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Study of the information technology knowledge of first-semester students at a private university in Huancayo based on the Indeterminate Likert Scale and Z-numbers

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Abstract. It is essential for today's professional to know and master the information technologies that are part of modern life. Otherwise, this constitutes an educational deficiency in our universities that must be reversed. This paper aims to determine the level of information technology knowledge of first-semester students at the Franklin Roosevelt Private University of Huancayo in Peru. The study population consists of 240 students. Simple random sampling was used to select a representative sample. Data collection was carried out using a survey consisting of a questionnaire containing a set of 37 questions. The survey measures students' level of skills in using information technologies. The survey was assessed utilizing an Indeterminate Likert Scale, where the respondent expresses degrees of opinion of self-perceived knowledge for each possible response option, rather than selecting a single option. In this way, the opinions of the respondents are captured more realistically. To increase the accuracy of the information obtained, a linguistic scale based on Z-numbers is used. So, we combine both the Indeterminate Likert Scale and the degree of confidence of the given response in the information processing. These models allow us to capture opinions that may be contradictory, but that more accurately reflect the opinions of respondents in complex environments.

Keywords: Information technologies, digital platforms, curricula, Indeterminate Likert Scale, Z-number, Neutrosophic Z-number, Triple Refined Indeterminate Neutrosophic Set.

1 Introduction

The higher education space in the academic world has been profoundly impacted by recent advances in digital technology. In light of these new developments, it is imperative that universities and higher education institutions mobilize quickly and efficiently and incorporate technology into their curricula, teaching, and all other activities to optimize students' learning experiences.

For students at higher education institutions, academic success is a priority. Therefore, it is crucial to identify the factors that contribute to student performance. The proliferation of various digital platforms has made it possible for people to communicate with each other, collaborate, and participate in a variety of conversations.

These platforms allow people to freely share their ideas and upload various online content for educational and learning purposes. For example, popular online platforms allow people to organize and collaborate on information and communicate with each other in real time. This increase in the use of online platforms has led to an increase in the use of online communities by various organizations as a means to unite people and facilitate the exchange of information.

The degree to which communication on online platforms influences user engagement can vary depending not only on the content of the messages but also on their format. In the world of higher education, several platforms have recently emerged for online learning and facilitating communication between instructors and students. These platforms allow for the sharing of various learning materials and online meetings.

In this sense, the general purpose of this research is to describe the level of information technology (IT) knowledge among first-semester students at the Franklin Roosevelt Private University of Huancayo (FRPUH) in Peru. To this end, a survey was administered to a sample of 148 first-semester students at this university. The questionnaire consists of 37 questions on different aspects of students' knowledge, skills, and abilities to manage digital technology tools.

One of the challenges in evaluating the results of a study of this type is capturing the opinions, thoughts, and feelings of respondents as accurately as possible. It is well known that humans evaluate everyday situations using natural language, rather than a numerical scale, and they do this effectively. Furthermore, these evaluations usually tolerate the uncertainty, indeterminacy, and vagueness of natural language.

To evaluate the survey results, we used an Indeterminate Likert Scale, which involves the respondent assigning a value to each of the possible options, rather than selecting only one option as is done with the classic Likert scale [1-3]. The Indeterminate Likert Scale is an evolution of the traditional Likert scale, designed to address the limitations that arise when capturing complex human responses, especially when these are ambiguous, imprecise, or contradictory [4-6]. The conventional Likert scale measures the degree of agreement or disagreement with a statement on an ordinal scale (e.g., 1 to 5) [7, 8]. However, this closed structure can lead to a loss of information, as the responses do not always accurately reflect the nuances of human thought. Data distortion can also occur, where the respondent's emotions, doubts, or contradictions are not adequately captured.

The indeterminate Likert scale incorporates the concept of neutrosophy, a logical theory developed by Florentin Smarandache, which allows for the representation of three simultaneous dimensions: Truth (T) Degree of acceptance or agreement, Falsehood (F) Degree of rejection or disagreement, and Indeterminacy (I) Degree of doubt, neutrality, or ambiguity [9, 10].

This allows a response to be more than simply “agree” or “disagree,” but can simultaneously reflect partial acceptance, partial rejection, and a zone of uncertainty. This new tool is useful because it better captures reality; human opinions are not always binary or linear. Suppose a person responds to the statement: “I trust the judicial system in my country.” On a traditional scale, they might mark “3 = Neutral.” On an indeterminate scale, they might express 40% agreement, 30% disagreement, and 30% uncertainty.

Specifically, the theory of the Indeterminate Likert Scale is based on a triple refined indeterminate neutrosophic set (TRINS), which incorporates “Indeterminacy leaning towards negative membership” and “Indeterminacy leaning towards positive membership”. These are special sets of the refined neutrosophic sets [11, 12]. To make the assessment more linguistically accurate, we ask students to associate an evaluative value in the form of a word with the Likert scale items and, additionally, the degree of reliability of their opinion as linguistic values. This reinforces the accuracy of the results obtained, at the cost of greater vagueness. One contribution of this paper is the combination of the Indeterminate Likert Scale with Z-numbers [13, 14].

The article is divided into a section called Materials and Methods, where we review the basic notions of the Indeterminate Likert Scale and neutrosophic Z-numbers [15, 16]. The Results section contains the specifications applied in the study, as well as the results obtained. The final section is the Conclusion.

2 Materials and Methods

The two fundamental tools we used in this study were the Indeterminate Likert Scale and the Neutrosophic Z-numbers. The basic notions of both theories are reviewed in subsections 2.1 and 2.2, respectively, of this section.

2.1 Brief notions about Indeterminate Likert Scale

Definition 1 ([17]). Let *U* be a universe of discourse. A *Single-Valued Neutrosophic Set* (SVNS) *N* over *U* is defined as:

$A = \{< x;\ T_A(x), I_A(x), F_A(x) >: x \in U\}$, where the functions $T_A: U \to [0,1]$, $I_A: U \to [0,1]$, and $F_A: U \to [0,1]$ represent the degrees of truth, indeterminacy, and falsity, respectively, associated with each element $x \in U$, under the constraint: $0 \leq T_A(x) + I_A(x) + F_A(x) \leq 3$.

Definition 2 ([17]). The *refined neutrosophic logic* is defined such that: a truth T is divided into several types of truths: $T_1, T_2, \dots, T_p$, I into various indeterminacies: $I_1, I_2, \dots, I_r$ and F into various falsities: $F_1, F_2, \dots, F_s$, where all $p, r, s \geq 1$ are integers, and $p + r + s = n$.

I.e., refined neutrosophic logic extends the classical neutrosophic framework by decomposing its components into subcategories:

- Truth *T* is partitioned into $T_1, T_2, \dots, T_p$.
- Indeterminacy *I* into $I_1, I_2, \dots, I_r$.
- Falsity *F* into $F_1, F_2, \dots, F_s$.

Satisfying $p, r, s \geq 1$ and $n = p + r + s$.

Definition 3 ([17]). A *Triple Refined Indeterminate Neutrosophic Set* (TRINS) *A* defined over a set *X* is characterized by five membership functions:

- Positive membership $P_A(x)$,
- Positive indeterminacy $I_{PA}(x)$,
- Neutral indeterminacy $I_A(x)$,
- Negative indeterminacy $I_{NA}(x)$,
- Negative membership $N_A(x)$.

Each function is associated with a weight $w_m \in [0,1]$. For every $x \in X$, the following conditions hold:

$$P_A(x), I_{P_A}(x), I_A(x), I_{N_A}(x), N_A(x) \in [0,1]$$

$$w_P^m(P_A(x)), w_{IP}^m(I_{P_A}(x)), w_I^m(I_A(x)), w_{IN}^m(I_{N_A}(x)), w_N^m(N_A(x)) \in [0,1].$$

And the total membership value satisfies:

$$0 \leq P_A(x) + I_{P_A}(x) + I_A(x) + I_{N_A}(x) + N_A(x) \leq 5.$$

Thus, the TRINS *A* is represented as:

$$A = \{\langle x;\ P_A(x), I_{P_A}(x), I_A(x), I_{N_A}(x), N_A(x)\rangle | x \in X\}.$$

Let A and B be two TRINS defined over a finite universe $X = \{x_1, x_2, \dots, x_n\}$, such that:

$A = \{\langle x;\ P_A(x), I_{P_A}(x), I_A(x), I_{N_A}(x), N_A(x)\rangle | x \in X\}$ and $B = \{\langle x;\ P_B(x), I_{P_B}(x), I_B(x), I_{N_B}(x), N_B(x)\rangle | x \in X\}$,

With all membership values in the interval [0,1]. Each element $x_i \in X$ is assigned a weight $w_i \geq 0$, such that:

$$\sum_{i=1}^{n} w_i = 1.$$

The generalized TRINS weighted distance between *A* and *B* is defined as:

$$d_\lambda(A,B) = \left\{\frac{1}{5}\sum_{i=1}^{n} w_i \left[|P_A(x_i) - P_B(x_i)|^\lambda + \left|I_{P_A}(x_i) - I_{P_B}(x_i)\right|^\lambda + |I_A(x_i) - I_B(x_i)|^\lambda + \left|I_{N_A}(x_i) - I_{N_B}(x_i)\right|^\lambda + |N_A(x_i) - N_B(x_i)|^\lambda\right]\right\}^{1/\lambda} \quad (1)$$

Where $\lambda > 0$.

The Indeterminate Likert Scale consists of five semantic levels of evaluation:

1. Negative membership,
2. Indeterminacy leaning toward negative membership,
3. Neutral indeterminacy,
4. Indeterminacy leaning toward positive membership,
5. Positive membership.

These categories replace the classical Likert scale values:

- Strongly disagree,
- Disagree,
- Neither agree nor disagree,
- Agree,
- Strongly agree.

Respondents are asked to express their level of agreement on a scale from 0 to 5, using the categories: "Very disagree", "Disagree", "Neutral", "Agree", and "Very agree". A visual scale, as illustrated in Figure 1, is provided to facilitate this evaluation.

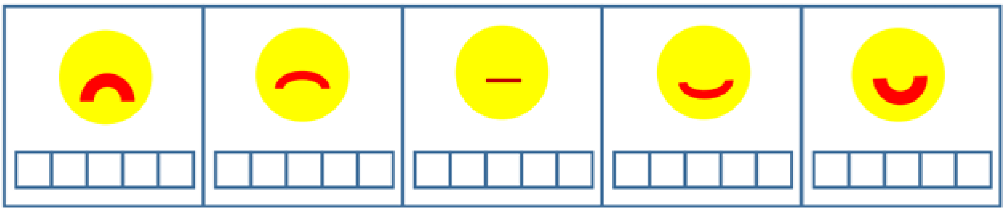

Figure 1. Pictorial illustration of the recommended Indeterminate Likert Scale. Source: [18].

2.2 On neutrosophic Z-numbers

Definition 4 ([15, 16]). Given X, the universe set, we have the following equation to represent a neutrosophic Z-number in X:

$S_Z = \{\langle x, T(V,R)(x), I(V,R)(x), F(V,R)(x)\rangle : x \in X\}$ (2)

In Equation 2 $T(V,R)(x) = \left(T_V(x), T_R(x)\right)$, $I(V,R)(x) = \left(I_V(x), I_R(x)\right)$, $F(V,R)(x) = \left(F_V(x), F_R(x)\right)$ are functions from X to $[0,1]^2$, or ordered pairs for truthfulness, indeterminacy, and falsity. Index V denotes the neutrosophic evaluations in X, whereas R measures the degree of reliability of V.

They fulfill the constraints $0 \le T_V(x) + I_V(x) + F_V(x) \le 3$ and $0 \le T_R(x) + I_R(x) + F_R(x) \le 3$.

Let us denote them by $\langle x, T(V,R)(x), I(V,R)(x), F(V,R)(x)\rangle$, and $S_Z = \langle T(V,R), I(V,R), F(V,R)\rangle = \langle (T_V, T_R), (I_V, I_R), (F_V, F_R)\rangle$, respectively, and let us name them with the abbreviation NZN.

Definition 5 ([15, 16]). If $S_{Z_1} = \langle T_1(V,R), I_1(V,R), F_1(V,R)\rangle = \langle \left(T_{V_1}, T_{R_1}\right), \left(I_{V_1}, I_{R_1}\right), \left(F_{V_1}, F_{R_1}\right)\rangle$ and $S_{Z_2} = \langle T_2(V,R), I_2(V,R), F_2(V,R)\rangle = \langle \left(T_{V_2}, T_{R_2}\right), \left(I_{V_2}, I_{R_2}\right), \left(F_{V_2}, F_{R_2}\right)\rangle$ are two NZNs and there is a crisp number $\lambda > 0$. The following relations are satisfied:

1. $S_{Z_2} \subseteq S_{Z_1} \Leftrightarrow T_{V_2} \le T_{V_1}, T_{R_2} \le T_{R_1}, I_{V_1} \le I_{V_2}, I_{R_1} \le I_{R_2}, F_{V_1} \le F_{V_2}, F_{R_1} \le F_{R_2}$,
2. $S_{Z_1} = S_{Z_2} \Leftrightarrow S_{Z_2} \subseteq S_{Z_1}$ and $S_{Z_1} \subseteq S_{Z_2}$,
3. $S_{Z_1} \cup S_{Z_2} = \langle \left(T_{V_1} \vee T_{V_2}, T_{R_1} \vee T_{R_2}\right), \left(I_{V_1} \wedge I_{V_2}, I_{R_1} \wedge I_{R_2}\right), \left(F_{V_1} \wedge F_{V_2}, F_{R_1} \wedge F_{R_2}\right)\rangle$,
4. $S_{Z_1} \cap S_{Z_2} = \langle \left(T_{V_1} \wedge T_{V_2}, T_{R_1} \wedge T_{R_2}\right), \left(I_{V_1} \vee I_{V_2}, I_{R_1} \vee I_{R_2}\right), \left(F_{V_1} \vee F_{V_2}, F_{R_1} \vee F_{R_2}\right)\rangle$,
5. $\left(S_{Z_1}\right)^c = \langle \left(F_{V_1}, F_{R_1}\right), \left(1 - I_{V_1}, 1 - I_{R_1}\right), \left(T_{V_1}, T_{R_1}\right)\rangle$,

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. $S_{Z_1}^{\lambda} = \langle (T_{V_1}^{\lambda}, T_{R_1}^{\lambda}), \left(1 - (1 - I_{V_1})^{\lambda}, 1 - (1 - I_{R_1})^{\lambda}\right), \left(1 - (1 - F_{V_1})^{\lambda}, 1 - (1 - F_{R_1})^{\lambda}\right) \rangle$.

We can use the score function shown in Equation 3 to compare two NZNs, $S_{Z_i} = \langle T_i(V, R), I_i(V, R), F_i(V, R) \rangle = \langle (T_{V_i}, T_{R_i}), (I_{V_i}, I_{R_i}), (F_{V_i}, F_{R_i}) \rangle (i = 1, 2)$ ([15, 16]):

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

3. Results

The research was conducted at Franklin Roosevelt University. An inferential statistical methodology was used to collect relevant information on the level of the student's IT knowledge. The study population consisted of 240 first-semester students. Simple random sampling was used to determine the sample. The sample size was calculated using the classic formula shown in Equation 4 ([19]).

$$n = \frac{k^2Npq}{e^2(N-1)+k^2pq} \quad (4)$$

Where:
n is the sample size,
N is the population size (N = 240),
Z = It is the deviation for the desired confidence level (equal to 1.96),
e = Maximum error margin allowed (equal to 0.05),
p = It is the proportion that we expect to find (equal to 0.5).
With these inputs, we obtain n=147.9530136722511≈148.
The questions of the survey are shown in Table 1.

Table 1. Survey questions.

#	Theoretical and practical knowledge
1	You know the basic operation of a computer and its peripherals.
2	You organize information using tools such as databases (Access), spreadsheets (Excel), or similar programs.
3	You organize the information found on the Internet, classifying it into folders and/or subfolders.
4	You find information using other forms and formats, such as CD-ROM, DVD, among others.
5	You establish communication with other people using collaborative work software, such as email, chat, instant messaging, blogs, among others.
6	You know the strengths and limitations of computers for storing, organizing, retrieving, and selecting information.
7	You know vocabulary related to Information Technology (IT, Hardware, Software, CD, Internet, Search, CPU, Search Engine, etc.)
8	You design academic tasks using different tools or programs such as CmapTools, SPSS, Excel, and others.
9	You retrieve information using different sources (online libraries, databases, electronic journals, etc.)
10	You know the electronic resources that are necessary for your academic work (URL search engines, databases, forums, weblogs, video conferencing, etc.)

#	Theoretical and practical knowledge
11	You can search for relevant information for your training through ICT.
12	You can design school activities assisted by the computer.
13	You can connect a computer and its peripherals: printers, scanners, keyboards, mouse, cameras, microphones, and more.
14	You can install and uninstall software on a computer.
15	You can configure email, Gmail, Hotmail, among others.
16	You can install and recognize a good antivirus program.
17	You use the keyboard and its basic functions
18	You use advanced features when writing a document in a word processor, such as changing the font type and size, inserting page numbers, using numbering and multi-level lists, among others.
19	You can insert tables, charts, or text from other documents using a word processor.
20	You use basic functions, such as sum, product, or average, in spreadsheets (Excel, among others).
21	You can use other spreadsheet functions such as formatting cells, inserting and hiding rows and columns, auto-adjusting the size of cells, rows, and columns, among others.
22	You use spreadsheet functions to create formulas, insert charts, images, hyperlinks, and more.
23	You can modify images and graphics using a computer program (PowerPoint, Paint, etc.)
24	You can create multimedia presentations (PowerPoint, among others) using static images, text, audio or video clips, graphics, etc.
25	You can use graphic organizers, such as concept maps, diagrams, or charts, to present relationships between ideas or concepts.
26	You browse the Internet using different programs such as Explorer, Mozilla, Chrome, among others.
27	You use the various links or hyperlinks that appear on the web pages you visit on the Internet.
28	You download programs, images, audio clips, etc. from the Internet.
29	You participate in discussion forums, either as a coordinator or participant.
30	You use different search engines on the Internet, such as Google, Yahoo, etc.
31	You use the "Advanced" options of Internet search engines.
32	You participate in video conferences using software (Hangout, Skype, others)
33	You use different types of storage devices (CD-DVD, Pendrive, Flashcard, external disk, others)
34	You perform bibliographic searches through different databases available on the Internet.
35	You use the language tool and spell checker to edit and revise your work using software programs such as word processors, spreadsheets, and presentations.
36	You participate in courses related to your career through the distance learning/e-learning system.
37	You use the Internet and IT as a tool to: communicate, research (academic activities).

An evaluation was carried out according to the following scales:

1. "Very disagree",
2. "Disagree",
3. "Neutral",
4. "Agree",
5. "Very agree".

Each of them is accompanied by the degree of certainty as follows:

1. "Very uncertain",
2. "Uncertain",

3. "As certain as uncertain,"
4. "Certain",
5. "Very certain."

The evaluation method followed by us consists of the following steps:

1. The survey in Table 1 is applied to the 148 students, the questions are numbered by the index i = 1, 2, …, 37; and the students by the index j = 1, 2, …, 148. The Likert scale values are denoted by the index k = 1, 2, …, 5, to represent "Very disagree", "Disagree", and so on. The values of the degree of certainty are modeled with the index l = 1, 2,…, 5, to denote "Very uncertain", "Uncertain", and so on.

Thus, there are pairs of evaluations (V_{ijk}, R_{ijl_k}) for each fixed i and j, there are values for all k = 1, 2,…, 5, and associated with each k, there is a value l that takes values 1, 2,…, 5.
In other words, each student for each question gives an opinion for each of the possible opinions regarding "Very disagree", "Disagree", etc., and it is associated with a value within the set "Very uncertain", "Uncertain", etc.

This is a *TRINS Z-number* for each student and each question, given by $\langle \mathrm{T}(\mathrm{V}_{ij}, \mathrm{R}_{ij}), \mathrm{I}_P(\mathrm{V}_{ij}, \mathrm{R}_{ij}), \mathrm{I}(\mathrm{V}_{ij}, \mathrm{R}_{ij}), \mathrm{I}_N(\mathrm{V}_{ij}, \mathrm{R}_{ij}), \mathrm{F}(\mathrm{V}_{ij}, \mathrm{R}_{ij}) \rangle$ where $\mathrm{I}_P(\mathrm{V}_{ij}, \mathrm{R}_{ij})$ is added to denote indeterminacy toward the positive and $\mathrm{I}_N(\mathrm{V}_{ij}, \mathrm{R}_{ij})$ is indeterminacy toward the negative. Let us illustrate this with an example.
Example 1. Suppose the first student on the list answers the first question with the following results:
He/she evaluates his/her knowledge on the basic operation of the computer and peripherals, such as "Very agree" for "Certain", "Agree" for "Very certain", "Neutral" for "Uncertain", "Disagree" for "Uncertain", and "Very disagree" in a "Very uncertain" manner. Note that greater accuracy was obtained in the responses, and the respondent uses natural language.

Each value $\mathrm{T}_{\mathrm{V}_{ij}}, \mathrm{T}_{\mathrm{R}_{ij}}, \mathrm{I}_{P\mathrm{V}_{ij}}, \mathrm{I}_{P\mathrm{R}_{ij}}, \mathrm{I}_{\mathrm{V}_{ij}}, \mathrm{I}_{\mathrm{R}_{ij}}, \mathrm{I}_{N\mathrm{V}_{ij}}, \mathrm{I}_{N\mathrm{R}_{ij}}, \mathrm{F}_{\mathrm{V}_{ij}}, \mathrm{F}_{\mathrm{R}_{ij}}$ is associated with its index in the set $\{1, 2, 3, 4, 5\}$, and then rescaled to values between 0 and 1 using Equation 5.

$$ev(x) = \frac{x-1}{4} \qquad (5)$$

Let us denote the new rescaled values as $\hat{\mathrm{T}}_{\mathrm{V}_{ij}} \hat{\mathrm{T}}_{\mathrm{R}_{ij}}, \hat{\mathrm{I}}_{P\mathrm{V}_{ij}}, \hat{\mathrm{I}}_{P\mathrm{R}_{ij}}, \hat{\mathrm{I}}_{\mathrm{V}_{ij}}, \hat{\mathrm{I}}_{\mathrm{R}_{ij}}, \hat{\mathrm{I}}_{N\mathrm{V}_{ij}}, \hat{\mathrm{I}}_{N\mathrm{R}_{ij}}, \hat{\mathrm{F}}_{\mathrm{V}_{ij}}, \hat{\mathrm{F}}_{\mathrm{R}_{ij}}$.

2. Each TRINS is converted into a crisp value using Equation 6.

$$\Upsilon_{TRINS}\left(\mathrm{S}_{\mathrm{Z}_{ij}}\right) = \frac{3+\hat{\mathrm{T}}_{\mathrm{V}_{ij}}\hat{\mathrm{T}}_{\mathrm{R}_{ij}}+\hat{\mathrm{I}}_{P\mathrm{V}_{ij}}\hat{\mathrm{I}}_{P\mathrm{R}_{ij}}-\hat{\mathrm{I}}_{\mathrm{V}_{ij}}\hat{\mathrm{I}}_{\mathrm{R}_{ij}}-\hat{\mathrm{I}}_{N\mathrm{V}_{ij}}\hat{\mathrm{I}}_{N\mathrm{R}_{ij}}-\hat{\mathrm{F}}_{\mathrm{V}_{ij}}\hat{\mathrm{F}}_{\mathrm{R}_{ij}}}{5} \qquad (6)$$

So, the values of each question are converted to crisp values using Equation 6. Let us denote them as x_{ij}.

3. The arithmetic mean of the variables x_{ij} concerning j is calculated for all students.
Below we show the results of applying the previous method. To make them more understandable, we used Equation 7, where each average is converted into a percentage.

$$\bar{\bar{x}}_i = \frac{\bar{x}_i}{148} \times 100 \qquad (7)$$

Where $\bar{x}_i$ is the average of the values x_{ij} obtained for the ith question for all students. Table 2 summarizes the results obtained from applying Equation 7.

Table 2. Results in percentage of correct answers to the questionnaire.

#	**Percentage of success in theoretical and practical knowledge**
1	5.77%
2	4.52%
3	25.77%
4	8.26%
5	17.33%
6	3.60%
7	24.10%
8	5.23%
9	4.80%
10	23.47%
11	21.70%
12	4.30%
13	4.98%
14	5.91%
15	16.81%
16	3.28%
17	5.16%
18	12.45%
19	16.10%
20	4.38%
21	4.22%
22	4.52%
23	19.90%
24	18.52%
25	5.24%
26	22.00%
27	26.04%
28	21.17%
29	3.64%
30	27.00%
31	24.00%
32	5.20%
33	16.29%
34	6.33%
35	15.70%
36	5.32%
37	23.41%

The results shown in Table 2 range from 3% to 27% positive responses, indicating that the students surveyed have very low levels of computer literacy in all aspects. It can be inferred that this is true for the entire study population, since we worked with a representative random sample.

4. Conclusion

The main goal of this article was to evaluate the level of knowledge and skills in the use of information technologies among first-semester students at the Franklin Roosevelt Private University of Huancayo in Peru. The research determined that the level of knowledge is deficient because the majority of the responses to the instrument showed that at most 27% demonstrated some basic skill. This situation calls for urgent analysis and the implementation of measures to reverse it, since it can lead to poor performance among students once they graduate. The measurement instrument was innovative, where techniques were used to capture student self-assessments on an Indeterminate Likert Scale. Respondents were asked to give an evaluation of their opinions for all possible answers, instead of choosing just one. The use of Z-numbers facilitated the task because they used a linguistic scale to evaluate the degree of reliance of their responses, which is not the case with the Indeterminate Likert Scales found in the literature. The advantage lies in the fact that students use only linguistic, not numerical, values to evaluate their opinions, which can be complex and contain contradictions or inconsistencies. In practice, we have extended the neutrosophic Z-numbers theory to TRINS and demonstrated its effectiveness in solving a real-life problem.

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