Board 441: Work in Progress: Unlocking Student Success: The Power of Public Speaking AI Software in Engineering Education

Mrs. Rachelle L Beckner, Clemson University

Rachelle Beckner is a dedicated communication lecturer in the Glenn Department of Civil Engineering at Clemson University, where she was instrumental in scaffolding oral and written communication instruction throughout the curriculum. She is passionate about equipping students for successful careers by equipping them with the essential professional skills to complement their technical expertise. She is a graduate of West Virginia University, holding a bachelor's in journalism and an E.MBA. With a background that extends over two decades, Beckner has accumulated a wealth of expertise and experience through roles in fundraising, marketing and journalism. This rich professional background enriches her classroom instruction and brings real-world relevance to her teaching. Beckner's dual background in communication and engineering education positions her as a unique and valuable contributor to the academic commuity, fostering the growth and achievement of future engineers.

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Unlocking Student Success: The Power of Public Speaking AI Software in Engineering Education

Abstract

Technical skills may get you hired, but professional skills get you promoted. For decades, program evaluation surveys have emphasized the need for improved student communication skills -- from intrapersonal communication to public speaking. However, those survey responses stayed the same after adding the required technical writing and communication courses. Scaffolding students to develop polished professional skills is a core component of our NSF:IUSE/RED curriculum transformation. The new curriculum shifts communication training from a single course in the first year to distributed training and practice from the sophomore through senior years within the civil engineering courses. To supplement our public speaking instruction, we have adopted software that creates a virtual audience for students to practice delivering presentations. Students must practice their presentations three times within the system to achieve total participation points. After each attempt, feedback is presented to students, including eye contact, pitch, volume, use of filler words and long pauses.

This study investigates the impact of AI-powered public speaking software on the performance of civil engineering students in their sophomore and senior years. The research draws upon data scores in their final presentations. A multiple regression model is employed, revealing that the software explains approximately 26% variation in final presentation scores. Notably, while the time spent in the software has a small but significant negative effect on estimated final scores, the number of sessions completed positively influences these scores. This finding suggests that the frequency of engagement with the software outweighs the cumulative time spent. The study also considers the roles of students' conceptual scores and final grades as additional predictors.

In summary, this research offers insights into the shifting landscape of communication instruction within engineering education, emphasizing the potential of AI-powered tools to enhance student performance in public speaking, thus bridging the gap between technical expertise and professional communication skills.

Introduction

The importance of robust communication skills in engineering cannot be overstated. Industry partners consistently emphasize the necessity for engineering graduates to be proficient in technical skills and effectively convey complex ideas. This encompasses written and oral communication tailored to a diverse audience, including those without a technical background.

In response to this industry feedback, the Glenn Department of Civil Engineering at Clemson University embarked on an initiative to enhance our curriculum, focusing on developing these essential communication skills. We integrated specialized public speaking and written communication training within our civil engineering courses.

A dedicated communication instructor (the author) was embedded into multiple civil engineering courses, ranging from the sophomore to the senior level. The instructor spent dedicated instruction time within each course and introduced engineering-tailored communication assignments to students. In the sophomore year, students focus on public speaking skills through the Springer 1 course, which includes two individual speeches, a design charrette, and a team

final design presentation. During their junior year, civil engineering students have more opportunities to practice public speaking in design studio courses. These courses typically focus on students presenting their design solutions or research. Finally, in the Keystone course, the senior civil engineering students present their designs three times – at the proposal, conceptual and final design phases.

Despite the clear benefits of this initiative, a significant challenge emerged due to resource constraints. With over 400 students and only one dedicated communication instructor, providing personalized coaching was not feasible.

We incorporated PitchVantage, an AI-driven public speaking software, into our program to address this gap. This tool offered a solution by delivering tailored feedback, enabling more frequent practice, and providing mini-lectures on various aspects of communication. This paper explores the effectiveness of such technological interventions in honing the communication skills of engineering students.

We aim to share insights and add to the ongoing dialogue about integrating communication skills training within the engineering curriculum. We theorize that an early introduction to these skills and consistent practice will equip the next generation of engineers to impact their field profoundly.

Background

In his 2005 article "Engineering Communication," author Jonas Dulevicius cited an ASEE study of more than 4,000 graduate engineers with several years of employment to determine which academic subjects were most important. Technical writing ranked second, and public speaking ranked fourth. Working with individuals, working with groups, and talking with people ranked sixth, seventh and ninth, respectively. This investigation highlights the critical role of professional communication skills in an engineer's career.

The use of artificial intelligence in modern society is growing exponentially. AI is commonly adopted in multiple fields, including higher education. A growing body of research indicates that students' comfort with using AI in their studies is also growing. In his research, Muh. Putra Pratama concludes that students overwhelmingly view AI as an appropriate tool for a personalized tutor and assistant. The survey results indicate that 88% of the respondents strongly agree that AI can serve as a tutor; 9% agreed, and 2% and 1% disagreed and strongly disagreed respectively.

"Artificial intelligence (AI) can function as a personalized virtual tutor that provides individual guidance based on the needs and weaknesses of learners. Virtual tutors can provide additional material, exercises, and appropriate feedback to help learners improve their understanding on a particular topic." (Pratama)

We assumed this approach by adopting PitchVantage as a tool to guide student's growth and performance in oral communication skills. The AI-powered software provides multiple opportunities for students to practice their public speaking. It provides detailed ratings and feedback on some delivery criteria, including pitch variability, volume, eye contact, length of

pauses, verbal fillers and pace. (See Figures 1, 2 & 3) Instructors can tailor the assignments to require students to use specific terminology and evaluate the performance on whether the terms were incorporated into their presentation. (See Figures 4 & 5)

With every new technology, there are pros and cons.
Certainly, PitchVantage offers more pros than cons, but it is not without its limitations. The software developer does not use student data to power learning for the AI. However, student privacy is a common concern in today's digital society. The time allocated for software training for both student and instructor can be another challenge.

Methodology

In our investigation, we aimed to assess the effectiveness of PitchVantage, an AI-powered public speaking software, in improving the communication skills of engineering students. Our participant group consisted of undergraduate students from the senior capstone course within our civil engineering department. All student teams used the PitchVantage software in their communication curriculum. The study was structured around two primary independent variables: the total time each student spent in the software and the number of individual practice sessions each student completed. These variables were chosen to understand how the duration and frequency of engagement with the software impacted the students' communication skills.

The primary dependent variable in our study was the students' final presentation scores in the Keystone, which were indicative of their oral communication proficiency. These scores were obtained by evaluating the final presentations in their communication course. The department's communication lecturer evaluated all students' final presentations to maintain consistency. The communication lecturer used a rubric that reinforced the delivery elements PitchVantage evaluates. Those elements include pitch variability, pace variability, pace, long pauses, volume, eye contact, verbal fillers, gestures and facial expression. (See Figure 6.) Additionally, the AI software tracks student's progression in each category. Between the software and the instructor's feedback, students receive ample input on areas of strength and room for improvement.

To add depth to our analysis, we also included two additional predictors: the students' conceptual scores from the Keystone course, representing their technical understanding, and their overall final grades in the communication courses, serving as another metric of their communication skill level.

Our statistical approach involved employing a multiple regression model. This model was designed to analyze the relationship between the time spent in the software versus the number of sessions completed and how each approach impacted students' final presentation scores. Using this model, we aimed to isolate the effects of each independent variable, providing a clear picture of how each contributed to the student's performance.

The findings from the regression analysis were quite enlightening. They revealed that the independent variables accounted for approximately 26% of the variation in the final presentation scores. Interestingly, we observed a small but significant negative effect of the time spent in the software on these scores. In contrast, a positive influence was noted from the number of sessions

completed. This indicated that engaging frequently with the software in shorter sessions – on average, 20-minute sessions -- was more effective than spending longer (close to 45 minutes) and less frequent periods. The additional predictors – students' conceptual scores and final grades – were also considered, offering a broader perspective on the factors influencing communication skill development among engineering students.

Through this narrative-based methodology, we sought to quantitatively evaluate the impact of the AI-powered public speaking software on the communication skills of engineering students. Our study highlights the importance of the frequency of engagement with educational technology, providing valuable insights for integrating such tools in engineering education.

Results and Recommendations

The results from our study offer significant insights into the effectiveness of AI-powered public speaking software in enhancing communication skills among engineering students. Our multiple regression analysis, focusing on the time students spent in the software and the number of sessions they completed, revealed that these variables together explained approximately 26% of the variation in the students' final presentation scores.

Table 1

Multiple Regression Results

Predictor	*n*	β	*95% CI* [LL, UL]
(Intercept)	79	94.55^{***}	[93.35, 95.76]
Total Time (in minutes)	79	-0.07^{**}	[-0.13, -0.01]
Sessions	79	0.22^{*}	[0.01, 0.44]

Note. $R^2 = .21$. $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$

The R2 value of 0.21 indicates that our model accounts for about 21% of the variation in the dependent variable. While this may appear modest, it's important to understand that the R2 value alone doesn't determine the effectiveness of a regression model. This is particularly true in fields like psychology or sociology, where human behavior introduces a great deal of unpredictability. In such disciplines, it's not uncommon to see R2 values below 50%, as human behavior is inherently complex and difficult to capture fully with statistical models.

Despite the lower R2 value, our model remains informative. The statistical significance of the model's parameters (with p-values less than 0.05) suggests that these factors do have a meaningful impact on the dependent variable. Moreover, the confidence intervals for the coefficients do not include zero, further affirming their influence. Therefore, even though the R2 is relatively low, the model provides valuable insights into the factors that affect the dependent variable.

Interestingly, the time spent in the software showed a small but significant negative effect on the final presentation scores. This suggests that merely spending a long duration in the software does not necessarily lead to better communication skills. In contrast, the number of sessions

completed positively impacted the scores, indicating that frequent, shorter engagements with the software were more beneficial than longer, infrequent usage.

This pattern in the results points towards the importance of regular practice and engagement with educational tools rather than prolonged, sporadic interactions. It underlines the effectiveness of consistent, focused practice over time spent passively in a learning environment.

In addition to these findings, the study considered the roles of Keystone course students' conceptual scores and final grades as further predictors. These additional variables provided a broader context for understanding the students' overall performance and skill development in communication, complementing the primary analysis of the software's impact.

Students who used the software to their advantage found tremendous benefits in the software.

“Surprisingly, I actually found PitchVantage to be very helpful. I know I’m not a perfect speaker, but to self-diagnose the issues that I have with my speeches would be difficult to find what I do wrong,” said Garrett Emory, a civil engineering student during the Springer 1 course. “PitchVantage repeatedly, especially toward the start of the year, said the same thing. It said I spoke too quickly, didn’t have enough variation in my tone, and sometimes my eye contact wasn’t the best. I didn’t think it was going to help, to be honest, when we first started, I thought it was just another assignment we had to do. But It kept telling me the same things. I realized if I’m getting good scores on the same things and bad scores on the same things after my fifth repetition of using PitchVantage then obviously that’s something you need to work on.”

Likewise, a fellow civil engineering student attributed the software to providing an equal ground for students to be able to grow as public speakers.

Student evaluations from the sophomore course included the following positive comments:

- Presentations made me realize how much I say ‘um’ and that I am jittery and fast. It was great to see myself and use pitch vantage.
- What I like most about communication was the pitch vantage questions since it helped me self-evaluate to recognize my strengths and weaknesses.
- Taught me how to communicate between other engineers, contractors, and just people in general.
- It was great to tie communication and engineering together.
- The communication assignments have helped me to feel more prepared for communicating and presenting as an engineer in the workforce.
- I liked pitch vantage and receiving feedback on my practices.
- Seeing myself grow in areas like eye contact and overall confidence level speaking
- Pitch vantage was a helpful way to practice for my speeches.

As educators in engineering, our primary aim is not only to impart technical knowledge but also to ensure our students emerge as well-rounded professionals proficient in all forms of communication. In this era of rapid technological advancement, integrating artificial intelligence into educational practices offers unprecedented opportunities for enhancing learning outcomes.

Our recent experience with PitchVantage, an AI-powered public speaking software, is a testament to the transformative potential of such tools in engineering education.

Adopting PitchVantage within our program has yielded significant improvements in student performance. This software offers personalized feedback, enabling students to refine their presentation skills in a supportive, iterative learning environment. By simulating a wide range of audience responses, PitchVantage prepares students for the unpredictable dynamics of real-world speaking engagements, fostering confidence and adaptability.

Our findings underscore the pivotal role of AI-powered tools in facilitating the development of essential communication skills among engineering students. The interactive nature of PitchVantage, coupled with its capacity for personalized feedback, has enhanced student engagement and expedited the learning process. Students have demonstrated marked improvements in their ability to articulate complex ideas clearly and persuasively, a competency critical to their success in both academic and professional settings.

Given the tangible benefits observed, we strongly recommend that other engineering departments consider incorporating PitchVantage or similar AI-powered public speaking software into their curricula. Integrating such tools represents a forward-thinking approach to education, equipping students with the oral communication skills necessary to thrive in the multifaceted engineering landscape. Adopting this technology offers a substantial opportunity to elevate the quality of engineering education, ensuring that students are technically proficient and effective communicators.

In conclusion, integrating AI-powered public speaking tools like PitchVantage into engineering education can significantly enhance the development of oral communication skills among students. We advocate for a broader adoption of this technology, confident in its potential to prepare the next generation of engineers for the challenges and opportunities of a dynamically evolving professional environment.

References

Dulevicius, J. (2005). Engineering Communication. Global Journal of Engineering Education. Vol. 19, No. 1.

Makhiboroda, Yegor. 2024. PitchVantage. https://pitchvantage.com/

Pratama, M. P., Sampelolo, R., & Lura, H. (2023). Revolutionizing education: Harnessing the power of artificial intelligence for personalized learning. Klasikal: Journal of Education, Language Teaching and Science, 5(2), 6. p-ISSN: 2656-9914 e-ISSN: 2656-8772.

Appendix

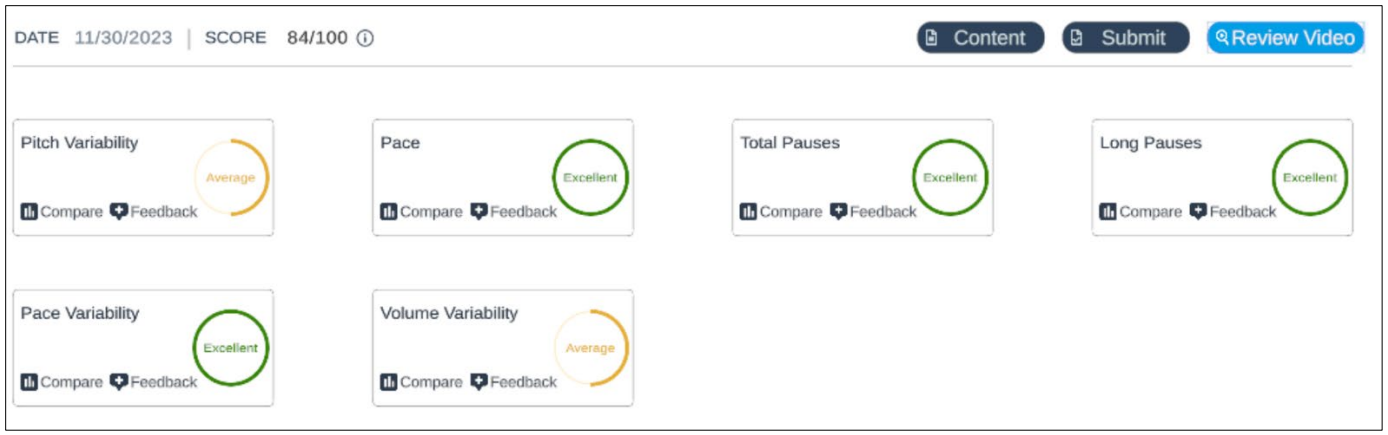


Fig. 1 A view of a student's performance in six public speaking criteria.

Fig. 2 A snapshot from PitchVantage that depicts a student's progress over multiple practice sessions.

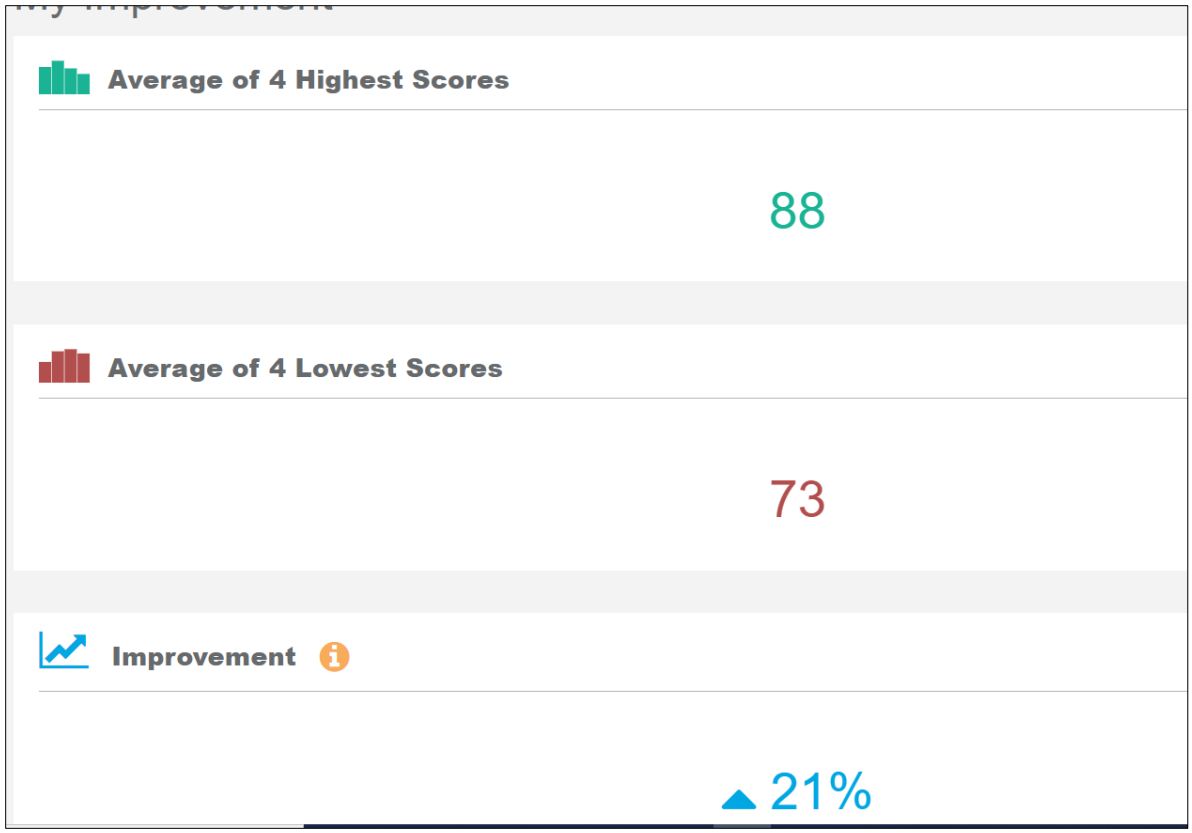
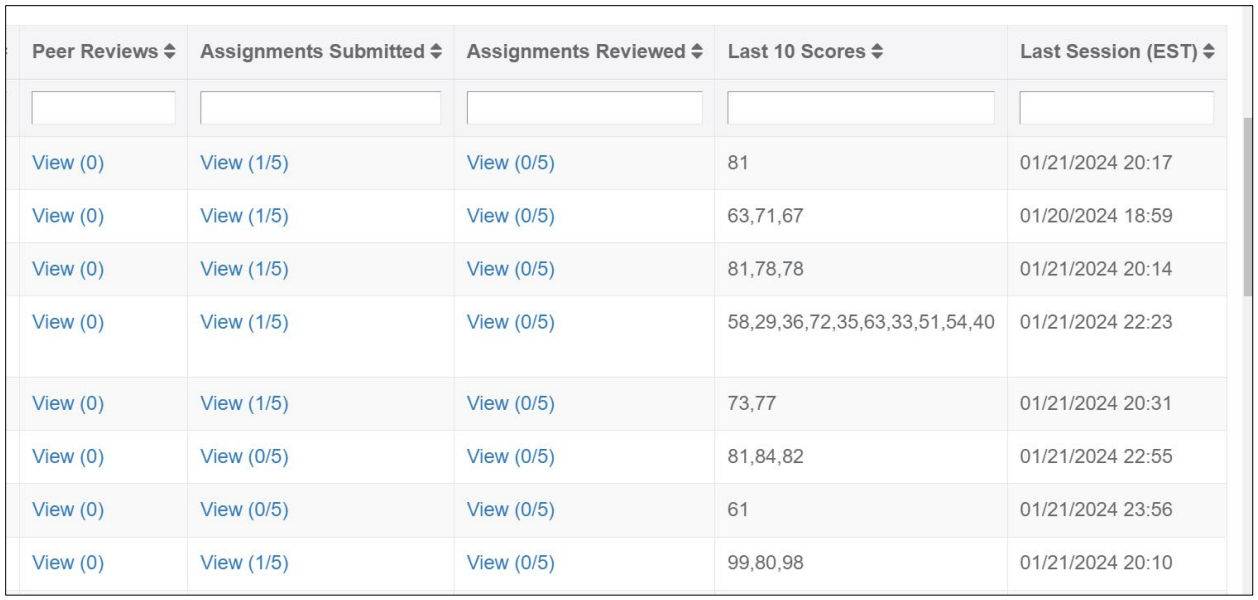


Fig. 3 Students can track their improvement over the course of the semester.

License Set Name	Average Score	Practice Time	Registered Users	Active Users
#7879 (CE 4570 Spring 2024)	0	0 s	18	0
#7798 (CE 4080 Spring 2024)	75	13 h : 45 min : 49 s	63	62
#7787 (CE 2100 Spring 2024)	77	4 h : 32 min : 39 s	31	28
#7318 (CE 4210 Spring 2024)	0	0 s	28	0

Fig. 4 Instructors can track performance and accumulated practice time within each course.



Peer Reviews	Assignments Submitted	Assignments Reviewed	Last 10 Scores	Last Session (EST)
View (0)	View (1/5)	View (0/5)	81	01/21/2024 20:17
View (0)	View (1/5)	View (0/5)	63,71,67	01/20/2024 18:59
View (0)	View (1/5)	View (0/5)	81,78,78	01/21/2024 20:14
View (0)	View (1/5)	View (0/5)	58,29,36,72,35,63,33,51,54,40	01/21/2024 22:23
View (0)	View (1/5)	View (0/5)	73,77	01/21/2024 20:31
View (0)	View (0/5)	View (0/5)	81,84,82	01/21/2024 22:55
View (0)	View (0/5)	View (0/5)	61	01/21/2024 23:56
View (0)	View (1/5)	View (0/5)	99,80,98	01/21/2024 20:10

Fig. 5 A view of individual student performances within a single course. Instructors can view the number of sessions, scores and date of last practice session.

Criteria	Ratings			Pts
Time requirement (- 5 pts., lose pts for running long or short starting at +/- 30 seconds)	**0 pts** **A** Meets time requirements	**0 pts** **Points Deducted** 5 points deducted for running short or long by more than 30 seconds.		0 pts
Introduction/Attention Getter	**15 pts** **A** Made audience sit up and listen, Clear and creative, related topic to audience throughout	**12 pts** **B** Audience engagement was heightened, clear topic and some related to audience	**11 pts** **C** Audience is pretending to listen.	15 pts
Content • Was it an informative, well-thought out statement? • Clear main points • Great and creative transitions	**20 pts** **A** Clear objective was communicated and supported with examples, had good organization, creative transitions,	**18 pts** **B** An objective was stated with some supporting examples, clear main points and good transitions	**16 pts** **C** No clear objective was communicated, research either missing or from sketchy sources, lacked flow or clear structure and transitions.	20 pts
Conclusion	**10 pts** **A** Clearly recapped main points, tied it back to thesis statement and audience relevance. Successful, impactful closing	**8 pts** **B** Clearly recapped points, tied to thesis statement, but lacked impact	**7 pts** **C** No real conclusion, ended by a version of “That’s all I have” or thank you.	10 pts
Supporting Material	**20 pts** **A** Clearly orally cited sources within speech and from 3 reputable sources (one academic journal)	**15 pts** **B** Clearly referenced 1-2 reputable source, including journal	**10 pts** **C** Missing any citations to research or used unreputable sources	20 pts

Criteria	Ratings			Pts
Vocal delivery Includes good pace, pitch, volume and no verbal fillers	**15 pts** **A** Mary Poppins "perfect in every way", varied rates of speech and pitch, good volume, no verbal fillers,	**13 pts** **B** Started off with fast pace (nerves), but gained control. Varied pitch some. Fewer than 5 verbal fillers.	**11 pts** **C** Speedy Gonzales or Zootopia DMV sloth) (i.e. either waaay too fast or waaay to slow.)	15 pts
Physical delivery Includes good stance, eye contact, facial expressions and positive body language.	**10 pts** **A** Audience felt the connection. Connected with all "sides" of the room. Great eye contact. Positive body language. No fidgeting.	**8 pts** **B** Looked at back of room, only made direct eye contact once or twice.	**6 pts** **C** Stared at floor, wall, anything other than the audience. did not speak confidently. Speaker didn't appear to know content well.	10 pts
PitchVantage Practice Practiced required times in PitchVantage Five points deducted for not practicing.	**5 pts** **Full Marks** Must complete all three practices to get full points.		**0 pts** **No Marks** Did not practice	5 pts
Complete Outline Turned In Outline must be typed, 12 pt Times New Roman, and in complete sentences. No handwritten submissions accepted. Five points deducted for not turning in a complete outline.	**5 pts** **Full Marks**	**0 pts** **No Marks**		5 pts
				Total Points: 100

Figure 6: The Informative Speech rubric that highlights the use of PitchVantage and evaluates students on the delivery methods outlined in the AI-software.

Fig. 7 Watch our Arch Initiatives video to hear students' reactions to using the PitchVantage software.