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Evaluating English Oral Production in University Students through Google Meet Using Neutrosophic Z-Numbers

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Abstract. The present study investigates a central problem in the field of virtual education: how it influences the use of Google Meet in the Oral Production Competition of University Students at a public university in Lima. The research issue focuses on determining whether this platform, widely integrated into current educational environments, effectively contributes to the development of oral communicative skills in a foreign language. In a context where digital technologies are essential for teaching, understanding their real impact is essential to optimize learning processes in non-face-to-face modalities. Therefore, this investigation adopts an innovative approach based on neutral Z numbers, which allows to the analysis of student perceptions with greater depth, including aspects of certainty, uncertainty and denial. The relevance of this issue lies in the growing dependence of higher education institutions of virtual and hybrid environments, as well as the strategic importance of the English domain in a globalized world. However, previous studies on platforms such as Google Meet have tended to privilege traditional quantitative approaches, leaving aside the complexity of students' subjective perceptions. To address this lagoon, semi-structured interviews with 40 students were used, evaluated by neutral Z numbers and compared to the U-Whitney U test. The results indicate significant differences between those who intensively use the platform and those who do not, highlighting greater confidence in oral production among the former. This research not only enriches the theoretical framework by introducing a novel methodology but also offers practical recommendations to enhance English teaching through digital tools.

Keywords: Google Meet, Oral Production Competence, English, Neutrosophic Z Numbers, Virtual Education, University Students, Language Teaching, Educational Technology.

1. Introduction

In an increasingly interconnected world, the ability to communicate orally in English has become established as an essential skill for university students, especially in globalized academic and professional environments. This study examines how the use of Google Meet, a widely adopted videoconferencing platform, impacts the development of oral production in English among students at a public university in Lima. The relevance of this research lies in its ability to shed light on the potential of digital tools in language teaching, a critical area in higher education today. According to recent research, mastery of a foreign language significantly improves job and academic opportunities [1], underscoring the need to explore how technologies can optimize this learning. Historically, language teaching has transitioned from face-to-face methods based on memorization to communicative approaches supported by technological resources. In the last decade, platforms such as Google Meet have gained ground in virtual classrooms, transforming the way students interact with their teachers and peers. This shift, driven by the digitalization of education, has opened up new possibilities but has also raised questions about its actual effectiveness. Previous studies have highlighted the role of videoconferencing in improving student-teacher interaction [2], paving the way for more specific research on language skills.

Today, public universities in Peru face the challenge of integrating accessible technologies into their curricula, especially in contexts where resources are limited. Google Meet, due to its ease of use and availability, has become a key tool for synchronous classes, allowing students to practice English in real-time. However, it is unclear whether this platform effectively strengthens oral production, a skill that requires confidence, fluency, and accuracy [3]. This panorama motivates an in-depth analysis of its impact on learning. The problem addressed by this study arises from the uncertainty about how digital platforms, such as Google Meet, influence oral communicative skills in English. Although its use is widespread, doubts persist as to whether it truly encourages oral expression or if, on the contrary, technical and pedagogical limitations hinder it. How does the use of Google Meet contribute to the development of oral production in English among university students, considering subjective perceptions and the uncertainty inherent in their experience? This question, still without a definitive answer, guides the direction of the research. Several authors have explored the use of technologies in language teaching, highlighting benefits such as flexibility and accessibility [4]. However, most of these works have focused on quantitative metrics, such as the number of participants, leaving aside more complex perceptions of students, such as confidence in their oral skills. This gap in the literature justifies the need for an approach that goes beyond numerical data and addresses the ambiguity of individual experiences, an aspect that this research seeks to cover. Furthermore, the Peruvian context adds a layer of relevance to the study. Public universities, such as the National Agrarian University La Molina (UNALM), operate under conditions that demand practical and effective solutions to improve English teaching [5]. Oral production, in particular, is a skill that students often perceive as challenging due to the lack of practice in authentic environments [6]. Therefore, evaluating the role of Google Meet in this process not only has pedagogical implications but also social and economic ones.

To address these concerns, the study employs neutrosophic Z-numbers, a methodology that captures truth, indeterminacy, and falsity in students' perceptions, offering a more comprehensive analysis than traditional approaches. This tool allows us to explore how university students evaluate their progress in oral production when using Google Meet, considering both their certainties and their doubts. Thus, the research positions itself as a bridge between theory and practice, with an innovative approach adapted to the challenges of the present.

The study's objectives are clear and aligned with the question posed. First, it seeks to determine the impact of intensive Google Meet use on self-perceptions of English-speaking proficiency among first-year students at UNALM. Second, it aims to identify significant differences between those who use the platform frequently and those who do not, using a neutrosophic analysis. Finally, the paper aims to propose pedagogical strategies based on the findings to optimize English teaching in virtual environments. These objectives will be developed throughout the article, offering a significant contribution to the field of education.

1. **Preliminares**

1.1 Oral Oral production proficiency

Oral production proficiency in a foreign language, such as English, represents a key skill that enables individuals to interact effectively in diverse contexts, from academic to professional. This mastery is not limited to correctly pronouncing words but encompasses the ability to convey ideas, adapt to communicative situations, and use language appropriate to the interlocutor. In a globalized world where communication transcends borders, its importance is undeniable. However, achieving this skill poses significant challenges, especially for university students who face barriers such as lack of practice or insecurity when expressing themselves. Historically, the teaching of oral production has evolved from rigid approaches focused on rote repetition to communicative methods that prioritize real-life interaction. Today, digital technologies, such as videoconferencing platforms, have transformed this landscape by offering environments where students can practice in real-time. However, this transition does not automatically guarantee success. Effectiveness depends on how these tools are integrated into teaching processes and on teachers' ability to foster an environment that encourages oral expression without fear of error [7].

A crucial aspect to consider is that oral production is not an isolated skill, but rather intertwined with linguistic, sociolinguistic, and pragmatic components. For example, mastering vocabulary and grammar is essential, but understanding the cultural norms that govern conversation is equally important [1]. This complexity requires students not only to memorize structures but also to apply them in authentic contexts. However, many educational programs still prioritize written comprehension over oral expression, leaving learners insufficiently prepared for practical situations. Furthermore, self-perception plays a determining role in the development of this skill. Students who feel insecure tend to participate less, which limits their opportunities for improvement. Conversely, those who perceive progress in their fluency tend to be more willing to interact, generating a virtuous cycle of learning. In this sense, digital platforms can act as catalysts by offering safe spaces for practice, although their impact varies depending on the frequency of use and the quality of the activities proposed [8].

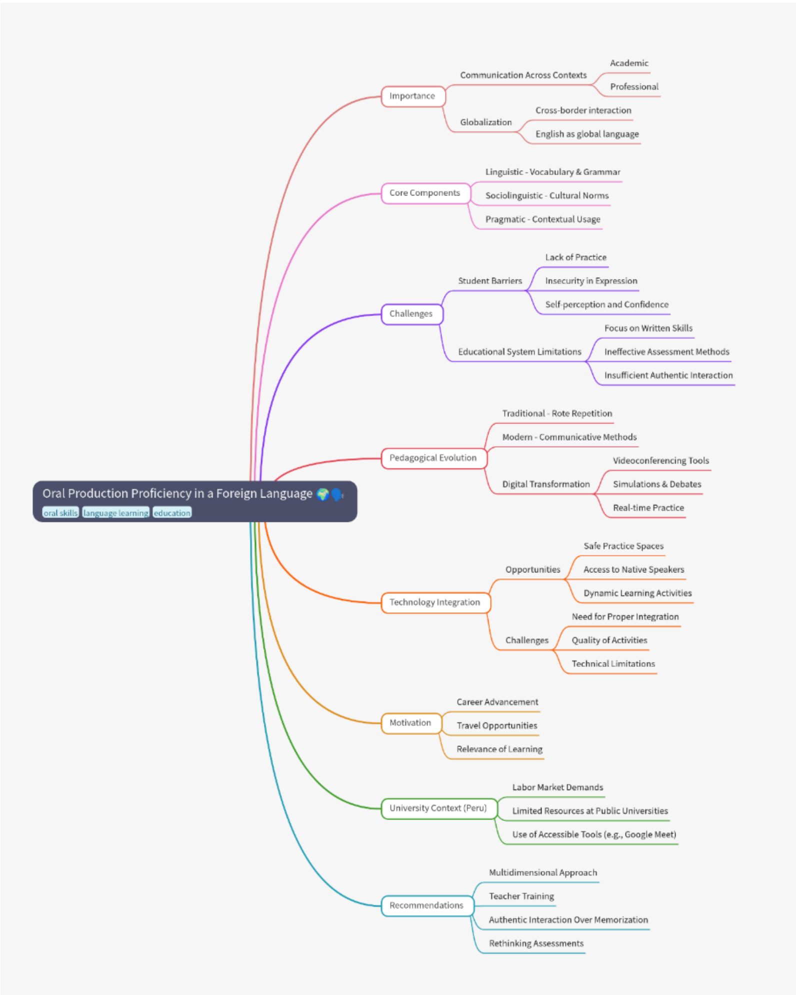

Figure 1. Dimensions and factors associated with oral production proficiency in English as a foreign language

Another point to consider is the influence of the educational environment on oral production. Virtual classrooms, for example, allow students to connect with native speakers or peers from different regions, enriching the communicative experience. However, the lack of immediate feedback or the dependence on stable connections can become obstacles. Thus, while technology expands possibilities, it also imposes challenges that teachers must overcome with well-designed strategies. From a critical perspective, it is worth asking whether current educational systems are equipped to prioritize this skill. In many cases, the assessment of oral production is reduced to formal exams that do not reflect the spontaneity of a real conversation [9]. This disconnect suggests the need to rethink teaching and assessment methods, integrating activities that simulate every day or professional contexts where English is an active tool[10].

On the other hand, motivation emerges as an essential factor for success in this area. When students see a clear purpose in improving their oral expressions such as advancing their careers or traveling—their engagement increases significantly. Technologies can enhance this motivation by facilitating debates, simulations, or exchanges that make learning relevant and dynamic. However, without adequate guidance, the use of these tools could remain a superficial exercise. In the Peruvian university context, oral production competency takes on special relevance due to the demands of the globalized labor market [8]. Recent studies indicate that graduates with strong English communication skills have greater employment opportunities in competitive sectors [11]. However, resource constraints at public universities often restrict access to intensive practice, highlighting the urgency of leveraging accessible tools such as Google Meet to close this gap.

Considering the above, it can be argued that the development of oral production requires a multidimensional approach that combines technology, innovative pedagogy and institutional support [10]. Current research highlights that digital platform, when used intentionally, improve students' confidence and fluency [12]. However, their implementation must be accompanied by teacher training and activities that prioritize authentic interaction over passive memorization.

In conclusion, oral production skills are a fundamental pillar of university student training but strengthening them requires overcoming traditional inertia and embracing modern approaches. The integration of digital technologies offers a promising path, provided that strategies are designed that respond to the real needs of learners [13,14]. Valuing this skill not only implies recognizing its immediate impact, but also its potential to transform personal and professional trajectories in an increasingly interdependent environment.

2.1. Neutrosophic Z Numbers.

This section contains the main concepts used in this article; let's start with the formal definition of the set of neutrosophic Z numbers.

Definition 1 ([15-17]). Let *X be* a set of universes. A *neutrosophic number Z The set* in *X* is defined as follows:

$$S_Z = \{\langle x, T(V,R)(x), I(V,R)(x), F(V,R)(x)\rangle : x \in X\} \quad (1)$$

Where $T(V,R)(x) = (T_V(x), T_R(x))$, $I(V,R)(x) = (I_V(x), I_R(x))$, $F(V,R)(x) = (F_V(x), F_R(x))$are functions from X to $[0,1]^2$, which are the ordered pairs of truth, indeterminacy, and falsity, respectively. The first component V is the neutrosophic values at X , and the second component R is the neutrosophic reliability measures for V , satisfying the conditions $0 \leq T_V(x) + I_V(x) + F_V(x) \leq 3$and $0 \leq T_R(x) + I_R(x) + F_R(x) \leq 3$.

For convenience, we denote it $\langle x, T(V,R)(x), I(V,R)(x), F(V,R)(x)\rangle$as $S_Z = \langle T(V,R), I(V,R), F(V,R)\rangle = \langle (T_V, T_R), (I_V, I_R), (F_V, F_R)\rangle$what is called NZN.

Definition 2 ([15-17]). Let$S_{Z_1} = \langle T_1(V,R), I_1(V,R), F_1(V,R)\rangle = \langle (T_{V_1}, T_{R_1}), (I_{V_1}, I_{R_1}), (F_{V_1}, F_{R_1})\rangle$ and$S_{Z_2} = \langle T_2(V,R), I_2(V,R), F_2(V,R)\rangle = \langle (T_{V_2}, T_{R_2}), (I_{V_2}, I_{R_2}), (F_{V_2}, F_{R_2})\rangle$ Let NZN and be two $\lambda > 0$. Then , we get the following relationships :

1. $S_{Z_2} \subseteq S_{Z_1} \Leftrightarrow T_{V_2} \leq T_{V_1}, T_{R_2} \leq T_{R_1}, I_{V_1} \leq I_{V_2}, I_{R_1} \leq I_{R_2}, F_{V_1} \leq F_{V_2}, F_{R_1} \leq F_{R_2}$,
2. $S_{Z_1} = S_{Z_2} \Leftrightarrow S_{Z_2} \subseteq S_{Z_1}$ and $S_{Z_1} \subseteq S_{Z_2}$,
3. $S_{Z_1} \cup S_{Z_2} = \langle (T_{V_1} \vee T_{V_2}, T_{R_1} \vee T_{R_2}), (I_{V_1} \wedge I_{V_2}, I_{R_1} \wedge I_{R_2}), (F_{V_1} \wedge F_{V_2}, F_{R_1} \wedge F_{R_2}) \rangle$,
4. $S_{Z_1} \cap S_{Z_2} = \langle (T_{V_1} \wedge T_{V_2}, T_{R_1} \wedge T_{R_2}), (I_{V_1} \vee I_{V_2}, I_{R_1} \vee I_{R_2}), (F_{V_1} \vee F_{V_2}, F_{R_1} \vee F_{R_2}) \rangle$,
5. $(S_{Z_1})^c = \langle (F_{V_1}, F_{R_1}), (1 - I_{V_1}, 1 - I_{R_1}), (T_{V_1}, T_{R_1}) \rangle$,
6. $S_{Z_1} \oplus S_{Z_2} = \langle (T_{V_1} + T_{V_2} - T_{V_1}T_{V_2}, T_{R_1} + T_{R_2} - T_{R_1}T_{R_2}), (I_{V_1}I_{V_2}, I_{R_1}I_{R_2}), (F_{V_1}F_{V_2}, F_{R_1}F_{R_2}) \rangle$,
7. $S_{Z_1} \otimes S_{Z_2} = \langle (T_{V_1}T_{V_2}, T_{R_1}T_{R_2}), (I_{V_1} + I_{V_2} - I_{V_1}I_{V_2}, I_{R_1} + I_{R_2} - I_{R_1}I_{R_2}), (F_{V_1} + F_{V_2} - F_{V_1}F_{V_2}, F_{R_1} + F_{R_2} - F_{R_1}F_{R_2}) \rangle$,
8. $\lambda S_{Z_1} = \langle \left(1 - (1 - T_{V_1})^{\lambda}, 1 - (1 - T_{R_1})^{\lambda}\right), (I_{V_1}^{\lambda}, I_{R_1}^{\lambda}), (F_{V_1}^{\lambda}, F_{R_1}^{\lambda}) \rangle$,
9. $S_{Z_1}^{\lambda} = \langle (T_{V_1}^{\lambda}, T_{R_1}^{\lambda}), \left(1 - (1 - I_{V_1})^{\lambda}, 1 - (1 - I_{R_1})^{\lambda}\right), \left(1 - (1 - F_{V_1})^{\lambda}, 1 - (1 - F_{R_1})^{\lambda}\right) \rangle$.

To compare two NZNs that have $S_{Z_i} = \langle T_i(V,R), I_i(V,R), F_i(V,R) \rangle = \langle (T_{V_i}, T_{R_i}), (I_{V_i}, I_{R_i}), (F_{V_i}, F_{R_i}) \rangle$(i = 1, 2), we have the scoring function:[18,19]

$$\Upsilon(S_{Z_i}) = \frac{2 + T_{V_i}T_{R_i} - I_{V_i}I_{R_i} - F_{V_i}F_{R_i}}{3} \qquad (2)$$

Note that $\Upsilon(S_{Z_i}) \in [0,1]$. Therefore, $\Upsilon(S_{Z_2}) \leq \Upsilon(S_{Z_1})$implies $S_{Z_2} \preccurlyeq S_{Z_1}$.

Let's illustrate equation 2 with an example.

Example 1. Let $S_{Z_1} = \langle (0.9, 0.8), (0.1, 0.9), (0.2, 0.9) \rangle$, then we have $\Upsilon(S_{Z_1}) = \frac{2 + (0.9)(0.8) - (0.1)(0.9) - (0.2)(0.9)}{3} = 0.81666$.

Definition 3 ([15-17]) **.** Sea $S_{Z_i} = \langle T_i(V,R), I_i(V,R), F_i(V,R) \rangle = \langle (T_{V_i}, T_{R_i}), (I_{V_i}, I_{R_i}), (F_{V_i}, F_{R_i}) \rangle$(i = 1, 2 , … , n) be a set of NZN and *NZNWAA* is a map from $[0,1]^n$into $[0,1]$, such that the operator NZNWAA is defined as follows:

$$NZNWAA(S_{Z_1}, S_{Z_2}, \cdots, S_{Z_n}) = \sum_{i=1}^{n} \lambda_i S_{Z_i} \qquad (3)$$

Where is λ_i $(i = 1,2,\cdots,n)$the weight of S_{Z_i}satisfying $0 \leq \lambda_i \leq 1$and $\sum_{i=1}^{n} \lambda_i = 1$.

Thus, the NZNWAA formula is calculated as:

$$NZNWAA(S_{Z_1}, S_{Z_2}, \cdots, S_{Z_n}) = \langle \left(1 - \prod_{i=1}^{n} (1 - T_{V_i})^{\lambda_i}, 1 - \prod_{i=1}^{n} (1 - T_{R_i})^{\lambda_i}\right), \left(\prod_{i=1}^{n} I_{V_i}^{\lambda_i}, \prod_{i=1}^{n} I_{R_i}^{\lambda_i}\right), \left(\prod_{i=1}^{n} F_{V_i}^{\lambda_i}, \prod_{i=1}^{n} F_{R_i}^{\lambda_i}\right) \rangle \qquad (4)$$

NZNWAA satisfies the following properties:

1. Is an NZN,
2. It is idempotent $NZNWAA(S_Z, S_Z, \cdots, S_Z) = S_Z$,
3. Note, $min\{S_{Z_1}, S_{Z_2}, \cdots, S_{Z_n}\} \leq NZNWAA(S_{Z_1}, S_{Z_2}, \cdots, S_{Z_n}) \leq max\{S_{Z_1}, S_{Z_2}, \cdots, S_{Z_n}\}$,
4. Monotony, if $\forall i\ S_{Z_i} \preccurlyeq S_{Z_i}^*$then $NZNWAA(S_{Z_1}, S_{Z_2}, \cdots, S_{Z_n}) \preccurlyeq NZNWAA(S_{Z_1}^*, S_{Z_2}^*, \cdots, S_{Z_n}^*)$.

Definition 4 ([15-17]) **.** Le $S_{Z_i} = \langle T_i(V,R), I_i(V,R), F_i(V,R) \rangle = \langle (T_{V_i}, T_{R_i}), (I_{V_i}, I_{R_i}), (F_{V_i}, F_{R_i}) \rangle$(i = 1, 2 , … , n) be a set of NZN and *NZNWGA* be a map into $[0,1]^n$, $[0,1]$such that the operator NZNWGA is defined as follows:

$$NZNWGA(S_{Z_1}, S_{Z_2}, \cdots, S_{Z_n}) = \sum_{i=1}^{n} S_{Z_i}^{\lambda_i} \qquad (5)$$

Where is λ_i $(i = 1,2,\cdots,n)$the weight of S_{Z_i}satisfying $0 \leq \lambda_i \leq 1$and $\sum_{i=1}^{n} \lambda_i = 1$.

Therefore, the NZNWGA formula is calculated as:

$$NZNWGA(S_{Z_1}, S_{Z_2}, \cdots, S_{Z_n}) = \langle \left(\prod_{i=1}^{n} T_{V_i}^{\lambda_i}, \prod_{i=1}^{n} T_{R_i}^{\lambda_i}\right), \left(1 - \prod_{i=1}^{n}(1 - I_{V_i})^{\lambda_i}, 1 - \prod_{i=1}^{n}(1 - I_{R_i})^{\lambda_i}\right), \left(1 - \prod_{i=1}^{n}(1 - F_{V_i})^{\lambda_i}, 1 - \prod_{i=1}^{n}(1 - F_{R_i})^{\lambda_i}\right) \rangle \quad (6)$$

NZNWGA satisfies the following properties:

1. Is an NZN,
2. It is idempotent $NZNWGA(S_Z, S_Z, \cdots, S_Z) = S_Z$,
3. Note, $min\{S_{Z_1}, S_{Z_2}, \cdots, S_{Z_n}\} \le NZNWGA(S_{Z_1}, S_{Z_2}, \cdots, S_{Z_n}) \le max\{S_{Z_1}, S_{Z_2}, \cdots, S_{Z_n}\}$,
4. Monotony, if $\forall i\ S_{Z_i} \preccurlyeq S_{Z_i}^{*}$ then $NZNWGA(S_{Z_1}, S_{Z_2}, \cdots, S_{Z_n}) \preccurlyeq NZNWGA(S_{Z_1}^{*}, S_{Z_2}^{*}, \cdots, S_{Z_n}^{*})$.

3. Material and Methods

Study Design

This research employed a quasi-experimental parallel-group design involving an experimental group and a control group. A mixed-method approach was adopted, combining quantitative analysis using neutrosophic Z-numbers and non-parametric statistical testing through the Mann–Whitney U test.

Participants

A random sample of 30 first-year undergraduate students from the National Agrarian University La Molina (UNALM) was selected. Participants were evenly divided into an experimental group (n=15) and a control group (n=15).

Inclusion criteria:

- Students enrolled in English as a foreign language courses at the intermediate level
- Sex : male or female
- People between 18 and 25 years old
- Students who have signed the informed consent
- Students with stable internet access and suitable devices for video conferencing
- Students with no prior experience in exclusively virtual oral training

Exclusion criteria:

- Students with native or advanced English level
- Students who have completed academic stays in English-speaking countries during the last year
- Students with recurring technical problems that prevent the proper use of virtual platforms
- Students who are absent from the intervention plan for three or more consecutive sessions
- Students simultaneously enrolled in other English-speaking courses

This research project was developed in the following phases:

Phase I

An initial interview was conducted with the participants, during which they were informed about the study topic, objectives, and assessments. They were informed about the use that would be made of the results obtained during the study, emphasizing that data would only be collected from those who had voluntarily signed the informed consent form. In addition, they were given a diagnostic oral proficiency test in English to ensure initial homogeneity among the groups.

Phase II

Subsequently, the participating students underwent the respective assessments, beginning with the collection of demographic and academic data to identify their linguistic profile and prior experience with digital tools. Oral production skills were then assessed using the Oxford Oral Placement Test, focusing primarily on fluency, pronunciation, vocabulary, grammar, and discourse coherence. Each assessment lasted between 15 and 20 minutes per participant. Oral proficiency tests were also administered at the end of the intervention, and the results were compiled in a database.

Phase III

The intervention plan focused on developing oral proficiency in English was implemented. For the experimental group, Google Meet was used as the primary platform, leveraging features such as breakout. rooms , shared whiteboard, real-time surveys, and session recordings. Specific activities were designed to promote oral interaction, including debates, presentations, role- plays , and guided discussions. For the control group, traditional face-to-face teaching methods were used with the same content and activities, but without technological mediation. The intervention protocol lasted 90 minutes per session, with two sessions per week for one academic semester (16 weeks).

Phase IV

Finally, a post-assessment was conducted using the same Oxford Oral Placement Test to identify the effects achieved during the intervention. Additionally, the experimental group administered a satisfaction survey on the learning experience mediated by Google Meet.

Instruments and Data Analysis

Neutrosophic Z-Number Evaluation

English language instructors evaluated each student using three score pairs (truth, indeterminacy, and falsity) for 16 components of oral production (e.g., fluency, intonation, vocabulary accuracy, pragmatic competence).

Conversion of Linguistic to Numerical Scores

Linguistic descriptors such as "High" or "Very Certain" were mapped to numerical values ranging from 0.1 to 0.9 based on a reliability scale.

Data Aggregation and Scoring

Neutrosophic evaluations were aggregated using the NZNWAA (4) operator, and converted into scalar scores using the scoring function ϒ (upsilon). The two groups' scores were statistically compared using the Mann–Whitney U test at a significance level of 0.05.

Satisfaction Survey

The experimental group completed a structured survey assessing usability, audio/video quality, interaction, and tool-specific features of Google Meet.

4. Results.

The tests applied are evaluated according to the following evaluation and reliability scale shown below:

Table 1: Linguistic truth and reliability values and their corresponding numerical value.

Numerical value equivalent	Reliability linguistics value	Truth linguistic value
0.1	Very bit sure	Very low
0.3	I'm not very sure	Low
0.5	Not even sure neither insecure	Half
0.7	Sure	High
0.9	Very sure	Very high

Expert English language teachers were asked to form three pairs of scores for each student's performance on the assessed components of oral production.

For example, an evaluator evaluates a student p as satisfying the component named c with a Z-number equivalent to the pair (High, Certain). Or, in other words, he is "Confidence" that p realizes a "High" truth value; a linguistic Z-number of falsity (Very Low, Very Certain), i.e., he is "Very Certain" that it is false that p realizes the component with a "Very Low" value; and with a linguistic Z-number of Indeterminacy (Low, Certain), i.e., he is "Confidence" that indeterminacy has a "Low" level. Therefore, the equivalent numerical neutrosophic Z-number is 〈 (0.7,0.7),(0.3,0.7),(0.1,0.9) 〉 according to the numerical values of the scale shown in Table 1.

Then, we denote by P_E={ p_{e1} ,p(e $_2$, ⋯ ,) p_{e15} } the students who are part of the experimental group, and by P_C={p_{c1} ,p ($_{c2}$, ⋯ ,) p_{c15} } the students who are part of the control group.

The components of oral English proficiency to be assessed are the following:

1. Fluency and coherence
2. Pronunciation of vowels
3. Pronunciation of consonants
4. Intonation and rhythm
5. General vocabulary
6. Vocabulary specialized
7. Precision grammatical in simple structures
8. Precision grammatical in structures complex
9. Using connectors discursive
10. Organization of ideas
11. Argumentation skills

12. Adaptation to the context communicative
13. Reformulation capacity
14. Competence pragmatics
15. Ability for maintain interaction
16. Communication strategies

The following procedure was performed for the experiment:

- The evaluator evaluates the ith student in the control group ($p_{ci} \in P_C$, i = 1,2, … ,15) on their performance on the jth component (c_j, j = 1,2, … ,16). Separately, another evaluator evaluates the ith student in the experimental group ($p_{ei} \in P_E$, i = 1,2, … ,15) on their performance on the jth component (c_j, j = 1,2,…,16). To do so, they use the linguistic values of the neutrosophic Z numbers according to the scale shown in Table 1.
- Let $x(e_{ij})$ be the evaluator's assessment of the ith student with the jth component in the experimental group. Similarly, $x(c_{ij})$ is the equivalent of the students in the control group.

  Please note that

  $x(e_{ij}) = \langle T_i(V,R), I_i(V,R), F_i(V,R)\rangle = \langle (T_{V_i}, T_{R_i}), (I_{V_i}, I_{R_i}), (F_{V_i}, F_{R_i})\rangle (i = 1, 2, \ldots, n)$

  are the measurement values in NZN format.

- The values for each student are aggregated for each group and for all components. To do this, the NZNWAA aggregation operator is used. The procedure shown in Equation 4 is applied as follows:

  $NZNWAA(S_{Z_1}, S_{Z_2}, \cdots, S_{Z_n}) = \sum_{i=1}^{n} \lambda_i S_{Z_i}$

- The obtained values of $\bar{x}(e_i)$ and $\bar{x}(c_i)$ are converted into individual numerical values with the help of Equation 2 using the following formulas :

  $\bar{\bar{x}}_{e_i} = \Upsilon(\bar{x}_{e_i})$ and $\bar{\bar{x}}_{c_i} = \Upsilon(\bar{x}_{c_i})$.

- The Mann- Whitney U test is applied to the two groups of data $G_e = \{\bar{\bar{x}}(e_i)\}$ and $G_c = \{\bar{\bar{x}}(c_i)\}$.

Recall that the Mann- Whitney U test is based on the following equations:

$$U_1 = n_1 n_2 + \frac{n_1(n_1+1)}{2} - R_1 \qquad U_2 = n_1 n_2 + \frac{n_2(n_2+1)}{2} - R_2$$

Where n_1 is the sample size for one group, n_2 is the sample size for the other group, and R_1 and R_2 are the sum of the ranges of the observations in samples 1 and 2, respectively. Here $n_1 = n_2 = 15$.

The hypothesis test is as follows:

H_0: Both populations are equally distributed and therefore the use of Google Meet does not produce significant improvements in oral production competence in English,

H_1: Both populations are distributed differently and therefore the use of Google Meet produces significant improvements in oral production competence in English.

The significance level is set at 0.05.
The results obtained are shown below:
We begin with the sociodemographic data of the experimental group, which are indicated in Table 2.

Table 2. Sociodemographic data of the experimental group

Variable	Category	Frequency	Percentage
Gender	Female	9	60%
	Male	6	40%
Age Ranges	18–19	5	33%
	20–21	7	47%
	22–23	2	13%
	24–25	1	7%
University Degree	Administration	3	20%
	Engineering	4	27%
	Social Sciences	5	33%
	Arts and Humanities	3	20%
Previous Experience with Virtual Tools	Low	3	20%
	Average	8	53%
	High	4	27%
Beginning English Level	B1	9	60%
	B2	6	40%

Table 3 contains the sociodemographic details of the control group.

Table 3. Sociodemographic Data of the Control Group

Variable	**Category**	**Frequency**	**Percentage**
Gender	Female	8	53%
	Male	7	47%
Age Ranges	18–19	4	27%
	20–21	8	53%
	22–23	2	13%
	24–25	1	7%
University Degree	Administration	4	27%
	Engineering	3	20%
	Social Sciences	5	33%
	Arts and Humanities	3	20%
Previous Experience with Virtual Tools	Low	4	27%
	Average	7	47%
	High	4	27%

Variable	Category	Frequency	Percentage
Beginning English Level	B1	8	53%
	B2	7	47%
	Total	15	100%

The results of the assessments conducted on both groups are presented below. Table 4 shows the results for the experimental group, which used Google Meet as the platform for developing oral English proficiency.

Table 4. NZN format assessments of the English oral competence components of the experimental group

Student	Assessment added (NZNWAA)	Score value ϒ
p_{e1}	⟨ (0.81,0.79),(0.23,0.25),(0.17,0.82) ⟩	0.8356
p_{e2}	⟨(0.79,0.82),(0.25,0.22),(0.19,0.78)⟩	0.8317
p_{e3}	⟨(0.84,0.76),(0.21,0.28),(0.15,0.85)⟩	0.8392
pe4	⟨(0.77,0.85),(0.28,0.20),(0.21,0.75)⟩	0.8284
p_{e5}	⟨(0.82,0.78),(0.22,0.27),(0.18,0.81)⟩	0.8367
p_{e6}	⟨(0.85,0.74),(0.19,0.29),(0.14,0.86)⟩	0.8403
p_{e7}	⟨(0.79,0.83),(0.26,0.21),(0.20,0.77)⟩	0.8317
p_{e8}	⟨(0.83,0.77),(0.20,0.26),(0.16,0.84)⟩	0.8382
p_{e9}	⟨(0.86,0.75),(0.18,0.27),(0.13,0.88)⟩	0.8431
p_{e10}	⟨(0.80,0.84),(0.24,0.19),(0.18,0.80)⟩	0.8356
p_{e11}	⟨(0.87,0.73),(0.17,0.30),(0.12,0.89)⟩	0.8441
p_{e12}	⟨ (0.78,0.86),(0.27,0.18),(0.22,0.74) ⟩	0.8294
p_{e13}	⟨ (0.88,0.72),(0.16,0.31),(0.11,0.90) ⟩	0.8451
p_{e14}	⟨ (0.82,0.81),(0.21,0.24),(0.17,0.82) ⟩	0.8377
p_{e15}	⟨ (0.89,0.71),(0.15,0.32),(0.10,0.91) ⟩	0.8461

Table 5 presents the results of the control group, where traditional methods were used for the development of oral competence in English.

Table 5. NZN format assessments of the English oral proficiency components of the control group

Student	Assessment added (NZNWAA)	Score value ϒ
p_{e1}	⟨ (0.72,0.69),(0.33,0.35),(0.27,0.72) ⟩	0.7867
p_{e2}	⟨ (0.70,0.71),(0.35,0.34),(0.29,0.70) ⟩	0.7828
p_{e3}	⟨ (0.74,0.67),(0.31,0.37),(0.25,0.74) ⟩	0.7895
pe4	⟨ (0.69,0.72),(0.36,0.33),(0.30,0.69) ⟩	0.7819
p_{e5}	⟨ (0.73,0.68),(0.32,0.36),(0.26,0.73) ⟩	0.7884
p_{e6}	⟨ (0.75,0.65),(0.30,0.39),(0.24,0.75) ⟩	0.7906
p_{e7}	⟨ (0.68,0.73),(0.37,0.32),(0.31,0.68) ⟩	0.7810
p_{e8}	⟨ (0.71,0.70),(0.34,0.35),(0.28,0.71) ⟩	0.7847
p_{e9}	⟨ (0.76,0.64),(0.29,0.40),(0.23,0.76) ⟩	0.7916
p_{e10}	⟨ (0.70,0.72),(0.35,0.33),(0.29,0.70) ⟩	0.7837
p_{e11}	⟨ (0.77,0.63),(0.28,0.41),(0.22,0.77) ⟩	0.7927
p_{e12}	⟨ (0.69,0.73),(0.36,0.32),(0.30,0.69) ⟩	0.7819
p_{e13}	⟨ (0.78,0.62),(0.27,0.42),(0.21,0.78) ⟩	0.7938

Student	Assessment added (NZNWAA)	Score value ϒ
p_{e14}	⟨ (0.72,0.69),(0.33,0.35),(0.27,0.72) ⟩	0.7867
p_{e15}	⟨ (0.79,0.61),(0.26,0.43),(0.20,0.79) ⟩	0.7948

When applying the Mann- Whitney U test to the Y score values obtained for both groups, the following results were obtained:

$$U1 = 0 \qquad U2 = 225$$

The critical value of U for $n_1 = n_2 = 15$ with $\alpha = 0.05$ is 56. Since $U_1 = 0 < 56$, the null hypothesis H_0 is rejected. The p-value obtained was $p = 0.0001 < 0.05$.

Additionally, the satisfaction of students in the experimental group with the use of Google Meet as a tool for developing oral proficiency in English was assessed. The results are shown in Table 6.

Table 6. Level of satisfaction with Google Meet in the experimental group

Aspect evaluated	Very satisfied	Satisfied	Neutral	Dissatisfied	Very dissatisfied
Ease of use	73%	20%	7%	0%	0%
Audio quality	53%	33%	7%	7%	0%
Video quality	60%	27%	13%	0%	0%
Breakout rooms	80%	13%	7%	0%	0%
Share screen	67%	20%	13%	0%	0%
Board interactive	47%	33%	13%	7%	0%
Recording sessions	87%	7%	6%	0%	0%
Interaction with peers	73%	20%	7%	0%	0%
Interaction with the teacher	67%	27%	6%	0%	0%
Overall satisfaction	80%	13%	7%	0%	0%

5. Discussion

The results obtained in this research show a clear positive relationship between the use of Google Meet as a teaching tool and the development of oral production competence in English in university students. The analysis using neutrosophic Z numbers has allowed to accurately evaluate the performance of students in the different components of oral competence, considering the uncertainty inherent in the evaluation process. The application of the Mann- Whitney U test revealed statistically significant differences between the experimental group (which used Google Meet) and the control group (which followed a traditional face-to-face methodology), with a p-value = 0.0001, well below the established significance level ($\alpha = 0.05$). This indicates that the use of Google Meet as a platform for the development of activities oriented to oral production in English has a considerable positive impact on student performance. An analysis of the Y score values obtained, it is observed that all students in the experimental group achieved values higher than 0.82, while students in the control group obtained values that did not exceed 0.80. This notable difference suggests that Google Meet- specific features, such as breakout rooms, rooms), the shared whiteboard, the possibility of recording sessions and real-time interactivity, significantly favor the development of communication skills in English.

Student satisfaction with using Google Meet as a teaching tool was overwhelmingly positive, with over 80% expressing "very satisfaction" with the overall experience. Aspects such as ease of use, breakouts , and Rooms and session recording were the most highly rated, suggesting that these features contribute significantly to learning oral production. Importantly, the neutrosophic methodology employed has allowed us to capture the uncertainty and subjectivity inherent in the language skills assessment process, providing more reliable results that are closer to the complex reality of language learning. Neutrosophic Z numbers have proven to be a suitable mathematical tool for modeling this type of assessment, where truth, falsity, and indeterminacy play a crucial role.

6. Conclusions

This research confirms that the use of Google Meet significantly enhances oral production skills in English among university students. Analyses supported by neutrosophic Z-values reveal a strong and positive correlation between the intensive use of the platform and the development of communication competencies, with notable differences compared to traditional methods. The Mann-Whitney U test ($p = 0.0001$) validates this trend, and ϒ scores exceeding 0.82 in the experimental group highlight the effectiveness of Google Meet's interactive features in improving oral performance. The high satisfaction levels reported by over 80% of students, who praised breakout rooms and session recordings, indicate that these functionalities not only facilitate practice but also bolster learners' confidence.

In light of these findings, it is recommended that higher education institutions systematically incorporate Google Meet into language instruction, particularly within public universities where resources are constrained. Such integration should be strategically planned, involving the design of targeted activities that leverage the platform's most valued features. Equally important is the provision of teacher training that addresses both technical and pedagogical dimensions to ensure effective implementation. Complementing Google Meet with digital tools such as Jamboard, Mentimeter, or Padlet is also advisable, as these can enrich the learning environment and promote varied forms of student engagement. The implementation of assessment systems based on neutrosophic Z-numbers is further encouraged, given their ability to capture the complexity, uncertainty, and subjectivity inherent in language learning.

From a research perspective, expanding the scope to include diverse populations and educational settings is necessary to enhance the generalizability of the findings. Future studies could explore the influence of variables such as prior language proficiency or access to technological infrastructure. Additionally, integrating neutrosophic Z-values with real-time analytics or artificial intelligence models may offer deeper insights into the dynamics of oral skill development. Longitudinal research is particularly recommended to assess the sustained impact of Google Meet on learners' oral proficiency, motivation, and autonomy, and to determine whether ongoing pedagogical adjustments are required to maintain learning outcomes over time.

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