A Neutrosophic approach to Youth University Entrepreneurship in Peru, Based on the Indeterminate Likert Scale

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Abstract

This paper aims to determine the level of potential and effective capacity of university youth entrepreneurship in Peru, analyzed from the indicators of social skills, attitude towards opportunities, cognitive skills, positive self-assessment and continuity, and finally coping skills. The research was carried out in four public and private universities in the country (National Autonomous University of Huanta, National University San Cristóbal de Huamanga, Universidad Peruana los Andes, and Universidad Continental), and the sample was 120 students, 30 from each university. A survey of 50 questions was used, 25 of each dimension, the instrument was validated by expert judgment, with a very good applicability opinion. The authors of the article decided to replace the traditional Likert scale with an Indeterminate Likert Scale since in this way the opinion of the respondents is more accurately taken into account. The Indeterminate Likert Scale allows the respondent to give a degree of opinion in every one of the possible answers, instead of selecting a single answer. In this way, the respondent can more reliably express their feelings and thoughts that may contain contradictions. The survey was supported by a graph that allowed the respondents to make the evaluations without the need to delve into the neutrosophic theory. The survey data were statistically processed to carry out the study with the help of Spearman's rho coefficient.

Keywords: University youth entrepreneurship; Cronbach's alpha; Spearman's Rho coefficient; Indeterminate Likert Scale; triple refined neutrosophic set.

1. Introduction

The study of the role that external events play in decision-making and the development of an individual's professional career has begun to gain momentum in the academic literature. These have historically been predominantly focused on the individual agency aspects of careers, thus placing less emphasis on the influence of external events. However, such unpredictable and unplanned events happen to most people and can have a strong influence on their careers, thus the need for entrepreneurship in university students [1].

According to Egorov et al. [2] it is known that the indicators that characterize the economic situation of the country are the dynamics of the unemployment rate, the capacity and situation of the labor market, and the relationship between the supply and demand of labor. Young people reluctantly go to employment centers, trying to solve the problem themselves. Developing youth entrepreneurship, among other skills, aims to reduce these indicators. Thus, entrepreneurship has as its objective the creation of new jobs, in addition, the development of small and medium-sized companies entails an increase in tax revenue for budgets at all levels. At the same time, there are the main problems that

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young people face when creating their own business. Hence, this is the motivation for the study of the entrepreneurial capacities of young university students in Peru.

This research is based on the study of a variable: University youth entrepreneurship, which is distributed in two dimensions: D1. Potential entrepreneurial capacity and D2. Effective entrepreneurial capacity, with ten indicators: I1. Social skills, I2. Attitude towards opportunities, I3. Cognitive skills, I4. Positive self-evaluation and continuity, I5. Coping skills, I6. Family factors, I7. Sociocultural perception, I8. Business training, I9. Personal traits and abilities, I10. effective entrepreneurship. The basic objective of this work is to compare the level of both dimensions, so, a survey of 50 questions was used, with answers on the Indeterminate Likert Scale, whose results determine the existence of a high level of potential and effective entrepreneurial capacities in young university students in Peru.

Capturing the thinking and feeling of respondents is known to be a difficult challenge. Human beings have different degrees of satisfaction and dissatisfaction and even contradictions and indifference about one subject. That is why the use of a traditional Likert scale is not capable of reflecting the full range of feelings that an opinion contains [3, 4]. For this, we use an Indeterminate Likert Scale where each of the possible ranges of opinions is allowed to evaluate according to a specific degree of satisfaction [5, 6]. This scale is consistent with the foundations of Neutrosophy, where it is recommended to deal with contradictions, neutrality, ignorance, and misinformation, among others, instead of avoiding them.

The price to pay for having an Indeterminate Likert Scale is its greater complexity compared to the traditional scale. This is avoided by briefly and simply explaining to respondents what is intended and providing them with an easy tool to measure their opinions. In the case of this research, it was done with graphic support. The survey was validated with Cronbach's Alpha reliability coefficient, which guarantees the rigor of the survey [7, 8]. The reliability of the scale allows the measurements to be consistent and stable, Cronbach's Alpha coefficient with a value closest to 1 guarantees greater reliability. It is used when we want to measure non-observable variables directly, using other observable variables. For example, it is difficult to measure entrepreneurial capacity, however, the opinion of the individual can be scored in the survey when they are placed in a specific situation where they should have initiative.

The data obtained from the survey were processed with the help of Spearman's Rho coefficient to reach conclusions about the correlations between indexes of entrepreneurship in young university students in Peru. For this, there was a sample selected by simple random sampling of young people from 4 universities, two private and two public.

This article is divided into the following sections; section 2 contains the Related Work, where the main concepts used are explained, such as Cronbach's Alpha, Spearman's Rho, and the Indeterminate Likert Scale. Section 3 contains the results of the survey. The work ends with the Conclusions. The Appendix A section contains the details of the proposed survey.

2. related work

Cronbach's alpha makes it possible to quantify the level of reliability of a measurement scale for the unobservable magnitude constructed from the n observed variables. Cronbach's Alpha is calculated using the variances with Equation 1 [8]:

$$\alpha = \left[\frac{k}{k-1}\right]\left[1 - \frac{\sum_{i=1}^{k} s_i^2}{s_t^2}\right] \qquad (1)$$

Where:

S_i^2 is the variance of the ith item,

S_t^2 is the variance of all the observed values,

k is the number of questions or items.

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Based on the correlation among items, the Standard Cronbach's Alpha is defined as follows in Equation 2:

$$\alpha_{stand} = \frac{kp}{1+p(k-1)} \quad (2)$$

Where:

k is the number of questions or items.

p is the mean of the linear correlations among the items.

Alphas bigger than 0.7 or 0.8 are enough to consider the scale reliable.

Spearman's Rho Correlation Coefficient results in a measure of the correlation between two variables. It is a non-parametric test, therefore it does not need to be verified that the sample satisfies a given distribution.

In the analyzed sample, the results were compared using Spearman's Rho Correlation Coefficient, which is calculated by Equation 3 [9].

$$\rho = 1 - \frac{6\sum_{i=1}^{N} D_i^2}{N(N^2-1)} \quad (3)$$

Where D is the difference between the corresponding x-y order statistics. N is the number of data pairs. $\rho \in [-1, 1]$, where 0 means no correlation, 1 means maximum positive correlation, and -1 means maximum negative correlation.

Definition 1: ([10]) The *Single-Valued Neutrosophic Set* (SVNS) N over U is $A = \{< x; T_A(x), I_A(x), F_A(x) > : x \in U\}$, where $T_A: U \to [0, 1]$, $I_A: U \to [0, 1]$, and $F_A: U \to [0, 1]$, $0 \leq T_A(x) + I_A(x) + F_A(x) \leq 3$.

Definition 2: ([11-15]) The refined neutrosophic logic is defined such that: a truth T is divided into several types of truths: $T_1, T_2, \ldots, T_p$, I into various indeterminacies: $I_1, I_2, \ldots, I_r$ and F into various falsities: $F_1, F_2, \ldots, F_s$, where all $p, r, s \geq 1$ are integers, and $p + r + s = n$.

Definition 3: ([11-15]) A triple refined indeterminate neutrosophic set (TRINS) A in X is characterized by positive $P_A(x)$, indeterminacy $I_A(x)$, negative $N_A(x)$, positive indeterminacy $I_{P_A}(x)$ and negative indeterminacy $I_{N_A}(x)$ membership functions. Each of them has a weight $w_m \in [0, 1]$ associated with it. For each $x \in X$, there are $P_A(x), I_{P_A}(x), I_A(x), I_{N_A}(x), N_A(x) \in [0,1]$, $w_P^m(P_A(x)), w_{I_P}^m(I_{P_A}(x)), w_I^m(I_A(x)), w_{I_N}^m(I_{N_A}(x)), w_N^m(N_A(x)) \in [0, 1]$ and $0 \leq P_A(x) + I_{P_A}(x) + I_A(x) + I_{N_A}(x)(x) + N_A(x) \leq 5$. Therefore, a TRINS A can be represented by $A = \{\langle x; P_A(x), I_{P_A}(x), I_A(x), I_{N_A}(x), N_A(x)\rangle | x \in X\}$.

Let A and B be two TRINS in a finite universe of discourse, $X = \{x_1, x_2, \ldots, x_n\}$, which are denoted by:

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

Where $P_A(x_i), I_{P_A}(x_i), I_A(x_i), I_{N_A}(x_i), N_A(x_i), P_B(x_i), I_{P_B}(x_i), I_B(x_i), I_{N_B}(x_i), N_B(x_i) \in [0, 1]$, for every $x_i \in X$. Let w_i (i = 1,2,...,n) be the weight of an element x_i (i = 1,2,...,n), with $w_i \geq 0$ (i = 1,2,...,n) and $\sum_{i=1}^{n} w_i = 1$.

The generalized TRINS weighted distance is ([5]):

$$d_\lambda(A, B) = \left\{\frac{1}{5}\sum_{i=1}^{n} w_i \left[|P_A(x_i) - P_B(x_i)|^\lambda + \left|I_{P_A}(x_i) - I_{P_B}(x_i)\right|^\lambda + |I_A(x_i) - I_B(x_i)|^\lambda + \left|I_{N_A}(x_i) - I_{N_B}(x_i)\right|^\lambda + |N_A(x_i) - N_B(x_i)|^\lambda\right]\right\}^{1/\lambda} \quad (4)$$

Where $\lambda > 0$.

The Indeterminate Likert Scale is formed by the following five elements:

–Negative membership,

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– Indeterminacy leaning towards negative membership,

– Indeterminate membership,

– Indeterminacy leaning towards positive membership,

–Positive membership.

These values substitute the classical Likert scale with values:

–Strongly disagree,

– Disagree,

– Neither agree nor disagree,

– Agreed,

– Strongly agree.

The relevance of using an Indeterminate Likert Scale is related to the mix of feelings that a person has when giving their opinion. If the person is forced to choose a single value among the 5 previously given, they will implicitly need to aggregate this mixture of sensations according to a single value and this may depend on the person. On the other hand, if the person is allowed to value each of their feelings and opinions in each of the possible values, accuracy will be gained over the most reliable opinion of the respondent.

Although we gain accuracy with the Indeterminate Likert Scale, it poses a challenge for the respondent, who is used to giving only one final value. That is why it is convenient to provide them with a visual scale like the one seen in Figure 1.

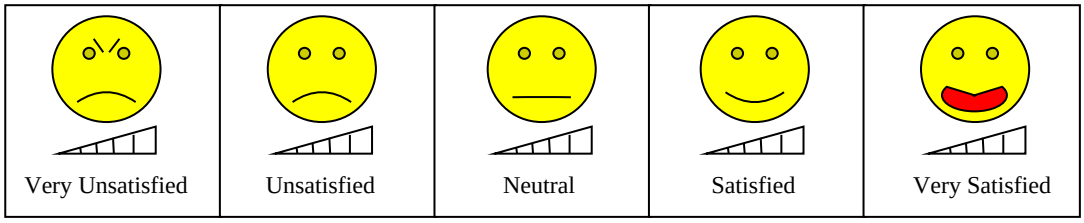

Figure 1: Graphical representation of the Indeterminate Likert Scale proposed to the respondents

3. The study

The first step was to design a survey to measure the degree of entrepreneurship of the students. A summary of the survey is found in Table 1.

Table 1: Operationalization Matrix of Variable 01. University youth entrepreneurship

Variable	Operational Definition	Dimension	Indicator	items
Variable 01. University youth entrepreneurship	The variable is distributed in two dimensions of five indicators each of them, and five items for each indicator, making a total of 50 questions.	D1. potential entrepreneurial capacity	I1.Social skills	from 1 to 5
			I2. Attitude towards opportunities	from 6 to 10
			I3. Cognitive abilities	from 11 to 15

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	I4. Positive self-assessment and continuity	from 16 to 20
	I5. coping skills	from 21 to 25
D2. effective entrepreneurial capacity	I6. family factors	from 26 to 30
	I7. Sociocultural perception	from 31 to 35
	I8. Training for business	from 36 to 40
	I9. Personal traits and skills	from 41 to 45
	I10. Effective Entrepreneurship	from 46 to 50

The instrument was validated by expert judgment, with a very good applicability opinion by three professionals from the administration sector. It has a reliability analysis of Cronbach's Alpha of 0.887, that is, the research instrument has acceptable reliability.

Table 2 contains the summary of the evaluations by the three experts on the proposed survey.

Table 2: Validation of the instrument by expert judgment

Indicators	expert 1	expert 2	expert 3
Clarity	92	92	95
Objectivity	97	95	90
Present	93	97	93
Organization	94	100	97
Sufficiency	91	100	92
Intentionality	90	100	93
Consistency	87	96	92
Coherence	88	98	94
Methodology	91	100	95
Relevance	87	98	97
Total	**91**	**97.6**	**93.8**

The detailed survey applied can be found in Appendix A.

The next step was to select the participants to answer the survey. A sample of 120 participants was selected with simple random sampling, 30 for each of the four Peruvian universities:

- National Autonomous University of Huanta
- National University San Cristóbal de Huamanga
- Universidad Peruana los Andes
- Universidad Continental.

This sample is not representative, taking into account that among the four universities it would be necessary to survey at least 7,600 students, which is an impossible task for the authors due to time,

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financial, and personnel limitations. However, the number of 120 gives an idea of the behavior of these indicators, although the conclusions cannot be generalized to the entire student population.

Before continuing we must establish some necessary concepts to be able to reach conclusions. The first of them is the definition of an order, let us denote it by $<_{TRINS}$, such that if $A(\mathrm{P_A}, \mathrm{I_{P_A}}, \mathrm{I_A}, \mathrm{I_{N_A}}, \mathrm{N_A})$ and $B(\mathrm{P_B}, \mathrm{I_{P_B}}, \mathrm{I_B}, \mathrm{I_{N_B}}, \mathrm{N_B})$ are two singletons TRINS then:

$A <_{TRINS} B$ if $\mathrm{P_A} \leq \mathrm{P_B}$, $\mathrm{I_{P_A}} \leq \mathrm{I_{P_B}}$, $\mathrm{I_A} \geq \mathrm{I_B}$, $\mathrm{I_{N_A}} \geq \mathrm{I_{N_B}}$, $\mathrm{N_A} \geq \mathrm{N_B}$ and at least one of the equalities does not hold.

$A =_{TRINS} B$ if $\mathrm{P_A} = \mathrm{P_B}$, $\mathrm{I_{P_A}} = \mathrm{I_{P_B}}$, $\mathrm{I_A} = \mathrm{I_B}$, $\mathrm{I_{N_A}} = \mathrm{I_{N_B}}$, $\mathrm{N_A} = \mathrm{N_B}$.

Then the following notations are used:

$A \leq_{TRINS} B$ if $A <_{TRINS} B$ or $A =_{TRINS} B$.

$A >_{TRINS} B$ if $B <_{TRINS} A$.

$A \geq_{TRINS} B$ if $B \leq_{TRINS} A$.

All these definitions are in agreement with the order definitions defined by Smarandache for neutrosophic sets.

However, there can be two TRINS $\mathrm{A}(\mathrm{P_A}, \mathrm{I_{P_A}}, \mathrm{I_A}, \mathrm{I_{N_A}}, \mathrm{N_A})$ that $\mathrm{B}(\mathrm{P_B}, \mathrm{I_{P_B}}, \mathrm{I_B}, \mathrm{I_{N_B}}, \mathrm{N_B})$ which are incomparable with that order. In that case, we say that:

$A \leq_{TRINS} B$ if $\theta(A) \leq \theta(B)$, where according to Equation 5:

$$\theta(X) = \left\{\frac{1}{5}\left[|\mathrm{P_A(X)}|^2 + \left|\mathrm{I_{P_A}(X)}\right|^2 + |\mathrm{I_A(X)} - 1|^2 + \left|\mathrm{I_{N_A}(X)} - 1\right|^2 + |\mathrm{N_A(X)} - 1|^2\right]\right\}^{1/2} \quad (5)$$

Note that Equation 5 is obtained as the distance between two TRINS, on the one hand, X, and the other $\mathbf{0} = (0,0,1,1,1)$ that it is the result of applying Equation 4 between these two elements and $\lambda = 2$.

Finally, it is useful to define a formula for the arithmetic mean of a set of TRINS, as shown in Equation 6.

If $\mathrm{A} = \{\langle \mathrm{x};\ \mathrm{P_A(x)}, \mathrm{I_{P_A}(x)}, \mathrm{I_A(x)},\ \mathrm{I_{N_A}(x)}, \mathrm{N_A(x)}\rangle | \mathrm{x} \in \mathrm{X}\}$ and $card(X) = n$, then:

$$\overline{\mathrm{A}}\left(\frac{\sum_{i=1}^{n} \mathrm{P_A(x_i)}}{n}, \frac{\sum_{i=1}^{n} \mathrm{I_{P_A}(x_i)}}{n}, \frac{\sum_{i=1}^{n} \mathrm{I_A(x_i)}}{n}, \frac{\sum_{i=1}^{n} \mathrm{I_{N_A}(x_i)}}{n}, \frac{\sum_{i=1}^{n} \mathrm{N_A(x_i)}}{n}\right) \quad (6)$$

Equation 6 is used to aggregate the results of the survey items.

Table 3 contains the criteria for classifying the data according to their importance. Given the singleton TRINS X, it is calculated:

$$RC(X) = 100 \cdot \theta(X) \quad (7)$$

The classification of X in qualitative ordinal values is given in Table 3.

Table 3: Classification of TRINS according to their CR

CR	TRINS Classification
[85, 100]	Very high
[65, 85)	High
[45, 65)	Medium
[30, 45)	Low
[0, 30)	Very low

Tables 4-7 contain the results of the classification according to Table 3 and the use of Equation 7, for each of the youth entrepreneurship indicators. For each of the young people surveyed, Equation 6 is applied to aggregate their results for each of the indicators, that is, the average of the items

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corresponding to each of the indicators for each young person is calculated, then the results of Equation 7 is applied and it is classified according to the scale in Table 3.

Table 4 below summarizes the frequencies and percentages of Potential Entrepreneurial Capacity (D1) and Effective Entrepreneurial Capacity (D2).

Table 4: Analysis of Dimension 1 (Potential Capacity) and Dimension 2 (Effective Capacity) of university youth entrepreneurship in Peru

		D1. potential entrepreneurial capacity		D2. effective entrepreneurial capacity	
		Frequency	Percentage	Frequency	Percentage
Valid	High	26	21.7	68	56.7
	Very high	94	78.3	52	43.3
	Total	120	100.0	120	100.0

Table 5 shows the results of Social Skills and Attitudes toward entrepreneurship opportunities :

Table 5: Analysis of I1 (Social skills) and I2 (Attitude towards opportunities) of university youth entrepreneurship in Peru

		I1. Social skills		I2. Attitude towards opportunities	
		Frequency	Percentage	Frequency	Frequency
Valid	Medium	3	2.5	6	5.0
	High	73	60.8	36	30.0
	Very high	44	36.7	78	65.0
	Total	120	120	120	100.0

Table 6 contains the results of Cognitive skills and Positive self-assessment and continuity.

Table 6: Analysis of I3 (Cognitive skills) and I4. (Positive self-assessment and continuity) of university youth entrepreneurship in Peru

		I3. Cognitive abilities		I4. Positive self-assessment and continuity	
		Frequency	Percentage	Frequency	Frequency
Valid	High	26	21.7	26	21.7
	Very high	94	78.3	94	78.3
	Total	120	100.0	120	100.0

Table 7 summarizes the results of I5 coping ability.

Table 7: Analysis of I5 (Coping Ability) of university youth entrepreneurship in Peru

		I5. coping skills	
		Frequency	Frequency
Valid	Half	5	4.2
	High	74	61.7
	Very high	41	34.1
	Total	120	100.0

Pairs of indicators are then compared using the neutrosophic order relationship $\leq_{TRINS}$ to obtain Spearman's correlation coefficient. Note that to use Equation 3 it is necessary to order the data values and for this, we use the previous order operator. Table 8 contains the results of Spearman's rho correlation coefficients.

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Table 8: Comparison of pairs of indicators using Spearman's rho correlation coefficient

Indicators to compare	Spearman's coefficient	Interpretation
D1 and D2	0.018	direct and low effect
D2 and I1	0.093	direct and low effect
D2 and I2	0.164	direct and low effect
D2 and I3	0.215	direct and low effect
D2 and I4	0.215	direct and low effect
D2 and I5	0.351	direct and low effect

6. Conclusion

The main goal of this research was to determine the state of entrepreneurship in young Peruvian university students. This is an aspect of the utmost importance for professionals because it means that they will be able to positively change the environment that surrounds them to achieve a better society. For this, a sample of 120 students from 4 Peruvian universities was studied, to whom a survey was applied and the result was that the vast majority of them obtained high or very high scores. This means that our young people surveyed have the capacity for entrepreneurship. To achieve these results, an Indeterminate Likert Scale was used, which made it possible to capture the opinions of the respondents more accurately. As future work, we have the challenge of repeating the study for a representative population of students, which means an important investment and work for the universities involved, but it will be worth doing this study because it will ensure that our higher education is on the right track.

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Appendix A

In Table 9 we summarize the items of the survey.

Table 9: Survey proposed in the study

number	Item
1	I think it is not necessary to debate if the whole group agrees
2	I like to do things on my own
3	I am full of energy when I start a new challenge
4	I believe I have the right skills to achieve my goals
5	I usually feel motivated to achieve the goals I set for myself
6	I like to discover new opportunities to break the routine
7	I like the idea of experimenting with new things, regardless of whether they will be successful or not.
8	I consider the problems I face as challenges
9	I modify my behavior to carry out strategies that facilitate my work
10	I think a lot about my options before taking advantage of an opportunity
11	I make decisions thinking about my future
12	I like to think of new ways to improve existing things
13	I think I'm good at what I do
14	I plan everything I do so that I can achieve my future goals.
15	I think I have to take risks to achieve my goals
16	I take responsibility when things do not go as expected
17	I need to have the autonomy to do things
18	I worry about fulfilling my commitments
19	I consider myself a creative person
20	I like challenges in which I can use my creativity and imagination
21	I prefer traditional alternatives that have already been shown to have good results
22	Once I commit, I do everything in my power to keep it.

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23	When I have doubts, I analyze my thoughts and evaluate them internally
24	I get as much information as possible when it comes to a topic that interests me
25	I prefer to use the most practical and proven ways to perform my tasks
26	I prefer things to remain stable and as they have always been
27	I find it easy to decide what is necessary to achieve my goals at the right time
28	In my family, there are businessmen whom I admire
29	In my family, they report the success stories of entrepreneurs
30	In my family, there is some kind of business
31	In my region, it is possible to achieve individual success through personal efforts
32	The culture of my region encourages risk-taking for the development of business ideas
33	The culture of my region encourages creativity and innovative ideas
34	The culture of my region facilitates the implementation of business ideas
35	At my university there exist finance for business ideas
36	I can solve problems and make the right decisions at the right time
37	When I have a problem, I can only think of one way to solve it
38	It took me a while to accept the changes in the plan
39	I prefer to take the initiative than to be told what to do
40	I consider myself a person who takes initiatives
41	Being an entrepreneur is a real way to earn money
42	Successful entrepreneurs have a high level of status and respect in my community
43	I consider that I can accept change easily
44	Entrepreneurs are successful people.
45	If someone sets their mind to it, they can become a successful businessman
46	The university offers an opportunity for your business development
47	The university offers adequate preparation for the development of business ideas
48	Business education is part of the content developed at my university
49	The business education at my university has sufficient means and didactic resources

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50	The people in charge of business education at my university have the necessary training

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