2022

MONEYBALL FOR EFFECTIVE COMMUNICATION

Enhancing Students' Communication Skills Through Machine Learning

Foreword

> Continuous improvement is better than delayed perfection.
>
> – Mark Twain

The LearningLeaders Research Institute

At LearningLeaders, we believe everyone has the right to be heard, respected, and understood. We are on a mission to prepare future leaders to consistently communicate with confidence. The LearningLeaders Research Institute is our thought leadership branch that operates with the sole purpose of conducting & sharing scientific findings that will help enhance our students' learning experience. To do so we collaborate with communication experts, data science, and machine learning experts, to bring our community actionable insights.

Obviously AI

Obviously AI believes that making machine learning accessible represents our greatest opportunity to empower the lives of everyday business users. That's why they have built a tool that enables non-technical business analysts to rapidly run predictions on their historical data, with just a few clicks. Allowing them to make better business decisions, fast. Obviously AI is a B2B predictive analytics startup based in San Francisco, CA. They have worked closely with LearningLeaders over the last 6 months to help collect, analyse, and model our data to uncover exciting insights in the EdTech space.

Acknowledgements

We would also like to acknowledge those who offered feedback, guidance, and support in the creation of this paper. Thank you to all the judges that diligently collected the speaker feedback data throughout our competitions. A huge thank you to all of the students that competed in the competitions, we hope this research serves you well. Also, thank you to Enting Lee & Sandeep Chulani for their thoughtful recommendations on the paper.

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Introduction

Why should students focus on feedback?

In today's day and age of online learning, which spans across continents and cultures, one's ability to effectively communicate with confidence comes to the forefront. **In fact, 90% of parents chose communication as the highest priority skill for their children to have** (Pew Research Center). However, like many other skills, communicating with confidence does not happen overnight. It takes iterative improvements & practice based on quality feedback from experts. In order for LearningLeaders to achieve our mission of inspiring 1M+ leaders, we must enable learners by providing actionable, skills focused feedback.

Why is LearningLeaders best positioned to help students communicate with confidence?

LearningLeaders is best positioned to create the leaders of tomorrow for multiple reasons. Firstly, our experience over the last 8 years of coaching speech & debate not only includes helping students win World Championships, but more importantly, the **earned insights** as to how to get there. Secondly, our **skills first feedback system is the first of its kind** in this space, and ensures that our students' success is lifelong and outcome oriented, not just a flash in the pan. Thirdly, **our partnership with machine learning experts Obviously AI** allows us to make data-driven decisions & recommendations, while finding patterns in our students' behaviours beyond what is immediately obvious. Additionally, we pride ourselves in taking no shortcuts, especially with our students' learning experience. This means not offering off the shelf feedback and not delivering "one size fits all" styles of coaching. There is no trade-off when it comes to our students. These combined factors make up our analytics strategy, which is underlined by the following premises:

Effective communication (defined as both clear and persuasive) can be broken down into component behaviours (ie. eye contact during interaction is more predictive of effective communication than lack of eye contact). What defines effective communication may change depending on the scenario in which it is desired.

Behaviours are performative demonstrations that are lagging indicators of skill acquisition (ie. when a student is able to outwardly display certain behaviours repeatedly, that student is said to have acquired a skill). The higher level of mastery of a skill achieved, the more likely the person is able to display that behaviour effectively at the right moment.

In order to effectively coach and hone skills over time, certain methods are higher-value (more effective and efficient) than others. These methods may change depending on the individual, their age, culture, etc.

There have been many studies within education that apply machine learning techniques to student data for predictive or analytical use. However to our knowledge, none within the public speaking & debate space. In this paper, we attempt to model outcome oriented communication skills, and competitive success. Like Billy Beane did with the Oakland Athletics when using analytics and evidence based decisions in player recruitment, we will attempt to do the same within speech & debate (hence the paper title). Our hypothesis is that there is a relationship between students demonstrating unique specific skills and their probability of competitive success. The null hypothesis is that there is no relationship.

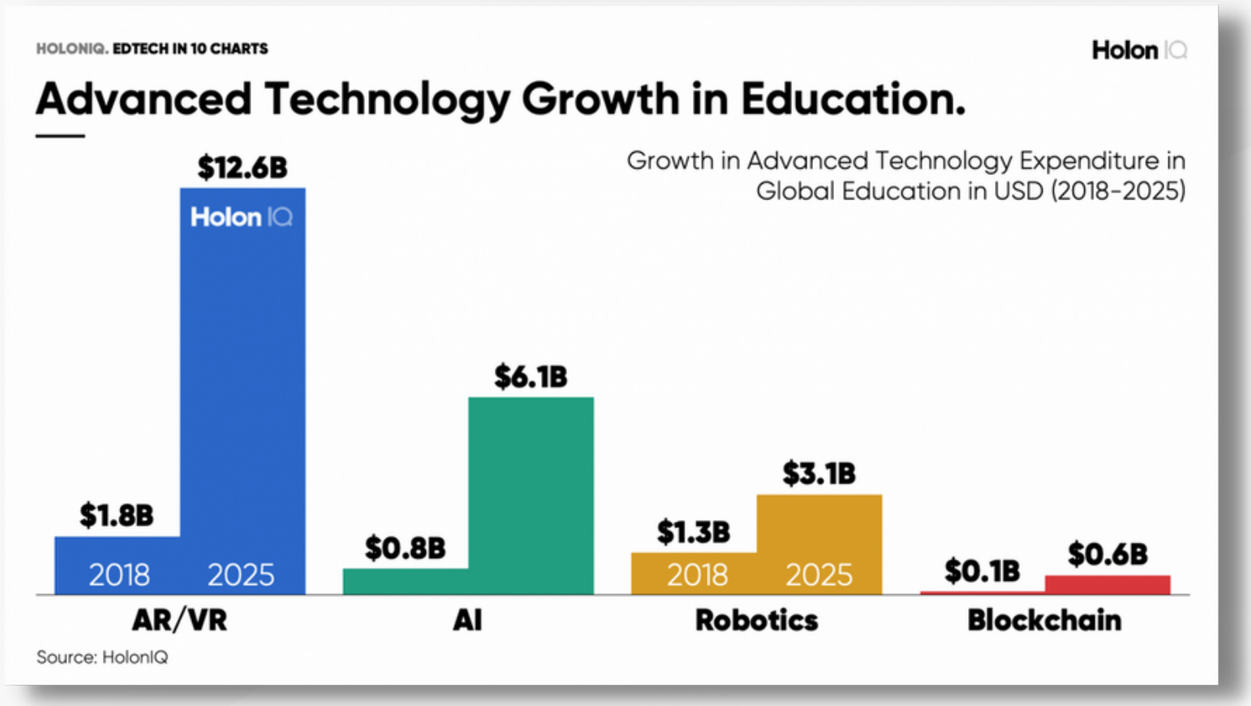
Introduction

Why Now?

You'd be hard pressed to find an industry that does not leverage data to delight & inspire its customer base. The migration from offline to online learning over the last 2 years is unlike anything we've experienced before. With the introduction of new technologies such as video conferencing, Artificial Intelligence, and Virtual Reality, the power of enhancing the live in-class experience has shifted towards tech & data. It's clear that the COVID-19 global pandemic was the catalyst in this movement but it shows no sign of slowing down.

By 2025 Augmented Reality (AR), Virtual Reality (VR), and Artificial Intelligence (AI) will have become increasingly integrated into core education delivery and learning processes(i). Advanced technology expenditure in global education in AR/VR will hit $12.6B by 2025, compared to $1.8B in 2018. Similarly for Artificial Intelligence, expenditure will reach $6.1B by 2025, compared to $0.8B in 2018. Although LearningLeaders has always been data driven, our current research, data, and technology now allows us to dive deeper, and truly "Focus on Feedback".

Unfortunately, however useful AI tools in education may be, they're not always beneficial to students. For example AI-based writing tools such as GPT-3 & Grammarly can make it very hard to decipher how much a student contributed, and how much of the contribution was the machine. Therefore, we understand the true impact of technology on students is when our AI generated insights are applied to live communication with students in the classroom or competitions. In this way the technology is used to guide and support towards lifelong learning, not to offer shortcuts.



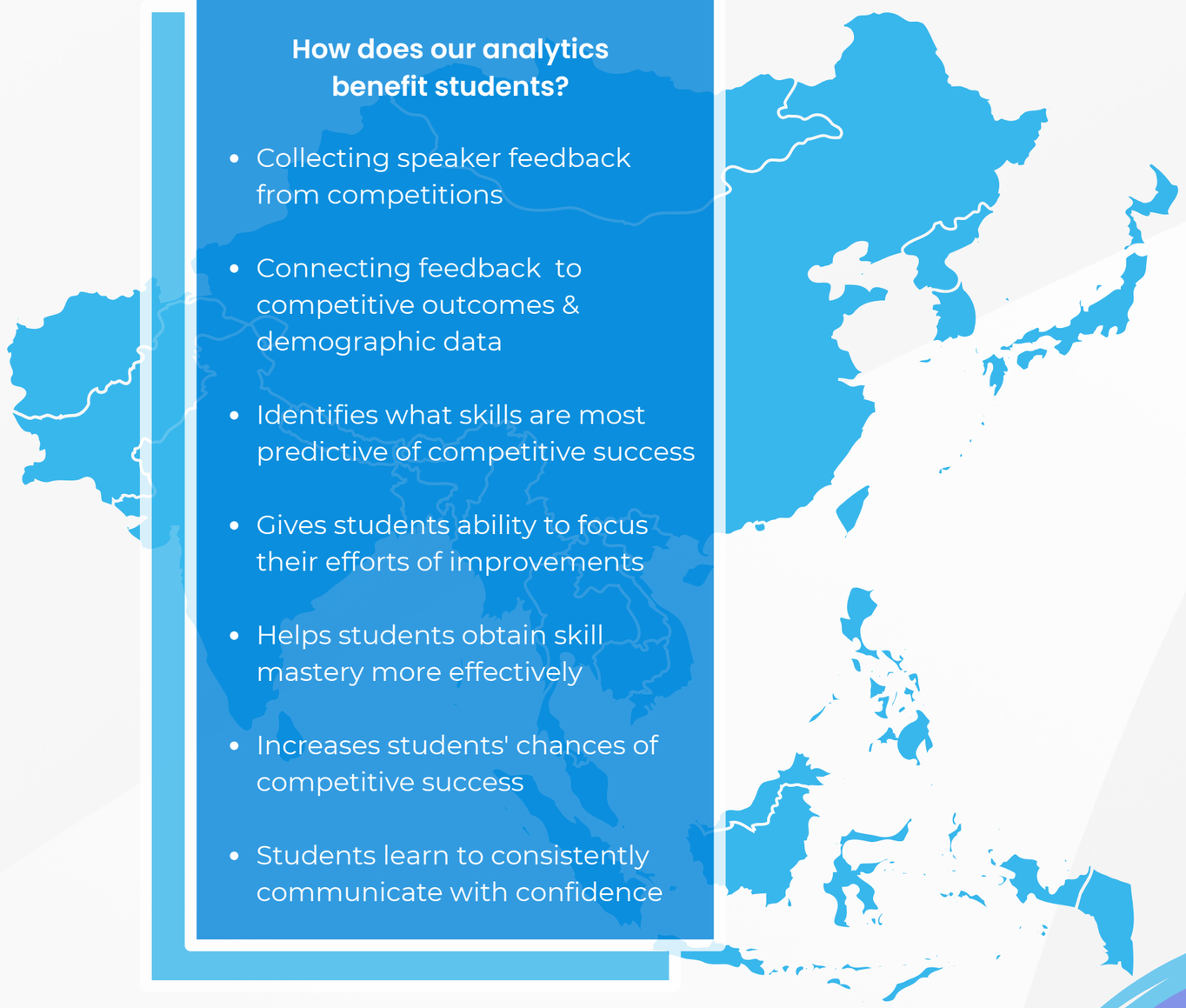
Executive Summary

In this paper we explore the relationship between 10 speech and debate specific skills and students' competitive success. The main purpose is to enable students to become outcome oriented communicators by using the insights we gain from exploring this relationship. The machine learning algorithm used is Voting Classifier. This algorithm is an ensemble based method that takes a majority vote over a number of sub-models. The model attempts to take various aspects of student skills & demographics and measure their importance towards steady-state competitive outcomes of win or lose. For the purpose of this paper we will consider competitive success as the most precise measurement of effective communication as possible. We will also outline the assumptions of the data that attest to this in a later section. Using the power of machine learning and analytics, we are now able to give students accurate & actionable insights into their learning to achieve competitive success, and ultimately, effective communication.

The data collection and analysis process was completed over a 6 months period at various competitions. The trained & experienced judges at these competitions played a vital role in the collection and delivery of feedback to the competing students. As mentioned in the foreword, the analysis and machine learning techniques were conducted by our data science partners Obviously AI who showed great support in the creation and authoring of this report.

How does our analytics benefit students?

- Collecting speaker feedback from competitions
- Connecting feedback to competitive outcomes & demographic data
- Identifies what skills are most predictive of competitive success
- Gives students ability to focus their efforts of improvements
- Helps students obtain skill mastery more effectively
- Increases students' chances of competitive success
- Students learn to consistently communicate with confidence



Problem Definition

What issues are students facing?

Feedback has been and always will be fundamental to students' progress in learning any skill. Realistic, specific, and high quality feedback that identifies both strengths & weaknesses, coupled with students' own active reflection (self-assessment) can transform their learning experience. What's also true is that effective communication comes in many forms, and differs from student to student and situation to situation. Therefore, we are formulating a new and improved way for students to take their learning into their own hands by using LearningLeaders' predictive insights to improve on their past performances. **The end goal is to become outcome oriented communicators.** This is to say that our analytics strategy uncovers clearly defined skills and metrics that students can then prioritise and master in order to achieve effective communication, be it in competitions, school, their future career, or everyday life. What we didn't know when we started but now know is that **90% of parents believe that communication skills are essential for their children's future. Also, communication skills are also the single most frequently-requested skill from hiring managers around the world on job boards**. So why aren't communication skills & effective feedback easily available for students? If they are, how do we ensure students benefit as much they can from speech and debate education?

High Level Solution

Machine Learning has been implemented into education over the last few years with multiple different applications. As many modern day classrooms are online, the addition of technology has enhanced the capabilities and scope of machine learning in education. A survey of current research trends of machine learning in education has surfaced that the main areas are as follows(ii):

- Grading students (12 studies)
- Improving student retention (17 studies)
- Predicting student performance (42 studies)
- Testing students (6 studies)

As this paper suggests, LearningLeaders aims to explore the application for predicting student performance and thus allowing students to identify areas for improvement.

There are some gold standard examples of other companies who have successfully used machine learning in education. For example, the language learning app Duolingo. Their use of machine learning to help with practice suggestions based on your level has been hugely important to their 42 million monthly active learners (as of Dec 31st 2021). Duolingo found that the application of data analytics and artificial intelligence to optimize learning increases learner motivation and improves learning outcomes(iii).

Unfortunately, there does not appear to be a leader in the segment for predictive analytics for students who are learning how to better communicate beyond basic language skills. It seems clear from the aforementioned collection of research that predicting student performance is an increasingly researched topic. Therefore, we cannot claim this method to be unique. However, we are unaware of any research that applies these techniques specifically to speech and debate education. This is our LearningLeaders Analytics Strategy and we believe it will have far reaching benefits for our students (as will be discussed later in the paper).

Solution

How can we help?

Speech and debate provides a unique case for testing communication skills with steady-state outcomes. The LearningLeaders Research Institute will leverage the existing skills-based progression system to generate predictive analytics of student performance, skill acquisition, and ultimately help LL design improved learning methods and platforms over time.

To win debating rounds in a competitive environment, a team needs to perform *comparatively better than other teams.* Each round is observed by an independent adjudicator that evaluates teams and individual performances. But how do judges determine that one team has performed better than another? How do they know which team has won or who is the best speaker in a particular round? Regardless of the format, judging manuals outline different types of metrics that judges should use when evaluating rounds. For instance, at the World Universities Debating Championship, judges are required to use the following criteria when evaluating a speaker's performance: quality of analysis, style, general knowledge, quality of engagement with other teams, comparative analysis, capacity to meet one's own burden of proof and others(iv). To have sound performance and achieve the best result under a specific criterion during a round, speakers need to present mastery of a wide set of skills in a way that is better than their competition. For example, let us take the criterion *analysis*. In its broadest sense, the term describes all of the reasons that a speaker offers to support their stance or claim in the round. According to the WUDC judging rules, to be successful in their analysis, speakers can: use sound logic to explain why their arguments are true, use empirical evidence to support their claim, expose a damaging logical implication of a contrasting argument, or use various other techniques that encourage the judge to believe that an argument is true and important to the debate. The rules also state that speaker's reasons may be stronger or weaker depending on the detail of explanation, precision of expression, moral intuitions and logical implications. Based on these criteria, judges will try to evaluate analytical contributions holistically and decide which team has been more successful at fulfilling their role in the round. What does this mean for debaters and educational designers of speech and debate curricula?

This means that to master the art of speech and debate, and consequently do well in competitive rounds, a speaker needs to identify and acquire a set of skills that would allow them to perform in line with the criteria prescribed in judging manuals.

> **If judging manuals, among other things, set expectations that one needs to provide sound analysis in their speech, speakers must therefore show the ability to perform this particular skill in the round. Thus, demonstrating mastery of communication skills eventually leads to a 'win' or a high speaker score, which is each speaker's indicator that they have effectively performed in the round.**

To get debaters ready to perform, curricula designers and coaches need to identify the most important skills that would help students win rounds and build lesson content that would help them acquire these skills. **Curricula designers would also need to understand which skills are more important than others and distribute their efforts in such a way that would help students focus more on key skills and less so on non-crucial ones.** For example, say one of the first criteria judges look for in a round is whether a team has fulfilled their burden of proof. Then they may focus on logical analysis that leads to a team fulfilling their burden. This probably means that teaching efforts should focus more on how to understand and use burdens of proof and reasoning in a round , and less so on non-crucial skills for competitive success such as eye contact. With that being said, how can speakers and debate coaches know that a speaker is improving their skills? Assuming a speaker acquires the ability to support their claims with logical reasoning, how do we track their progress and understand their level of mastery of this particular skill?

Solution

Regardless of tournament results, one could make an argument that every debater acquires a valuable set of skills through debate rounds and regular practice. **To have higher success rates in debate competitions, students must perform *comparatively better than their peers*.** This means that they need to be more skilled at reasoning, note-taking, processing of information, meta-analysis, and other skills that judges find important. By identifying a key skill set and understanding how to best track student progress, curricula designers and debate instructors can provide more nuanced and accurate personal feedback for speakers, while the lesson design matches the individual needs of each speaker. By creating evaluation metrics that we can successfully use to keep track of student performance, we are better able to keep track of student progress, estimate efficiency of teaching methodology and better predict learning outcomes. Consequently, a more nuanced teaching approach that revolves around improvement of skills would lead to skill acquisition and improvement. This would help students achieve greater competitive success and education outcomes.

It can often be challenging to collect and predict subjective and qualitative behaviours, such as in speech & debate. However, thanks to our skills based feedback system, comprehensive judge training and judging criteria, and elite level speakers, we were able to create a comprehensive data collection and analysis process that ensured accurate and quality results. Below are some assumptions made for the data collection:

- Competitions are as close to measuring skills mastery as we could get.
- Our Judges were experienced and trained to evaluate speaker performance. Having no prior experience working with our students ensured impartial and objective judging.
- Speaker performance could be evaluated on 10 essential skills (within BP & WS format)
- A binary level of skill mastery e.g “Exhibited strong use of this skill”, “Did not exhibit strong use of this skill” accurately labelled outcomes.

In total we have collected data on 1138 speeches across 5 different debate competitions.

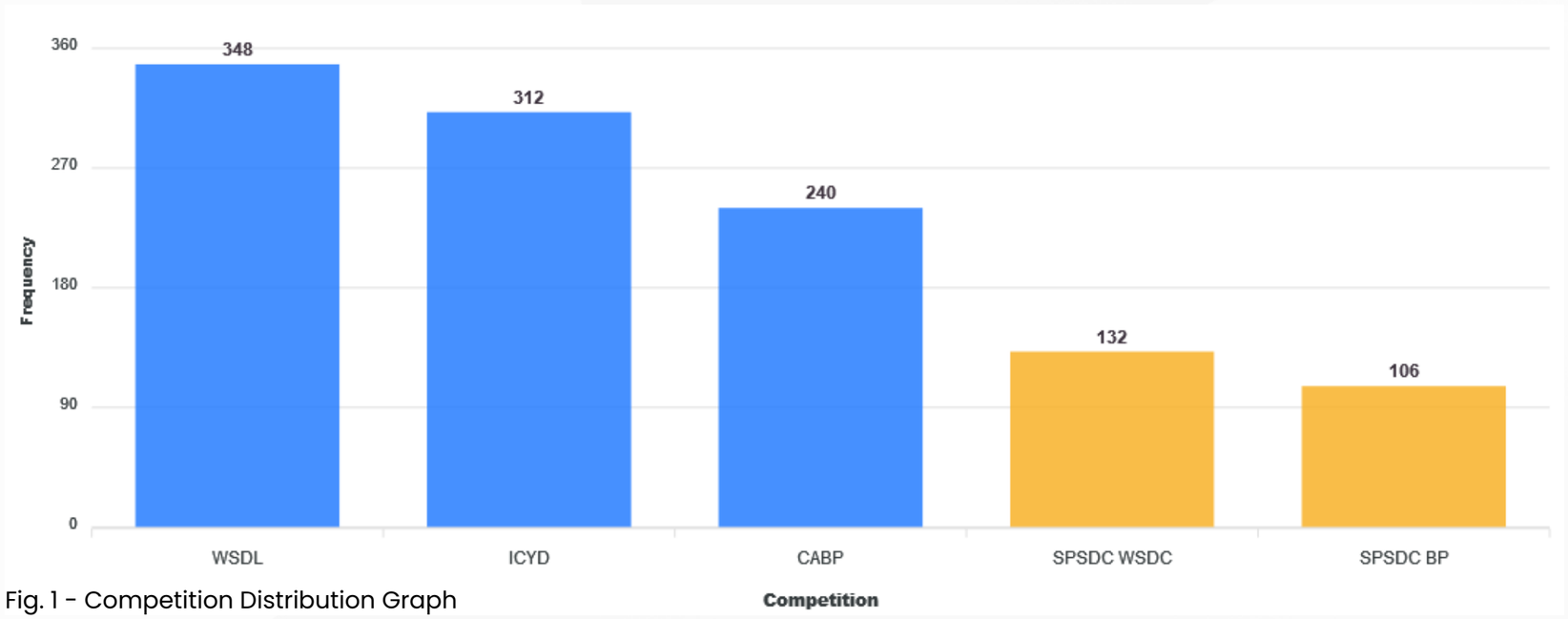


Fig. 1 - Competition Distribution Graph

Solution

These competitions are organised by LearningLeaders which ensures consistency during the data collection. These competitions include the World Schools Debating League, International Competition for Young Debaters, Cambridge Asia British Parliamentary, and Shanghai Public Speaking & Debate Championship in both WSDC & BP formats. Through an iterative process, our experienced debate coaches boiled down the BP & WS formats into 10 specific skills that they deemed were essential and fundamental to debate. These skills are clearly defined within our curricula and are as follows.

- Contextualizing and Framing
- Rebutting Comprehensively
- Using Rhetoric to Build Emotional Appeal
- Building Plausible Impacts
- Building Relevant Arguments
- Building Strong Reasoning
- Using Appropriate Pacing
- Weighing Impacts
- Contributing Actively Through POI's
- Delivering a Structured Speech

Judges were then responsible for completing a form after every round of debate they adjudicated which collected the speaker performance feedback. This form asked for a few specific data points: Adjudicator Name, Round Number, Winning Side, and then proceeded to ask questions which collected the skill data. For each speaker, judges were asked to evaluate them on the 10 skills (outlined, left) by asking the following question for each skill. "Please choose the skills that the speaker exhibited strong use of". For example, if a judge believes the speaker showed strong use of "using relevant arguments", they marked the skill as exhibited, if not, they marked the skill as not exhibited. The outcome was a database of skills that each speaker used or did not use, represented by 1 or 0. Aside from this feedback system, judges also completed ballots as usual which collect data such as speaker score, winning team, and reason for decision. The final step of the data collection process was to combine both the skill feedback data, and the ballot data so that each speaker had their score for that round, their result, and each skill they demonstrated.

Once the data collection process was completed and the data merged, the data preparation and model building process was conducted by our partner & machine learning experts Obviously AI. Their in house Data Science team cleaned and prepared the dataset to be ML ready before uploading it on the Obviously AI platform that automatically generates the best predictive model in less than a minute with the following results.

Results

The Model

The model used for this analysis is a Voting Classifier model which is a collection of different classifiers that averages over the prediction results for each as the final predicted category. **This machine learning algorithm is built to predict a competitive outcome of Win or Lose and has an accuracy of 80.18%**. This metric represents the accuracy of the model on the Test set. The Test set is the portion of the data which the model has never seen before and is used to evaluate the model's performance. The accuracy value means that when you test this model by uploading data of 100 random or new students, you can expect the model's predictions to be correct around 80 times and incorrect around 20 times. Let's compare predicting a round winner to a coin toss. Given a round between two random unknown debate teams, the probability of predicting a winner would be 50/50, similar to that of a coin toss. However, using this new-found information about skill deployment in debates, given the team data, the probability of predicting the round winner becomes 80/20. **We therefore see an increase of 60% in the probability of predicting the winner.**

We can break the results into a variable's contribution to the model, and its impact on predicted outcome. A variable's "contribution" to the model can be seen as its measure of how much the model relies on it in order to make predictions. The higher the contribution, the higher the influence it has on predictions. For example, in a model that predicts tomorrow's weather, we'd most likely rely on today's weather more than what day of the week it is. However, this does not tell us the impact today's weather has on tomorrow's weather, only that we should rely on it more compared to other variables. Today's weather could in fact have a high contribution to the model but a negative impact on the outcome i.e. hot humid weather today, thunderstorms tomorrow. **Therefore, It's important to note that contribution is a different metric to "increases probability of winning by x%". Contribution can be seen as how important the variable is *to the model* (better predictions), whereas its effect on the outcome can be seen as how important the variable is *to the student* (better outcomes).**

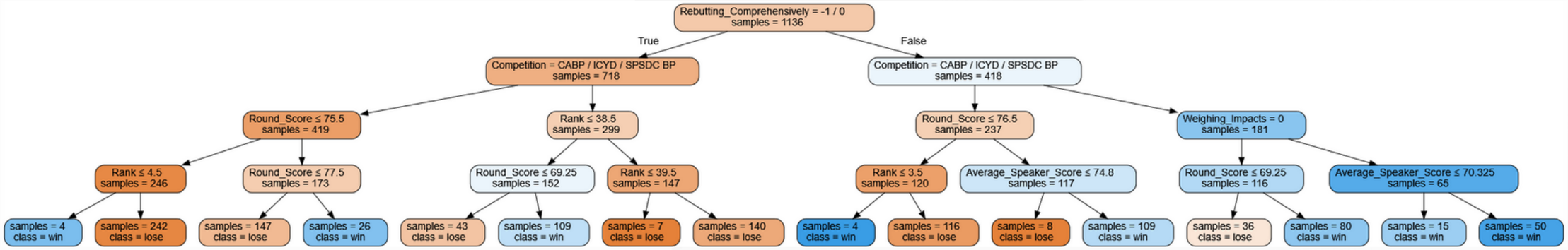
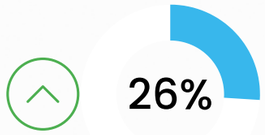


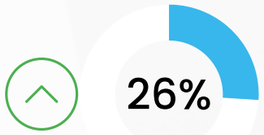
Fig. 2 - 1. Decision tree. Check the model's decision making process to predict each outcome

Results



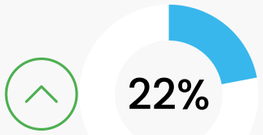
Rebutting Comprehensively

Rebutting Comprehensively contributes 5.4% to outcome and **having this skill increases your chances of a win by 26%**. In fact, not having this skill will actually increase your probability of losing by 5%.



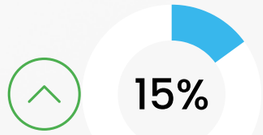
Weighing Impacts

Weighing impacts contributes 2.2% to outcome and **having this skill increases your chances of a win by 26%.**



Contextualizing and Framing

Contextualizing and framing contribute 2.9% to outcome and **having this skill increases your chances of a win by ~22%.**



Building Relevant Arguments

Building Relevant Arguments contributes 3% to outcome and **having this skill increases your chances of a win by 15%.**

Practically speaking, based on this preliminary analysis, in order to maximise probability of winning a round, students should first ensure they are exhibiting strong use of rebuttals above exhibiting other skills. In order to do so they should drill this with their partner(s), focus on coach & judge feedback, and actively ask coaches for support in this area. This focused work may result in an additional 1 win for every 4 debates!

There are other driving factors in the prediction of competitive outcomes for students, such as speaker role, debate round, which competition format, and many more. However, for the purpose of this research we will be focusing on the skills and the driving effect they have behind competitive success.

Impact

For Students

From our experience of coaching debate and running debate competitions over the last 8 years, we understand the value that students place in the feedback they receive from coaches and judges. **A judge that offers relatable, concise, and accurate feedback to a speaker can be the difference between the student just losing a debate or learning exactly how to improve for their next round.** The insights we're now able to provide students every week in the classroom will not only aid them in their competitive success but will also allow them to become confident in their everyday communication.

Additionally, thanks to our machine learning partners Obviously AI we now have the ability to offer instant & live predictions on our Learning Platform by integrating this model with their classroom performance data. This will offer students a benchmark as to their learning level as they enter our program. They will then be able to use our feedback system to track their progress. This framework of feedback can also impact students in the following way:

- Help students better understand their goals by offering extremely clear metrics, as apposed to a judge manual or speaker score.
- Feedback is far more targeted which complements & condenses the longer form feedback offered on ballots & after rounds as to not overwhelm students.
- Immediacy of the feedback as mentioned above. Students can see how they have improved their chances of competitive success after each round in lessons.

Debate aims to achieve several different goals. It aims to create advocacy-oriented education, teach persuasion skills, teach critical thinking, create positive classroom atmosphere, create new patterns of knowledge, and create a fun atmosphere(v). As these goals are achieved, students receive a wide palette of skills that they can use in a variety of different segments of their lives.

By encouraging educational institutions to enrich their curricula with competitive speech and debate, we are preparing young people for their current academic journeys and their future professional careers. Through debate, students develop their competitive mindset, as well as technical skills, confidence and teamwork skills, all attributives highly valued by employers(vi). The existing research in educational psychology gives us a strong reason to expect that these benefits will only increase as debate pedagogy is implemented across curriculum(vii). This in turn will help a huge number of students develop their reasoning skills, which are essential to understanding the world. Increased knowledge of argument building, results in increased knowledge of the reasoning process and this should help reinforce learning(viii). **As the world's population becomes better educated and literacy levels rise, the demand for improved argumentative processes increases(ix).**

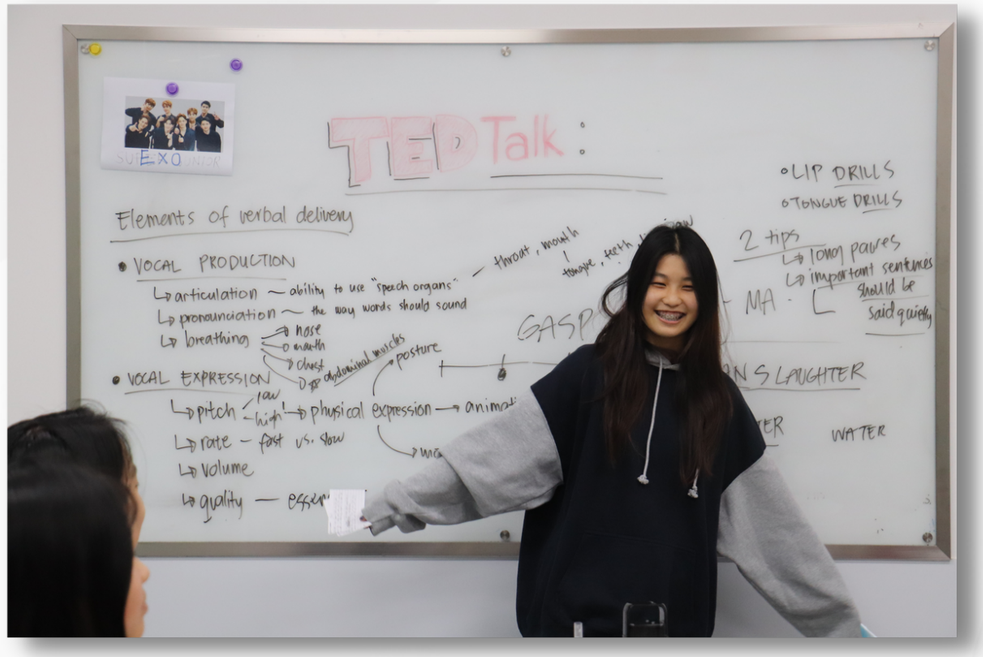
Impact

One of the main skills that a student needs to master in order to become a successful debater is critical thinking. In essence, critical thinking means analysing and synthesising ideas, going below the surface of an argument, articulating unstated assumptions and testing validity of ideas. How does critical thinking impact education outcomes for students of speech and debate? Critical thinkers learn how ideas relate to each other and understand the importance of logical consistency(x). Critical thinking involves analysing problems, selecting and examining evidence, interpreting data, determining logical relationships, testing reasoning, reaching conclusion, and selecting appropriate language. These are all critical skills for making good rational choices when confronted with a large amount of information(xi). **The most frequently cited perks of participating in competitive speech and debate activities, generally shared in this order, include improvement of critical thinking, communication competency, college and employment prospects, and teamwork and relational skills(xii). Listening to debates generates benefits as well: spectators often learn a new way of thinking about a problem or an issue(xiii).** These observations might feel intuitive and clear, but what is less obvious is the extent to which the acquisition of speech and debate skills has a positive impact on educational outcomes for students.

To understand the answer to this puzzle, we should look at available research results on the impact of speech and debate on education outcomes. In a study conducted in the Houston Independent School District that covered over 35,788 students (amongst whom there were 1145 debaters and 34643 non-debaters) researchers tried to identify a causal link between debate participation and student achievement. **According to this research, debate participation was associated with higher GPA scores than comparison students, higher scores on Math, and higher scores on the reading and writing section on the SAT.** This study was one of the largest quantitative evaluations of debate participation and achievement among high school students conducted to date and provides robust evidence of the benefits of debate on academic performance and college readiness(xiv). **In a separate study where debate participants were surveyed on their views and attitudes of debate, over 96% of them "agreed" or "strongly agreed" with the statement, "Debate has enhanced my critical thinking skills."**

These attitudes indicate that respondents hold the perception that they increase their critical thinking skills through debate(xv). Additionally, Susannah Anderson and Briana Mezuk, after reviewing data from the Chicago Debate League generated between 1997 and 2007, found that debate had a positive impact on students' academic achievement. **Some of their key findings were that among the highest risk students, 72% of debaters graduated as compared with 43% non-debaters, they scored higher on the ACT and were more likely to achieve college readiness benchmarks in English, Reading and Science(xvi).**

Based on these observations, it is fair to say that competitive speech and debate helps students develop a variety of different skills that are applicable across many different segments of the education process and that there is a strong link between positive educational outcomes and participation in speech and debate. **The competitive ecosystem of speech and debate allows students to become equipped with the tools that they need for school and their future job posts.**



Impact

Effective use of Analytics will allow LL to best serve our customers by providing them with actionable insights that help students and parents best understand how to improve their skills to become outcome-oriented communicators.

There are of course many factors that influence the decision of parents and students to pursue a certain educational pathway. **We believe that a key driver in this decision is demonstrated student outcomes. Parents enroll their children in LearningLeaders courses with the goal that their children develop a range of soft and hard skills.** These are unique skills that universities and companies look for in applicants - skills like public speaking, research, organisation, and critical thinking. Unlike other academic subjects where student outcomes can be measured by testing, in speech & debate, student outcomes can't be measured with a test. Rather, students, coaches, and parents look to performance at competitions as a measure of student outcomes.

LearningLeaders is proudly represented by our students at tournaments around the world. By understanding the top skills that are required for competitive success, students can better prepare for these competitions and improve their chances of succeeding at these competitions.

This research also supports in the curriculum development & pedagogy at LL. If the goal of LearningLeaders is to foster outcome oriented communicators, it intuitively makes sense that LearningLeaders should look towards outcomes to inform its teaching methods. By leveraging data on skill acquisition on student success at competitions, LearningLeaders can apply a data-driven approach to its curriculum development and overall teaching pedagogy. **For example, we find that Rebutting Comprehensively contributes more to a tournament outcome than any other skill that was measured.** With this in mind, speech & debate curricula should put an emphasis on student interaction in the classroom, giving students the opportunity to hear opposing arguments and develop effective rebuttals. A speech & debate curriculum that doesn't put an emphasis on practicing rebuttals, on the other hand, would likely see worse student outcomes.

Conclusion

There are numerous different educational benefits that students get from competitive speech and debate. Through active participation in tournaments and regular practice, students develop a variety of skills that are applicable in different settings. In this portion of the paper, we have observed some of the links between participation in competitive speech and debate, and education outcomes. These links, we argue, are a result of intentional efforts by students and educational designers to acquire and develop skills that are observed and evaluated in a competitive speech and debate environment. **To what extent students will develop these skills, it will depend on many factors. However, we also argue that it is possible to target these skills through skills-based lesson customisation, that could help debaters both acquire and actively track their progress in a specific set of skills.** Through incorporation of skill evaluation tools in speech and debate curricula, educators can adjust their teaching style to match the needs of individual students, they can adjust teaching practices based on evaluation reports and consequently help students fulfill their potential and acquire the skills that they would need today and in the future.

We would like to end this portion of our paper with a quotation from Professor Alfred C. Snider that captures the spirit of our observations: “All over the world educational systems are being reorganised to emphasise active learning, critical thinking and creativity. I do not pretend to believe that debating is a magic bullet for all of the issues we face, but I do think it is a very strong candidate for something that can be done to better prepare students for the future” (xvii). We agree wholeheartedly with the late Professor Snider. **Debating may not be a panacea for all challenges in the education system, though the activity is proving to be one of the most powerful methods to teach students skills required to succeed in the twenty-first century.**

If you are interested to learn how LearningLeaders can help your students & children to communicate with confidence, please book a placement test with us at your convenience here:

For more information on this paper and the LearningLeaders Research Institute please contact our Chief of Staff Tom Cronin at **Tom@learningleaders.com.**

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Sources

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Glossary

Model
A specification of a mathematical (or probabilistic) relationship that exists between different variables. Because “modeling” can mean so many things, the term “statistical modeling” is often used to more accurately describe the kind of modeling that data scientists do.

Predictive Analytics
The analysis of data to predict future events, typically to aid in business planning. This incorporates predictive modeling and other techniques. Machine learning might be considered a set of algorithms to help implement predictive analytics. The more business-oriented spin of “predictive analytics” makes it a popular buzz phrase in marketing literature.

Predictive Modelling
The development of statistical models to predict future events.

Machine learning model
The process of training an ML model involves providing an ML algorithm (that is, the learning algorithm) with training data to learn from. The term ML model refers to the model artifact that is created by the training process.

Algorithm
A series of repeatable steps for carrying out a certain type of task with data. As with data structures, people studying computer science learn about different algorithms and their suitability for various tasks. Specific data structures often play a role in how certain algorithms get implemented.

Artificial intelligence
Also, AI. The ability to have machines act with apparent intelligence, although varying definitions of “intelligence” lead to a range of meanings for the artificial variety. In AI’s early days in the 1960s, researchers sought general principles of intelligence to implement, often using symbolic logic to automate reasoning. As the cost of computing resources dropped, the focus moved more toward statistical analysis of large amounts of data to drive decision making that gives the appearance of intelligence.

Decision Trees
A decision tree uses a tree structure to represent a number of possible decision paths and an outcome for each path. If you have ever played the game Twenty Questions, then it turns out you are familiar with decision trees.

Dependent & Independent variable
The value of a dependent value “depends” on the value of the independent variable. If you're measuring the effect of different sizes of an advertising budget on total sales, then the advertising budget figure is the independent variable and total sales is the dependent variable.

Prediction
A model's output when provided with an input example.

Feature
The machine learning expression for a piece of measurable information about something. If you store the age, annual income, and weight of a set of people, you're storing three features about them. In other areas of the IT world, people may use the terms property, attribute, or field instead of “feature”.

Null hypothesis
If your proposed model for a data set says that the value of x is affecting the value of y, then the null hypothesis—the model you're comparing your proposed model with to check whether x really is affecting y —says that the observations are all based on chance and that there is no effect.

Accuracy
The fraction of predictions that a classification model got right.

Data Analysis
Obtaining an understanding of data by considering samples, measurement, and visualization. Data analysis can be particularly useful when a dataset is first received, before one builds the first model. It is also crucial in understanding experiments and debugging problems with the system.

Interpretability
The ability to explain or to present an ML model's reasoning in understandable terms to a human.

Model Training
The process of determining the best model.

Numerical data
Features represented as integers or real-valued numbers. For example, in a real estate model, you would probably represent the size of a house (in square feet or square meters) as numerical data. Representing a feature as numerical data indicates that the feature's values have a mathematical relationship to each other and possibly to the label. For example, representing the size of a house as numerical data indicates that a 200 square-meter house is twice as large as a 100 square-meter house. Furthermore, the number of square meters in a house probably has some mathematical relationship to the price of the house.

Variable Importance (Contribution)
A set of scores that indicates the relative importance of each feature to the model. For example, consider a decision tree that estimates house prices. Suppose this decision tree uses three features: size, age, and style. If a set of variable importances for the three features are calculated to be {size=5.8, age=2.5, style=4.7}, then size is more important to the decision tree than age or style. Different variable importance metrics exist, which can inform ML experts about different aspects of models.

*Provided by The Google Developers Machine Learning Glossary

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