is a misunderstanding of the word itself rather than a language problem. Therefore, the lecturer needs to be aware of these statistical vocabulary confusions and clarify them for students. The first step is to present the actual definitions of this vocabulary on slides to draw students' attention. This will benefit all students, but especially ELLs, as they may not pick up statistical vocabulary by only listening.

However, it is debatable whether ELLs will listen at all if they have the chance to read. From my personal experience, reading is easier than listening for ELLs, and ELLs may choose to read rather than listen and read simultaneously to ensure they can follow up in lectures, as reading is a more comfortable way for them to process the ideas. It is acceptable in the short term, as the goal of ensuring ELLs understand lectures is achieved. However, it does not help with their actual English abilities in the long term.

Avoid Using Long Sentences

Evidence from Cervantes and Gainer's investigation shows that syntactic simplification helps ELLs' understanding. Having simpler sentences, ELLs may be able to follow the lecture more smoothly, as they can understand more of the content. Moreover, this may help them with their attention as they can follow more.

Nevertheless, Blau argues that lecturers should not overemphasise sentence structure. From my understanding, as long as the lecturers are mindful about the sentences they are saying and using pauses or repetition strategies, complex sentences should not be a problem anymore. Therefore, there is no need to apply all strategies in the same lecture, as this risks making the lesson boring, especially for native speakers. Lecturers should try different strategies and see which one works best for their students.

Use Easier Vocabulary

In Stats 399, Fewster and Stevenson (2024) introduce the idea of using simpler vocabulary to explain definitions. The slide examples are not the explanation for a statistical term; however, students in Stats 399 were asked to put their definition of a statistical term into the "UP-GOER FIVE TEXT EDITOR" to check if the words they chose are simple enough as a class task. Students are only allowed to have a red underline under statistical words that cannot be replaced, such as 'p-value'; otherwise, every word in the student's statistical explanation must be among the top 100 most frequently used words.

This activity may be a good direction to think about teaching ELLs. ELLs may have a limited vocabulary with which they are familiar. It may take them longer to process the words, or they may struggle to recognise them if they are not the ones they use most frequently in daily life. In my personal experience as an ELL, I often had to ask my homestay to explain most of the words she said to me when I first came to New Zealand. I found adjectives the hardest to understand back then. For example, I could understand if someone

said to me, “You did a very good job,” but if they had said, “You have done an extremely fantastic job,” I would not have understood ‘extremely’ or ‘fantastic’ back then. Hence, if the lecturers can modify the words that are not necessarily required in a statistical definition, it may facilitate ELLs' understanding, as they can pick up more words under their familiar vocabulary list, thereby reducing the processing time in their heads.

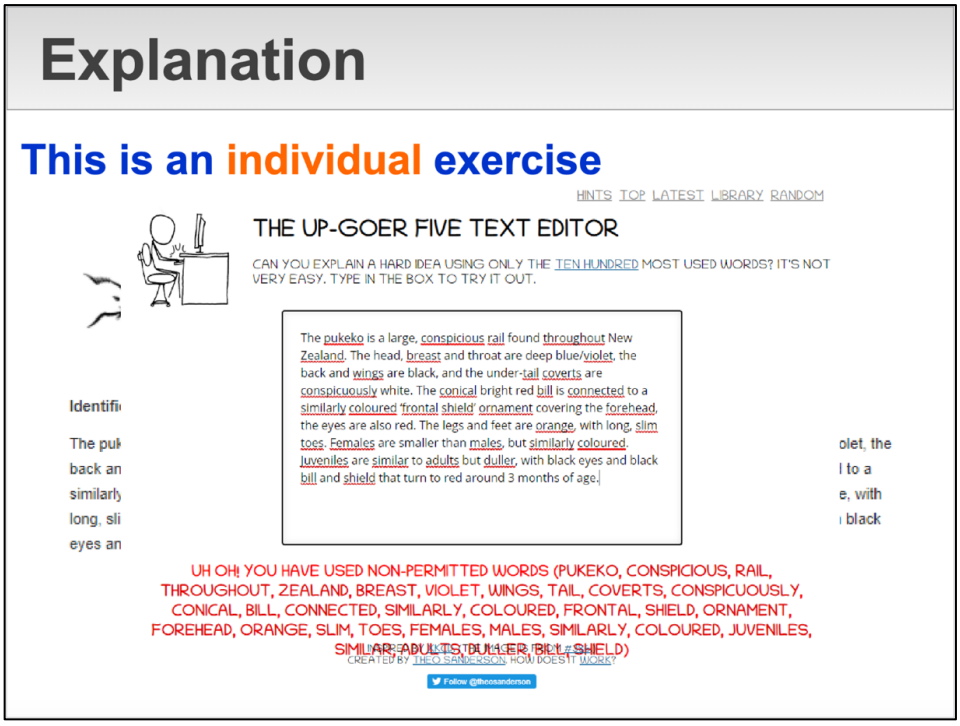

Figure 1 | Slide for “UP-GOER FIVE TEXT EDITOR” example (Fewster & Stevenson, 2024)

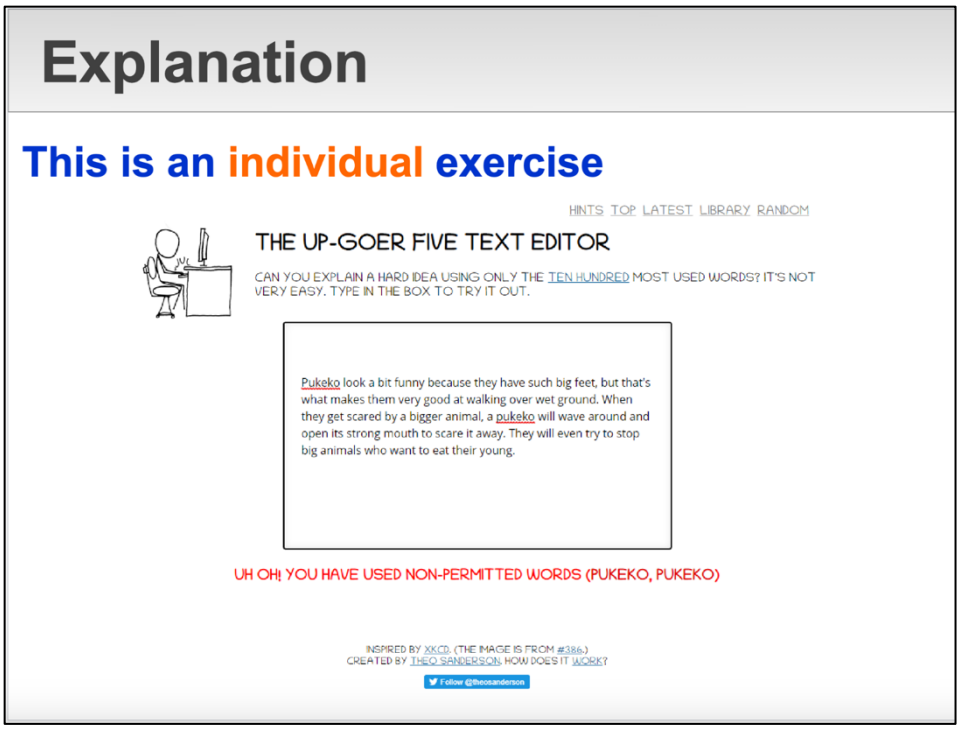

Figure 2 | Slides for "UP-GOER FIVE TEXT EDITOR" example (Fewster & Stevenson, 2024)

Give Easy Statistics Definitions

The definition of statistical concepts can be confusing even for native speakers if we use professional statistical vocabulary and logic to explain it. From the example in the Stats 399 lecture slide, Fewster and Stevenson (2024) provide an example from the website "Explain like I'm five" which illustrates how to simplify a statistical definition. The two key components to having an easier statistics definition are easy vocabulary and a real-world example.

It is essential to provide students with proper statistical definitions. However, if the lecturers can provide a simpler definition after the proper explanation, the help will not only benefit ELLs but also students with English as their first language.

Figure 3 | Slide for "Explain Like I'm Five" example (Fewster & Stevenson, 2024)

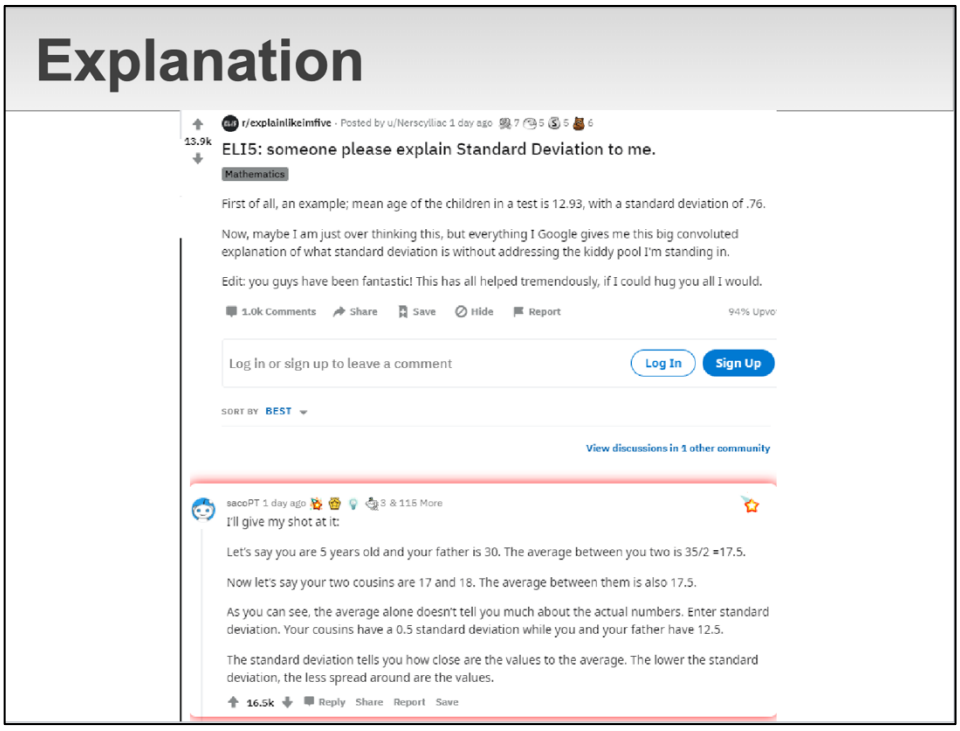

Figure 4| Slide for "Explain Like I'm Five" example (Fewster & Stevenson, 2024)

Gesture

Gregersen (2007) states that ELLs can receive additional hints about the message the speaker conveys through their gestures. For ELLs, it is essential to provide them with extra hints and direction when they become lost verbally with the lecturers. Gestures can at least bring their attention back and inform them of the next step to follow up, even if they were lost.

Goldin-Meadow et al. (2009) experimented with students to investigate how gestures can aid in learning the idea of grouping for addition primary-level mathematics. They found that gestures can not only help with learning basic ideas, but also help to create new ideas. For example, the idea of grouping was only conveyed through gesture, not verbally, in the experiment; however, some students eventually expressed verbally to the interviewer that they were using a grouping idea after having used the gesture themselves in learning. Hence, gestures can help process basic ideas and also aid in creating new ones if students can use them effectively in their own learning. In statistics teaching, the content background may differ slightly. However, there is no doubt that gestures can help students process information more effectively. Lecturers should often use gestures in their teaching and encourage students to use them as well to aid in learning. At this point, gestures are benefiting both ELLs and native speakers.

Informal Experiment with ELLs applying some low-effort teaching strategies

ELLs who participated in this experiment are third-year students or graduated students majoring in statistics or data science. The average grade for level three statistics courses is B+ and above for the participants. Hence, a basic and good understanding of statistics concepts can be assumed. These ELLs came to New Zealand for university study.

Experiment One

As shown in Figure 1, it is a simple introduction to bootstrapping from Stats 330 (STATS 330 Teaching Team, 2024). The participant was given the materials in front of them. Rather than letting the participant read by themselves, I read through the materials with the participant, using strategies such as pausing, changing easy vocabulary, repeating sentences, and using gestures (as shown in Figure 2).

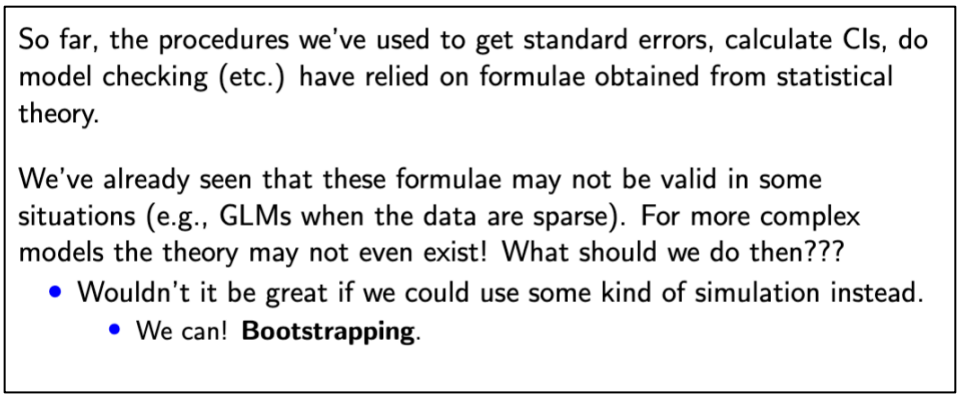

Figure 1 | One slide for an introduction to bootstrapping (STATS 330 Teaching Team, 2024)

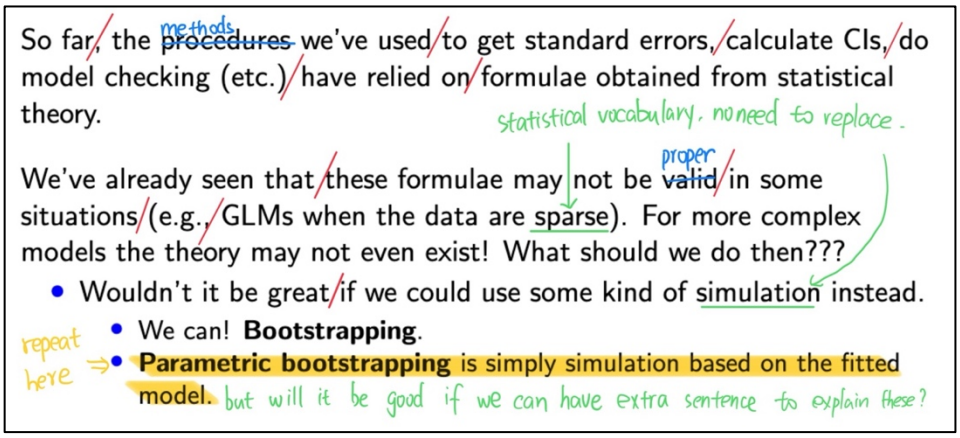

Figure 2 | One slide for an introduction to bootstrapping with explanations for the participant (STATS 330 Teaching Team, 2024

The participant was able to translate this slide back to me in their own language almost perfectly after we read through it together. They said they would not understand this if I did not explain these materials in this way. These participant experienced these teaching strategies helping with their understanding.

Following this experience, there are a few observations. First, the participant tended to stop following the rest of the sentence when they encountered an unfamiliar word. When I asked the reason behind this, the participant said that they wanted to think about that word, hence they were not able to focus and follow the rest of the sentence. Moreover, the vocabulary that the participant did not understand may not necessarily be a difficult one; it could be a relatively common word, they may have misunderstood or not picked it up due to the pronunciation.

Experiment Two

Two participants joined in experiment two. As shown in Figure 3, this is another page from the bootstrapping chapter from Stats 330 (Bolton, 2024). I have added pauses when reading the slides, as shown in Figure 4. The participants were not given the slide to read while listening for the first time. Instead, they were asked to put their hands up whenever they did not understand a word or a sentence. After listening, the participants were given the slide in front of them to read. At this point, they were asked again to point out the word or sentence they did not understand. The purpose of this experience is to simulate lecture situations and test the different levels of comprehension between listening and reading. According to Flowerdew and Miller's (1992) study, ELLs demonstrate better comprehension when visual tools, such as pictures, diagrams, and written text, are used. Hence, in this experience, I want to test the difference in comprehension between listening alone and reading alone for ELLs.

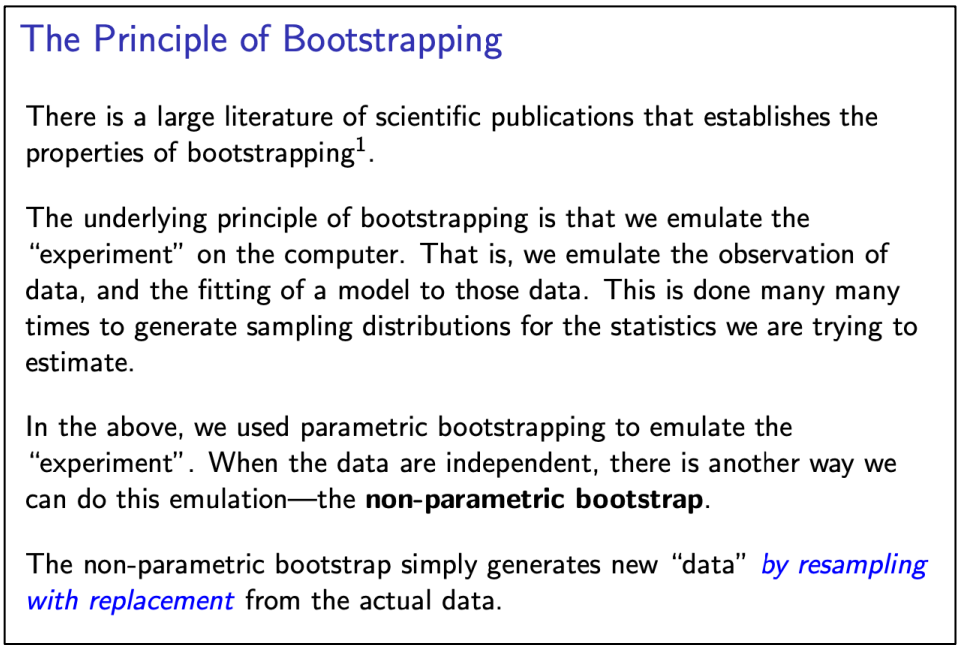

Figure 3 | A different slide for bootstrapping (STATS 330 Teaching Team, 2024)

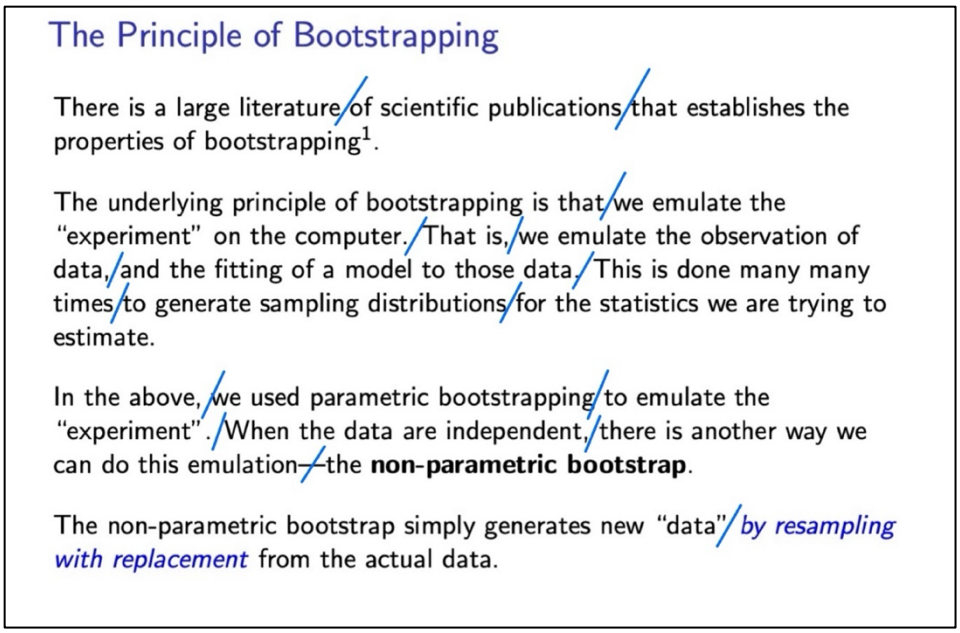

Figure 4 | Adding a pause at the blue slashes when reading it out for ELLs (STATS 330 Teaching Team, 2024)

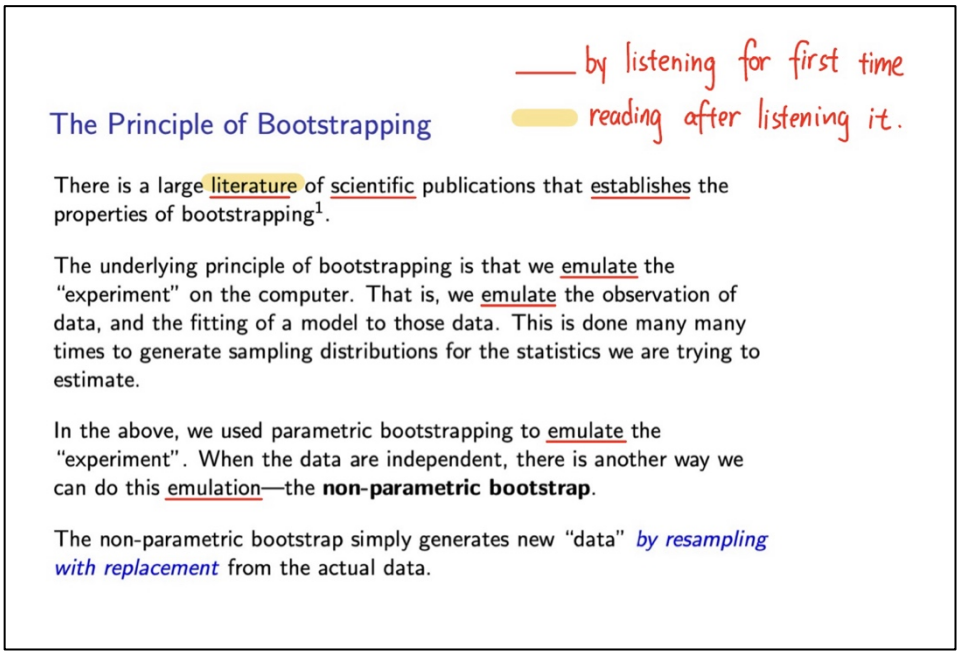

Figure 5 | Experiment result for participant one (STATS 330 Teaching Team, 2024)

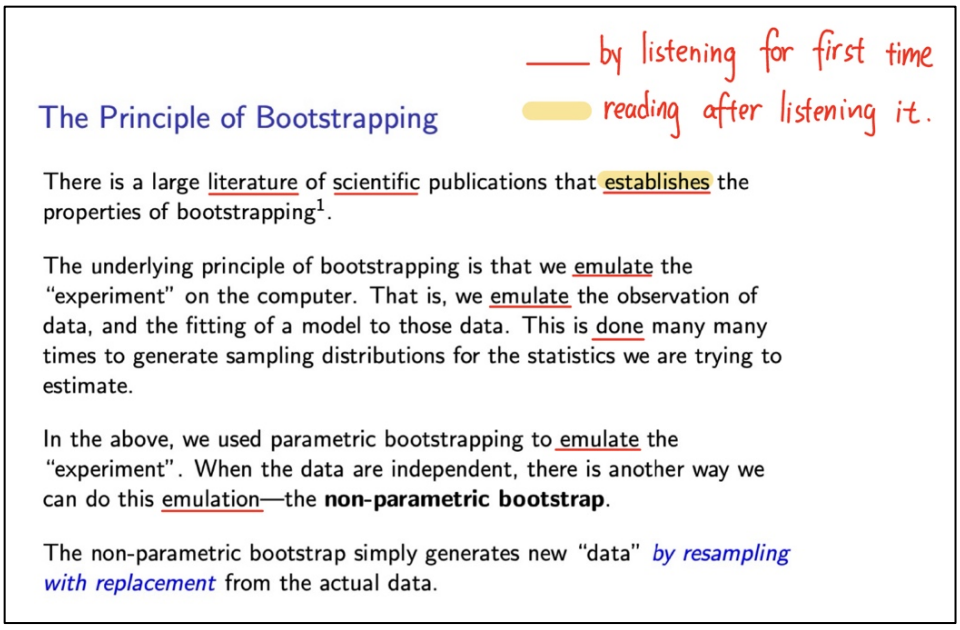

Figure 6 | Experiment result for participant two (STATS 330 Teaching Team, 2024)

From Experiment Two, we can see that the ELLs are definitely not familiar with relatively high-level vocabulary, such as "literature" and "scientific," among others. It is important to keep in mind that some words that we think are mostly used and common may still be challenging for ELLs, especially for ELLs who have been in New Zealand for less than one year. At this point, the "UP-GOER FIVE TEXT EDITOR" website will help identify the kind of words that are more appropriate to use to enhance ELLs' understanding. The "Up goer five" is the most restrictive example of a word list, but there are also tools based on other research into academic language. For example, the EAPFoundation website provides vocabulary lists that can help with selecting the most appropriate words for ELLs. (EAPFoundation, n.d.).

However, we can see that there are some statistical words, like "emulate", that the participants did not pick up. We cannot entirely abandon using these words; however, if lecturers are mindful when they use these words and provide a few more sentences to explain the statistical terms, understanding will increase not only for ELLs but for all domestic students. By explaining these unfamiliar words in detail, it generally helps everyone in the lecture to have a better understanding of the concepts and facilitates memorisation.

In addition to the above observations, I realised that we cannot predict which vocabulary the ELLs did not pick up. Sometimes, the words that ELLs did not pick up can be easy to understand, and this happened in Experiment One, too. For example, Student Two did

not pick up the word “done.” There are multiple reasons why ELLs may not understand a word. The reason could be that they have never heard of the word before, as it is a higher-level vocabulary term. However, the reason may also be that they misheard the pronunciation in a sentence or did not pay full attention to listening, so they were unable to pick it up. Therefore, we cannot predict with certainty every word that ELLs are confused about. In this case, lecturers may want to create an open and warm learning environment to make ELLs confident in asking when they cannot follow.

Experiment Three

I followed the same steps as in Experiment 2; the only difference this time was that I did not add any pause when reading out the slide. The slide, as shown in Figure 7 (Bolton, 2024), is still under the same bootstrap topic.

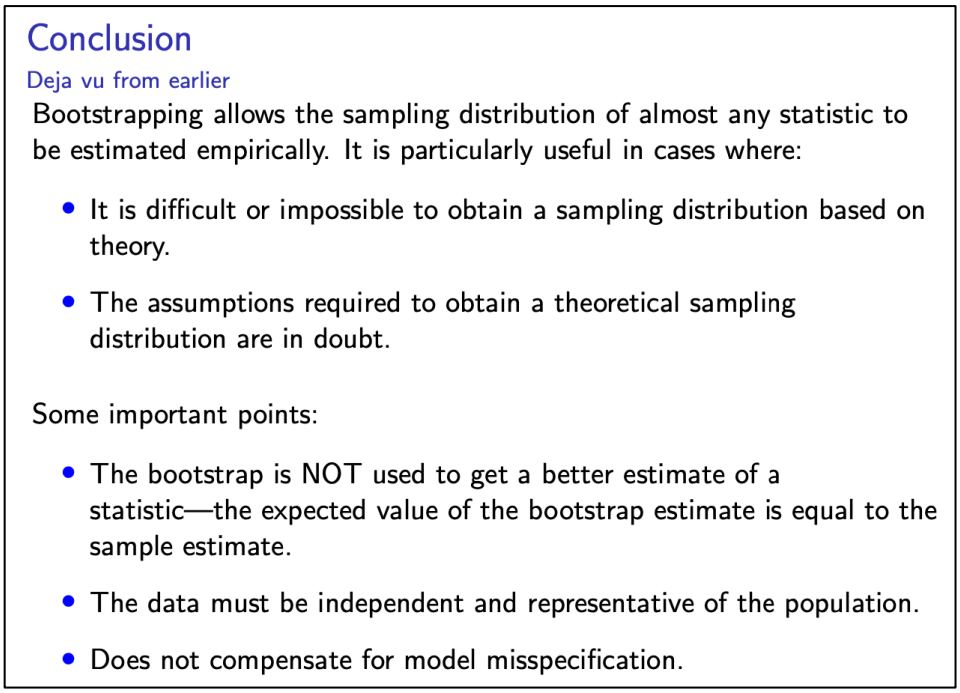

Figure 7 | A different slide for bootstrapping (STATS 330 Teaching Team, 2024)

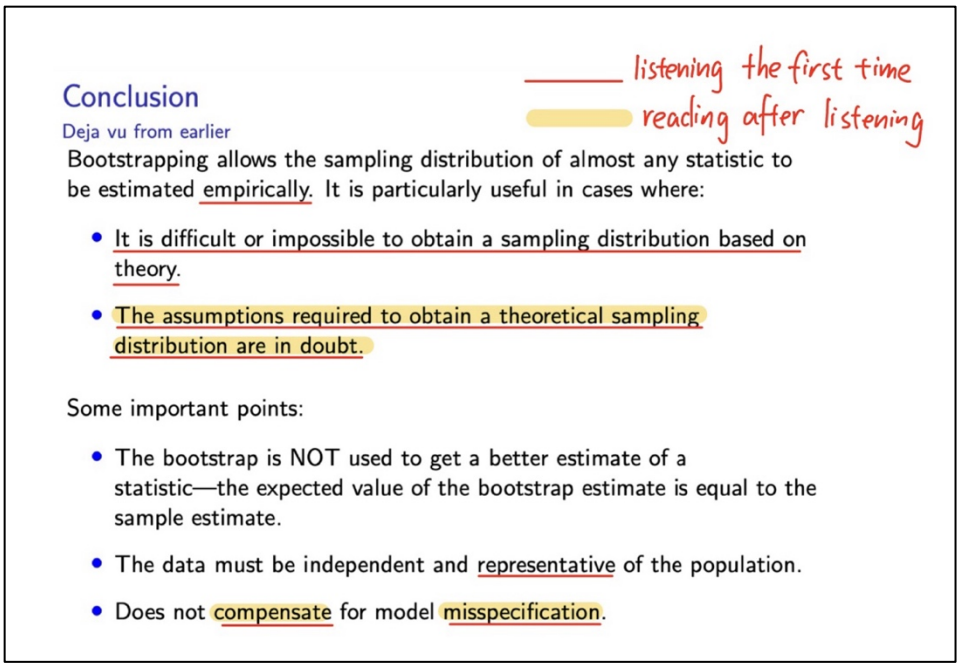

Figure 8 | Experiment result for participant one (STATS 330 Teaching Team, 2024)

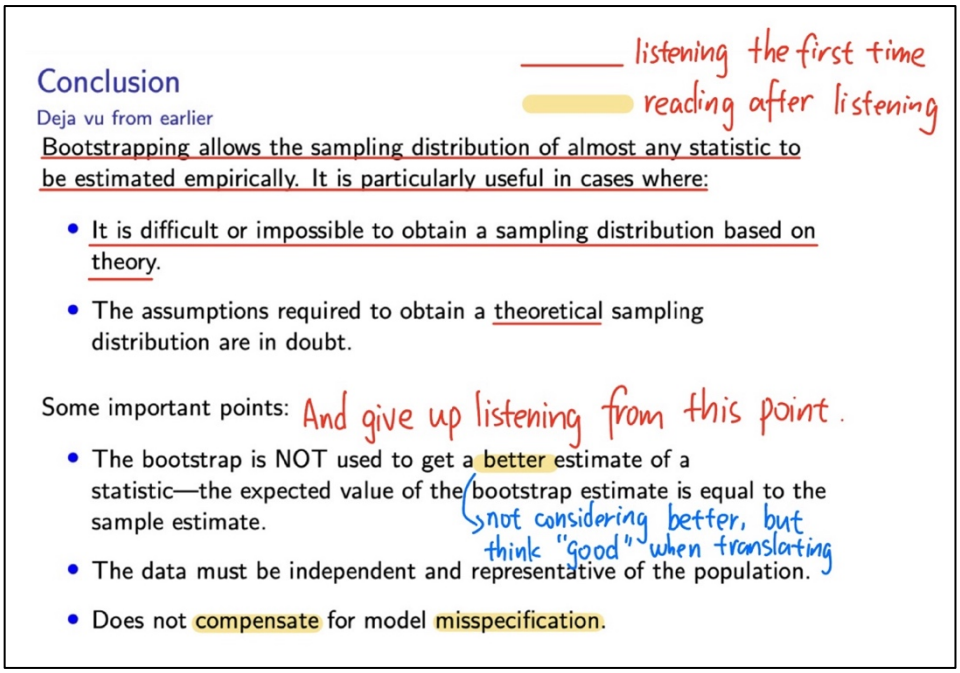

Figure 8 | Experiment result for participant two (STATS 330 Teaching Team, 2024)

The first significant observation from this experiment is that the pause strategy definitely facilitates ELLs' understanding. We can see that the participants in Experiment Two only have words they do not understand; however, in Experiment Three, the participants cannot understand whole sentences, rather than just a few words, without pausing. Hence, a

pausing strategy helps break sentences down for ELLs, giving them more time to process the sentence in their minds.

A similar situation occurs again here, just as in Experiment One. The participant gave up listening after they realised they could not follow the first half of the materials, and they decided not to listen to the rest of them. A worse attitude happened here; they gave up completely. The reason that the participant did not give up in Experiment One may be that I was still reading and explaining to them, which may have provided a sense of support; however, in this case, they were alone while listening. Even under experimental conditions, this participant did not show a high level of motivation to listen, despite being unable to follow most of the materials. I think this situation of ELLs giving up in real lectures may be worse. Hence, lecturers need to ensure that there are some sentences that ELLs can follow. Our goal is never to have ELLs understand every single sentence in a lecture; however, if they can understand even a quarter of the lecture, they will gain a sense that they can learn something by listening. The motivation to listen more and understand more through each lecture will be higher.

Conclusion on Informal Experiment

In this informal experiment, I have tried low-effort teaching strategies, including pausing in sentences, repeating key sentences, using simpler vocabulary and using gestures. From the result of the experiment, we can see that any of these strategies can help ELLs to increase their understanding to a certain level. I do not recommend using all strategies simultaneously, as I did in Experiment One. Applying all strategies simultaneously will require a significant amount of effort, and it may also impact the teaching speed, which may lead lecturers to be unable to cover everything required in one lesson. Moreover, from Experiments Two and Three, we can see that even a single teaching strategy, such as pausing, still helps ELLs improve their understanding.

The goal is never to make the lecture perfectly understandable for ELLs; this is not the responsibility if the lecturer alone. ELLs have responsibilities to push themselves to participate more in the lectures. However, we know ELLs tend to give up if they cannot understand a large portion of the materials from this experiment. Hence, it is essential to employ one or two strategies to ensure that a proportion of concepts are accessible to ELLs, thereby providing them with the motivation to listen and learn more.

Future thoughts after talking with ELLs

I spoke with the participants after their experience to gain a deeper understanding of their true attitude toward learning English and Statistics.

Every participant told me that they care more about their grades than their English abilities. They said that if they can eventually guarantee a good grade, they do not care much about understanding the concepts in lectures. At this point, I asked them when they last fully grasped the concept of statistics in English. The answer is never. All participants have never had an experience of learning about statistics without putting the concepts back into their own language. One of the participants stated that they prioritised the grade and wanted to ensure they could complete all assignments, quizzes, tests, and exams. In their opinion, translating the concepts into their own language appears to be the most effective and straightforward way to learn and achieve a good grade.

Some participants also mentioned that the statistics courses they found easiest were Stats 125 and Stats 210. The participants said that all the definitions in these courses are mathematical formulae rather than English definitions. However, the participants said they find the questions hard to understand and answer when there are scenario-style problems.

One participant also mentioned that she has been taking statistics tutoring outside of university. They mentioned that the tutor teachers explained all statistical concepts in their own language, and the tutors focused more on how to achieve a higher grade rather than helping students understand the concepts.

By reflecting on the experiments and future talks with the participants, I began to think about and develop medium- and high-effort teaching strategies.

Medium or high-effort teaching strategies

Building a safe and enjoyable learning environment

For my personal learning experience as an ELL, I found learning new concepts in English very hard when I first came to New Zealand, when I was in high school. I realised that there were too many academic words that I had not learn at all before. Sometimes, I did not even understand some of the sentences my teachers said, even though there was no challenging vocabulary involved at all. I did not understand either the language or the culture; I had to pretend to laugh in class when the teacher told a joke. It was a very dark time for me, and I almost wanted to give up as I did not see any hope of picking up the language. However, I met my very supportive mathematics teacher. She understood my situation and often stayed

with me after class to explain concepts I had not grasped in class. At that point, I had the motivation to keep trying. I just wanted to understand more of the sentences she spoke in class. I wanted her to see my progress and be proud of me. However, it only took me eight months to become fluent in English and fully understand the material in class. The motivation from the teacher played a significant role in my English learning process.

When I became a teacher myself and started teaching ELLs, I heard most of my students gave me the same feedback. They said one of the reasons that they were trying very hard was that they wanted me to be proud. Rost (2014) states that the learner's achievement of a language is affected by the learner's attitude to this language and the speakers of this language. Hence, a good teacher can have a positive impact on ELLs.

At university, it can be challenging to establish a connection with ELLs, as many of them do not seek help and often do not attend lectures. Hence, it is even more challenging to influence them as the chance of making connections is limited. However, things like trying to provide more detailed slides, having lecture recordings that are more understandable for ELLs, and providing more opportunities to ask questions after lectures can be a starting point.

I never thought that we could change and help every ELL. Some ELLs have strong motivation and will seek help voluntarily. Some ELLs do not care about English or statistics learning at all. We do not need to help ELLs with high motivation, and I do not believe we can effectively assist ELLs with no motivation at all, regardless of our efforts. However, there is a large group of ELLs who still want to try, deep in their hearts, but they need someone to push them and be their mentor for the first few months of the English learning process. For this kind of ELL, it is essential to have a good teacher who serves as their motivation to try harder. The message I am trying to convey is that the action we take may not impact all ELLs, but at least three or four students will be motivated for one semester because of the effort the lecturer put into them. Moreover, I believe that changing the lives of three or four students is still impressive and worthwhile.

Having a safe and enjoyable learning environment, ELLs may still want to use their translator to learn at first. However, they may want to listen more attentively in each lesson as they become more comfortable with their lecturer, and they may try harder because they think this class may be the point at which they can start to learn English concepts correctly. After a few weeks, they may decide to learn more statistics concepts in English immediately, and then they put them into the translator for checking afterwards. Eventually, they stop relying

on translators and they can learn a statistics course in English fully. This is our goal for our ELLs; although most of them may not be able to achieve the last stage, reducing the need for a translator can already be considered a significant achievement. Lecturers should also convey these expectations to ELLs.

Pushing ELLs harder

When we want to build muscles, we will experience pain. Learning English should be the same. ELLs must experience some level of pain to achieve the goal of thoroughly learning a statistics course in English.

Making students feel comfortable in class may be just the starting point to give them motivation; however, there is more to it than this. It is more about how the lecturer can still challenge ELLs and help them to get used to an English teaching environment, so when they go into a different lecture in the future, they can still settle down, even if their new lecturers do not have much understanding of ELLs' learning habits. The question the lecturers need to ask themselves constantly is whether ELLs can eventually settle into an English teaching environment after they leave my class.

However, the methods for pushing ELLs and determining how much we can push them, so that they can try their best without entirely losing confidence and giving up, need to be discussed in more detail.

Further actions

More ideas have not been explored. Ideas and further actions are listed below as bullet points.

- Low-effort teaching strategies
  - Give a diagram for the scenario.
  - Having more global or common scenarios in class rather than New Zealand culture-based scenarios.

    Gerdes (1988) makes the point that some aspects of mathematics education are influenced by colonialism, and mathematics teaching should be more closely tied to students' own culture to help them better adapt to the concepts. Our challenge here is that we have students from diverse cultural backgrounds. Picking examples can make more students feel related is challenging. Providing multiple examples for different cultural backgrounds can also be an option, which may require more effort.

    - Writing while talking. (especially useful for a pure statistics course like Stats 210)

- Medium or high-effort teaching strategies
    - Group work (mix local students with ELLs)
    - Set up questions for ELLs to attempt by restricting the use of a translator.

The teaching strategy listed in this report is general. However, the teaching strategies need to be considered differently for the application of pure statistics and applied statistics. Some should be specific to teaching pure or applied statistics, while others may apply to both. Moreover, teaching strategies should be tailored to consider the varying sizes of classrooms. Some strategies may be more helpful in a smaller class, such as a level three statistics lecture, and may be challenging to apply in a larger classroom. These specific ideas have not been mentioned in this report yet.

In addition to these, it is also important to consider how to balance the lecturer's workload and support ELLs simultaneously. Moreover, this report includes some strategies that benefit not only ELLs but also other students, such as providing easier statistical definitions. By implementing more strategies like these, we can achieve more effective statistics education that benefits a broader range of people.

It is also interesting to observe how these strategies, outlined in this report, are applied in real lectures. The experiment described in this report was somewhat rough, and several assumptions were made. Applying some of these strategies in real lectures can help determine if using one of these strategies is efficient enough or if a combination of these strategies is more effective.

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