

Identifying Self-Confidence Profiles of Elementary School Students through Clustering of Public Speaking Training Results

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Abstract

This study investigated the effectiveness of a public speaking training intervention for elementary school students. 27 students were assessed on five public speaking aspects: intonation, articulation, facial expression, confidence, and creativity. Students showed greater proficiency in confidence and creativity compared to intonation and facial expression. Hierarchical clustering using Ward's linkage method identified two distinct clusters of students with differing public speaking profiles. The research highlights the benefits of public speaking training for elementary students and the importance of tailoring interventions to address specific weaknesses. The identification of distinct student clusters based on their public speaking abilities provides a framework for developing targeted interventions that cater to individual student needs, promoting effective communication skills from an early age. Future research could explore the long-term impact of such targeted interventions and the relationship between public speaking abilities and other academic and social outcomes.

Keywords : *public speaking, hierarchical, clustering*

1 INTRODUCTION

In fact, public speaking is a vital skill that is crucial to the development of students. Through public speaking, students learn to articulate thoughts and ideas in a clear, structured, and persuasive manner. This skill is not only useful for making presentations in class, but also trains them to actively participate in discussions, express opinions, and communicate effectively in various situations. In addition, public speaking plays an important role in developing students' self-confidence. By daring to speak in front of others, students gradually overcome fear and nervousness, enabling them to build a positive self-image.

Unfortunately, despite its significant impact on students' academic and social skills, public speaking training is often marginalized in the elementary school curriculum. Many schools in Indonesia still focus on developing cognitive aspects such as math and science, while soft skills such as public speaking receive less attention. In fact, the ability to speak in public can help students achieve better academic results. Students who are skilled in public speaking tend to be more active in class, able to explain ideas well, and more confident in participating in various academic activities. Some of the research and services conducted have created new ways to help students learn to speak in public [1]. The lack of emphasis on public speaking training in elementary school can affect students' readiness to meet the demands of higher education and the workplace. In this digital age, good communication skills, including public speaking, are one of the keys to success. Therefore, it is important for educators and policymakers to pay more attention to integrating effective public speaking training into the elementary school curriculum.

Students participating in public speaking training are typically assessed on various parameters, including intonation, articulation, expression, confidence, and creativity. These five aspects serve as crucial indicators in evaluating speaking effectiveness, as each contributes to the student's ability to convey messages clearly and engagingly. Intonation, the rise and fall of the voice, adds depth and meaning to spoken words. Proper articulation ensures that each sound is produced clearly and distinctly, enhancing message comprehension. Expressiveness, conveyed through facial expressions and body language, adds emotional depth and strengthens audience engagement. Confidence, reflected in posture and voice projection, enhances the speaker's credibility

and persuasiveness. Finally, creativity allows students to craft unique and memorable presentations, capturing the audience's attention and leaving a lasting impression. [2]

However, evaluating public speaking skills often remains subjective and reliant on teacher perception. This subjectivity can introduce bias and inconsistency into the assessment process. To address this limitation, this study employs a more objective, data-driven approach to analyze student performance in public speaking training. By utilizing quantitative data and statistical analysis, we aim to provide a more comprehensive and unbiased evaluation of student progress and identify specific areas for improvement. This approach contributes to a more rigorous and scientific assessment of public speaking skills, enhancing the validity and reliability of the evaluation process. Several studies have used machine learning, expert systems or artificial intelligence to solve problems. Some examples are research conducted by researcher Hermansyah were using Simple Additive Weighting to determine the value of the best child in the class [3], then research conducted by researcher Afreyna in higher education to determine the quality of websites in education using WebQual. Finally [4], research conducted by Muliawan regarding the grouping of value data in a MTs Nahdlatul Arifin school using Decision Tree Approach C4.5 [5].

This study demonstrates how cluster analysis can be applied to public speaking practice at the elementary school level to tailor instruction to students' specific needs and improve learning outcomes. This data-driven approach has the potential to be adapted to improve other non-academic skills, such as creativity and leadership. The ultimate goal of this research is to provide recommendations on how to improve public speaking instruction through a more targeted and data-driven approach. By understanding how clustering can help identify groups of students with similar training needs, this study has the potential to improve the quality of public speaking training in elementary schools and ensure that students develop the communication skills necessary for future success.

2 RESEARCH METHOD

This research process is carried out by training students, then assessing the results of training and clustering processes. The following is the flow of the research process.

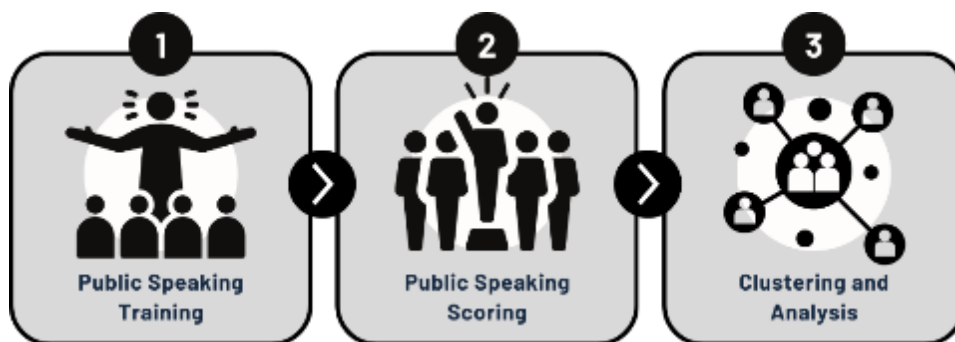


Figure 1. Reasearch Diagram

1. Public Speaking Training

Public speaking training serves as a critical component of this research study, as it establishes the foundation upon which students develop essential communication skills. The training's objective is to equip elementary school students with fundamental public speaking techniques, encompassing both verbal and non-verbal communication. By focusing on key aspects such as intonation, articulation, facial expressions, and body language, the training provides students with a comprehensive toolkit to effectively convey their message and engage their audience. Furthermore, the training underscores the significance of breath control, emphasizing its role in managing nervousness and sustaining vocal projection during presentations.

The training process employs small group formations to encourage active student participation and a sense of comfort within the learning environment. This approach allows students to practice their skills in a supportive setting and receive explicit instruction on various public speaking techniques. These techniques include voice modulation to emphasize key points, clear articulation for enhanced comprehension, and the use of facial expressions and body language to reinforce the

message. Furthermore, students are instructed in breathing exercises to mitigate anxiety and maintain vocal control.

The training involves practical application through activities such as storytelling and poetry recitation, which provide students with opportunities to apply their newly acquired skills in a real-world context. These activities help students develop valuable experience in presenting in front of an audience, which has been shown to build confidence and reduce anxiety. Furthermore, the incorporation of constructive feedback from mentors allows students to identify areas for improvement and refine their public speaking abilities. This continuous process of practice and feedback, or cycle of training, is instrumental in facilitating students' mastery of essential communication skills.

2. Public Speaking Scoring

Following the training sessions, the next stage involves an assessment to evaluate the students' development in public speaking abilities. This assessment aims to gauge the extent to which students can apply the learned techniques and express themselves effectively in public. Students are tasked with either composing their own poems or selecting from existing ones, with the goal of measuring their creativity and speaking proficiency.

The evaluation is conducted by three independent judges with expertise in public speaking or education. Each judge assesses the students based on five key aspects: intonation, articulation, facial expressions and body language, confidence, and creativity, using a scoring range of 0 to 10 for each aspect. The results of this assessment will provide insights into the students' strengths and weaknesses in public speaking for further analysis.

3. Clustering and Analysis

After conducting the assessment and obtaining public speaking results from elementary schools, the next process is to cluster and analyze the results. The clustering process used in determining the number of clusters for public speaking results is using the hierarchical method. In the context of analyzing public speaking data in elementary schools, hierarchical clustering offers several advantages. First, it allows for the exploration of data without a predetermined number of clusters, making it suitable for discovering natural groupings within the data. Second, it produces a dendrogram, a visual representation of the clustering process that aids in understanding the relationships between students and clusters at various levels of granularity. This visualization can provide insights into the hierarchical structure of students' public speaking abilities, identifying different proficiency levels and potential areas for targeted intervention. Furthermore, hierarchical clustering can handle various distance metrics and linkage criteria, offering flexibility in adapting to the specific characteristics of the public speaking data and research objectives. Finally, its ability to accommodate non-spherical clusters aligns well with the potential variability and complexity of public speaking skills development in young learners. [6], [7]

Having opted for hierarchical clustering, the next crucial step is selecting an appropriate linkage method, which dictates how the distance between clusters is computed. Several linkage methods exist, each with unique properties and implications for the resulting clusters. Commonly used methods include:

- (a) **Single linkage:** This method defines the distance between two clusters as the shortest distance between any two points in the clusters. It tends to produce long, chain-like clusters and is sensitive to outliers.
- (b) **Complete linkage:** In contrast to single linkage, complete linkage defines the distance between two clusters as the greatest distance between any two points in the clusters. This method tends to produce compact, spherical clusters and is less susceptible to outliers.

- (c) **Average linkage:** This method calculates the average distance between all pairs of points in two clusters, offering a balance between single and complete linkage. It often yields clusters with moderate size and shape.
- (d) **Ward's method:** This method aims to minimize the variance within clusters, resulting in clusters with similar sizes and variances. It is less susceptible to noise and outliers compared to single linkage.

Choosing the appropriate linkage method is critical, as it influences the shape, size, and interpretation of the resulting clusters. The choice should be guided by the specific characteristics of the data, the research question, and the desired outcome of the clustering analysis. Careful consideration of the strengths and weaknesses of each linkage method ensures a robust and meaningful clustering solution for understanding the nuances of public speaking development in elementary school students.

Determining the optimal linkage method and the ideal number of clusters for hierarchical clustering often requires a systematic approach. Cross-validation techniques can be particularly valuable in this regard. By partitioning the data into training and validation sets, cross-validation allows for the evaluation of different linkage methods and cluster numbers on unseen data. This process helps to identify the combination that yields the most robust and generalizable clustering solution.

For instance, one can employ k-fold cross-validation, where the data is divided into k subsets. The clustering algorithm is trained on k-1 subsets and validated on the remaining subset. This process is repeated k times, with each subset serving as the validation set once. By comparing the performance of different linkage methods and cluster numbers across the k iterations, one can identify the configuration that minimizes a predefined error metric, such as the silhouette score or Davies-Bouldin index. This data-driven approach ensures that the chosen linkage method and cluster number are not overly sensitive to the specificities of the training data and are more likely to capture the true underlying structure of the public speaking abilities in the student population. [8]

3 RESULTS AND ANALYSIS (11 PT)

The mentors involved in the training students, comprised of university students, played a crucial role in providing support and individualized attention to each student, fostering a positive and encouraging learning environment. Their presence, coupled with constructive feedback and guidance tailored to the student's needs, contributed significantly to the success of the training sessions. The mentors' ability to maintain a supportive atmosphere and facilitate active participation in various activities, such as storytelling and poetry recitation, fostered a sense of comfort and confidence among the student, enabling them to freely develop their public speaking skills. This positive learning experience, characterized by active engagement and enjoyment, underscores the importance of supportive mentorship in facilitating effective learning and skill development.



Figure 2. Public Speaking Training Sessions

Following the training, an assessment was conducted on 27 students, focusing on five key aspects of public speaking: intonation, articulation, facial expression, confidence, and creativity, while 10 students were unable to participate due to absences such as illness or other activities.

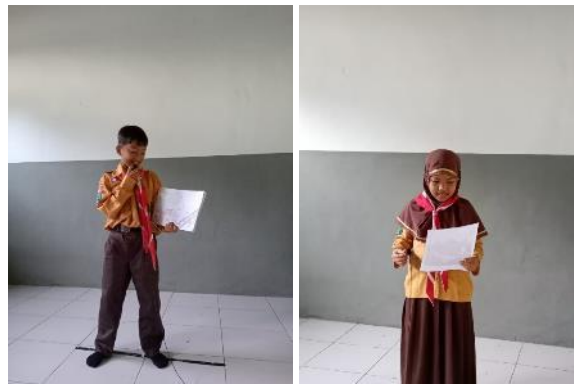


Figure 3. Public Speaking Scoring Sessions

The assessment was conducted using a 1–10 scale to evaluate five distinct aspects. The following presents the average scores obtained by the student in each aspect:

Table 1. Average of Public Speaking Scoring

Scoring Aspect	Average
Intonations	6.33
Articulations	6.69
Expressions	6.36
Self-Confidence	7.19
Creativity	7.03

The average scores reveal that students exhibit greater strength in confidence and creativity compared to intonation and facial expression, suggesting that while they can speak confidently and generate creative content, further development in vocal modulation and expressive communication is needed. Notably, confidence and creativity received higher scores, indicating a comfort level in public speaking and an ability to produce creative work, such as poetry composition. These findings underscore the importance of fostering both confidence, which enhances effective communication, and creativity, which enriches presentations with original ideas. Conversely, the relatively lower scores in intonation and facial expression suggest a need for further guidance in utilizing vocal variety to express emotions and enhance message delivery, as well as in incorporating facial expressions to augment verbal communication and bring presentations to life.

To ensure the accuracy of clustering results, this study employs cross-validation techniques. This involves partitioning the data into subsets and evaluating the clustering model across various data combinations to

guarantee that the resulting clusters are not dependent on a single data partition. Prior to clustering, a thorough data check is performed to ensure completeness and address any missing values. This data cleaning process is crucial for maintaining the accuracy of the clustering results. In determining the optimal number of clusters, cross-validation is employed to evaluate clustering outcomes with varying cluster numbers (ranging from 2 to 5) and diverse linkage methods (including single, complete, average, and Ward's). Each combination of linkage methods and cluster numbers is rigorously tested to identify the most representative outcome using the Silhouette Score as an evaluation metric.

Table 2. Cross Validation Result

	Ward	Single	Complete	Average
Cluster 2	0.445	0.442	0.445	0.445
Cluster 3	0.373	0.326	0.373	0.368
Cluster 4	0.355	0.279	0.355	0.355
Cluster 5	0.233	0.162	0.264	0.330

Cross-validation results revealed varying Silhouette Scores across different linkage methods and cluster numbers, with higher scores indicating better-defined clusters. Notably, Ward, Single, Complete, and Average linkage methods exhibited similar Silhouette Scores for 2, 3, and 4 clusters, potentially due to the data's inherent structure or the methods' similarities at lower cluster numbers. Ward linkage with 2 clusters yielded the highest Silhouette Score (0.445), suggesting optimal cluster separation and homogeneity for this dataset. While Single, Complete, and Average linkage methods showed comparable performance at 2 clusters, their scores decreased with higher cluster numbers, indicating less stable performance. Therefore, Ward linkage with 2 clusters was deemed most suitable for this study, prompting further analysis to discern the characteristics distinguishing these clusters and inform targeted training interventions.

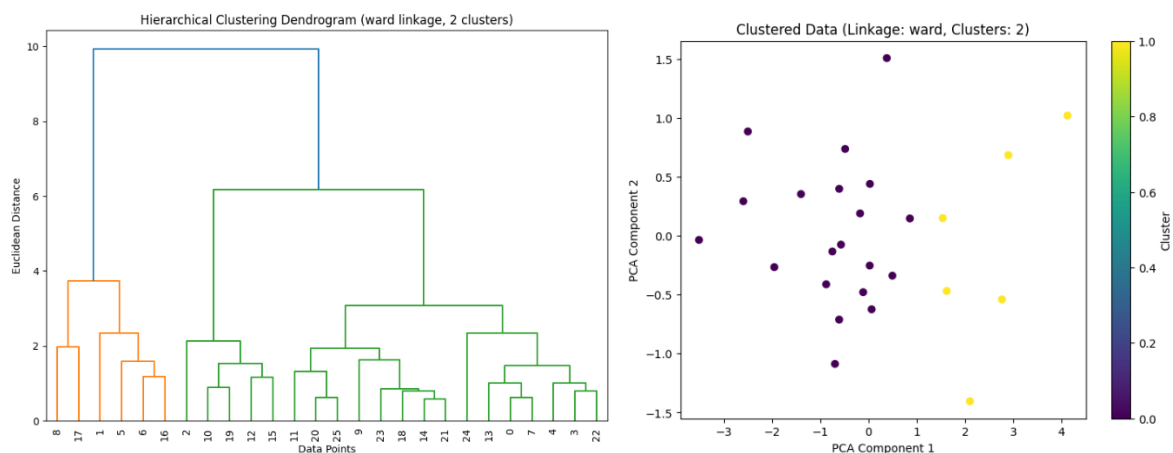


Figure 4. Dendrogram and Cluster Diagram

The Ward linkage method with 2 clusters yielded a Silhouette Score of 0.445, indicating a clear separation between two distinct groups of students based on their public speaking abilities. The first cluster likely comprises students with generally stronger public speaking skills, exhibiting higher scores across various aspects such as intonation, articulation, expression, confidence, and creativity. Conversely, the second cluster likely includes students who require further improvement in these aspects, demonstrating comparatively lower scores. The formation of these two clusters demonstrates the effectiveness of Ward linkage, which focuses on minimizing within-cluster variance, in grouping students with similar abilities and creating a clear distinction between higher and lower performing groups. The high Silhouette Score for this 2-cluster solution signifies that the clustering effectively captures the underlying data structure, with distinct differences between clusters and strong within-cluster cohesion.

4 CONCLUSION

A study on public speaking training in elementary schools has revealed that children exhibit high levels of enthusiasm and engagement throughout the mentor-guided training process. Assessment results indicate

commendable average scores in confidence and creativity, while other aspects such as intonation, articulation, and expression show greater variability. The clustering process, employing Ward's linkage method, effectively divides the participants into two distinct groups: those with stronger public speaking skills and those requiring further development. The utilization of cross-validation techniques and Silhouette Scores to determine the optimal cluster number confirms that a two-cluster solution yields the most robust results, with clear inter-group distinctions. This finding enables the tailoring of training approaches to better address the specific needs of each group.

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