

## SELF-EFFICACY AND COMPLEX THINKING IN HIGHER EDUCATION STUDENTS IN PERU

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### ABSTRACT

The objective of the study was to determine the relationship and predictability between self-efficacy and complex thinking in higher education students in Peru, making comparisons by gender, in 543 students aged 18 to 25 years, from four public universities to whom the scales of Self-Efficacy (EAPESA; Palenzuela, 1983) and Complex Thinking created by CIFE (2017) were applied. The results show a moderate positive relationship and complex thinking is a predictor of self-efficacy in 17.6% of the cases observed, and there are no significant differences according to gender, and most were located at medium and high levels in both variables.

**Keywords:** Self-efficacy, complex thinking, higher education students

### RESÚMEN

El objetivo del estudio fue determinar la relación y predictibilidad entre la autoeficacia y el pensamiento complejo en estudiantes de educación superior del Perú, efectuándose comparaciones por género, en 543 estudiantes de 18 a 25 años, de cuatro universidades públicas a quienes se les aplicó las escalas de Autoeficacia (EAPESA; Palenzuela, 1983) y Pensamiento Complejo creado por CIFE (2017). Los resultados evidencian relación positiva moderada y el pensamiento complejo es predictor de la Autoeficacia en el 17.6% de los casos observados, además no existe diferencias significativas según género y la mayoría se ubicaron en niveles medio y alto en ambas variables.

**Palabras Clave:** Autoeficacia, pensamiento complejo, Estudiantes de Educación superior

## Introduction

In the last decade, the type of education offered by universities and the profiles they generate are being evaluated to ensure that they guarantee quality in professional training, where information becomes paramount for decision making and its importance grows exponentially. A professional with specialized knowledge in information becomes the main actor in society (Sánchez, 2016). Therefore, it is a necessary component of self-efficacy in student learning, which is self-regulation as a fundamental strategy in the educational process and which highlights the relevance of the commitment and personal performance of the student to be autonomous, independent and constant. Then, any type of work requires planning objectives, using strategies to achieve these objectives and making changes and adjustments to the strategies used to optimize learning and performance (Sandars and Cleary, 2011). In addition, complex thinking must be developed, as Lipman (1992) points out, and education has the elementary purpose of strengthening the objective and rational character of the individual to conceive the totality of reality.

Social Learning Theory regarding the regulation of human motivation and action points to three types of expectations: situation-outcome expectations, action-outcome expectations, and perceived self-efficacy. In this sense, according to Bandura (1995), Self-Efficacy will determine what “type” of activities a person performs, how much “time” a person is immersed in their achievement, and how much “intensity” a person puts into what he or she is trying to achieve. It is the individuals' appraisal of their ability or competence to successfully execute a specific behavior, which functions as an important component in their academic performance (Bandura, 1999). Velducea *et al.* (2019) point out that in the complex thinking approach, there is a tendency to use information and communication technologies as an intervention strategy. Examples are the design of instruments, the use of Moodle, virtual sessions and the use of the Internet for research so that the strategies analyzed with the complex thinking approach contribute to students' meaningful learning, motivation and collaborative work. In addition, there is a tendency to use

Information and Communication Technologies (ICT) to find solutions to real problem situations.

Likewise, given the COVID-19 pandemic, virtual teaching has been emphasized through the use of technology that has allowed teachers and students to use different platforms and virtual strategies, regulating the way of thinking and acting to respond effectively to educational requirements, which has to do with complex thinking. According to Criollo *et al.* (2017), with regard to university education, it must be taken into account that people who access it must organize themselves very differently from how they did before reaching this higher educational level. To this end, universities must equip students with skills such as those referred to by Castañeda *et al.* (2014), which enable them to construct, validate and integrate knowledge to make decisions in a changing world, foster cognitive and executive control skills that allow them to construct knowledge of the best quality, validate knowledge with solid evidence, adapt it to unpredictable situations and transmit it appropriately. This is related to complex thinking, which implies facing a reality that is multiple and surprising in a strategic way. When facing this complex reality, this must be done in a reflective way (Flores, 2020).

Betancourth and Cerón's (2017) proposal is that students regulate their way of thinking and acting so that they respond effectively and efficiently to educational and labor demands. However, a current problem in education is the tendency to teach subject contents, which neglects the development of cognitive skills and abilities (Balladares *et al.*, 2016). Therefore, it is important that universities promote complex learning, and this implies not only curricular changes in the training of the different university careers, but also in the critical approach where the analysis of subject contents should be promoted through the investigation of problems that occur in reality (González, 2014), which is supported by the complexity approach. As Muñoz and Maldonado (2011, p. 2) state, “working in complex situations, similar to real life, allows building concepts, sustaining practical learning and solving problems”.

In higher education, there is a concern to regulate pedagogical models that promote in students

competencies of complex thinking, critical research, in which the learner and the educator interactively acquire skills, knowledge and attitudes to solve a real situation. Having network discussions that allow the development of self-efficacy in student learning so that both parties have the opportunity to learn to avoid the traditional teacher-student relationship, where the student is only a receiver of the information provided by the educator (Yanes, 2016). This vision has a complex approach described by Morin (1999, p. 17) as the paradigm that “presents the paradox of the one and the multiple”. Moreover, as Lipman (1998) points out, it is necessary to teach directly and punctually for the development of this type of thinking that is linked to criticality and creativity as pillars of complexity, so the objective of this study is to identify the levels and the relationship between self-efficacy and complex thinking in higher education students in Peru.

Gratacós *et al.* (2021) studied the relationship between complex thinking, self-efficacy and resilience in novice teachers of Spanish. They found a strong relationship between the three variables and that the presence of the Motivation and Social dimensions of Resilience predicted the variance of self-efficacy, concluding that resilience was a factor that improves abilities to face challenging situations and leads to having an adequate level of self-efficacy and that this variable should be included in all induction programs. Similarly, Asakereh and Yousouf (2018) found a positive and statistically significant relationship between self-efficacy, self-esteem and academic performance, while reflective thinking and its dimensions were not significantly related to the three variables. They did find that self-esteem and self-efficacy were good predictors of academic performance.

Therefore, it is important to know how university students use complex thinking and academic self-efficacy as one of the main axes of their academic behavior. Likewise, to take into account that their decrease could directly affect their performance to, based on these results, analyze the teaching strategies in which self-efficacy and complex thinking are developed in university education. Therefore, the following objectives are set out: to

determine the relationship between self-efficacy and complex thinking in students of four public universities in Peru, to analyze the predictability of the dimensions of complex thinking on self-efficacy, and to compare both variables according to gender.

## Method

This is a quantitative, associative strategy, cross-sectional predictive design study (Ato *et al.*, 2013); that is, it aims to analyze the relationship between self-efficacy and complex thinking, along with the predictability of both variables at a single point in time and is comparative according to gender.

## Participants

The participants were 543 university students from different careers and from four national universities, two from the capital city and the other two from different provinces of Peru. The age range was 18 to 25 years, 382 (71.27%) were women and 156 (28.73%) were men.

## Instruments

### Academic Situations Specific Perceived Self-Efficacy Scale (EAPESA; Palenzuela, 1983)

The version adapted for Peruvian university students (Domínguez, 2014a; Domínguez *et al.*, 2012) was used, which consists of a unidimensional measure formed by nine items with four response options (from Never to Always). The items ask participants to respond how often they manifest beliefs related to their academic self-efficacy. The  $\alpha$  coefficient obtained a high magnitude (.901; 95% CI: .888, .913), the confirmatory factor analysis performed indicates that the data fit the unidimensional structure, and the reliability coefficients used showed high magnitudes. The EAPESA scores do not fit a normal distribution, so the scales were constructed using percentiles. The results are discussed and guidelines for the use of norms are suggested. Cronbach's Alpha was used to determine

reliability, which was .931 and is considered high, and the instrument items have a high level of internal consistency.

### Complex Thinking Scale for University Students

It is a likert-type scale for self-assessment of complex thinking skills based on the problems faced by university students, created by CIFE (2017) based on the approaches of Lipman (1998), who states that complex thinking integrates the other types of thinking. It consists of 22 questions that evaluate five dimensions: problem-solving, conceptualization, critical analysis, systemic analysis and creativity. Each question is evaluated using a frequency scale: never, almost never, sometimes, almost always and always. Content validity was determined by the evaluation of 13 experts. Reliability was determined with the sample data using Crombach's Alpha with a value of .948, which is high. Both instruments were administered virtually with the authorization of the institutions and the informed consent of the participants.

### Procedure

After the initial selection of the research instruments, a pilot test was carried out with 30 university students from the provinces and 30 university students from the capital, to detect difficulties related to the content of the instruments and to identify their relevance.

Arrangements were made with the selected university institutions and, after obtaining the corresponding permissions, the research project

was described, explaining the evaluation process and safety guidelines. Consent forms were given to the participants, who signed their agreement, guaranteeing the anonymity and confidentiality of the data collected in the study.

The evaluation process was carried out virtually and in groups with the support of the teachers who were in class, with an approximate time of 30 minutes to complete both instruments. Once the evaluations were completed, the data were systematized in the database for statistical analysis and comparison according to the objectives and hypotheses proposed and the preparation of the research report.

### Data Analysis

The data analysis process was performed through a descriptive and comparative analysis by gender to determine the frequency and percentage by category in the variables of perceived self-efficacy and complex thinking. This was followed by correlation analysis using Spearman's Rho ( $r$ ) and predictability analysis using linear regression ( $R^2$ ) between complex thinking and self-efficacy.

The data were administered by computer using the SPSS version 24 program for inferential analysis of the data.

### Results

The following are the results obtained in the data collection, under the objectives of this study.

**Table 1**

*Data normality analysis of the Self-Efficacy and Complex Thinking variables along with their dimensions.*

	Kolmogorov-Smirnov <sup>a</sup>		
	Statistics	df	Sig.
Self-Efficacy	,086	543	,000
Problem-Solving Analysis	,083	543	,000
Critical Analysis	,084	543	,000
Conceptual Analysis	,075	543	,000

Systemic Analysis	,141	543	,000
Creativity	,096	543	,000
Complex Thinking	,038	543	,065

Note: df = degrees of freedom      Sig = significance level

According to the data observed in Table 1, the null hypothesis is rejected for the Self-efficacy and Complex Thinking dimensions ( $p < .05$ ), concluding that the data for both variables deviate from the normal curve; likewise, for the Complex

Thinking variable, the null hypothesis is accepted ( $p > .05$ ) and the data are close to the normal curve. Since the vast majority of the data deviate from the normal curve, nonparametric statistics were used for the inferential analysis.

**Table 2**

*Relationship between self-efficacy and complex thinking in Peruvian higher education students.*

		Complex Thinking
Spearman's Rho	Correlation coefficient	,449**
	Sig. (bilateral)	,000
	N	543

Note: \*\* significant correlation level ,01 (bilateral). Sig = significance level    N = number of participants

Table 6 shows that the relationship between Self-Efficacy and Complex Thinking ( $p < .05$ ) is positive and moderate ( $r = .449$ ).

**Table 3**

*Relationship between self-efficacy and the dimensions of complex thinking in Peruvian higher education students.*

		Problem Solving Analysis	Critical Analysis	Conceptual Analysis	Systemic Analysis	Creativity
Spearman's Rho	Correlation	,439**	,368**	,415**	,370*	,350**
	Sig.(bilateral)	,000	,000	,000	,000	,000
	N	543	543	543	543	543

Nota: \*\* Significant correlation level 0,01 (bilateral). Sig = significance level    N = number of participants

Table 3 shows that there is a relationship between the dimensions of complex thinking and self-

efficacy ( $p < .05$ ). This relationship is positive and moderate ( $r = .368$  to  $.439$ ).

**Table 4***Predictability Analysis of Complex Thinking about Self-Efficacy*

Model	Change statistics									
	R	R squared	Adjusted squared	RStandard error of estimate	R squared change	F change	df1	df2	Sig. change	FDurbin-Watson
1	,419 <sup>a</sup>	,176	,174	5,638	,176	115,365	1	541	,000	2,011

Note: a. Predictors: (Constant), Complex thinking    b. Dependent variable: self-efficacy

R= correlation    df= degrees of freedom    F= overall significance in regression    sig= significance level

Table 4 shows the linear regression model, where the correlation coefficient is 0.419, indicating a significant correlation. The R-squared value is 0.176; therefore, for the regression model, 17.6% of the variance of the dependent variable, namely Self-efficacy, is explained by the presence of the

Complex Thinking variable. The result of the Durbin-Watson test (2.011) indicates the independence of the errors since the value for accepting this hypothesis is between 1 and 3.

**Table 5***Average score range in Self-Efficacy, Complex Thinking and its dimensions.*

	Gender	N	Average Range
Self-Efficacy	Female	387	269,37
	Male	156	275,10
	Total	543	
Problem Solving Analysis	Female	387	269,33
	Male	154	275,20
	Total	541	
Critical Analysis	Female	387	273,84
	Male	154	263,86
	Total	541	
Conceptual Analysis	Female	387	269,34
	Male	154	275,18
	Total	541	
Systemic Analysis	Female	387	263,27
	Male	154	290,42
	Total	541	

Creativity	Female	387	267,82
	Male	154	278,99
	Total	541	
Complex Thinking	Female	387	269,13
	Male	154	275,70
	Total	541	

Note: N = Number of participants

**Table 6**

*Comparison of self-efficacy and dimensions of complex thinking in university students based on gender.*

	Self- efficacy	Problem Solving Analysis	Critical Analysis I	Conceptua Analysis	Systemic Analysis	Complex Creativity	Complex Thinking
Mann-Whitney U test	29167,000	29152,500	28700,00	29156,000	26808,00	28568,500	29074,500
Asymtotic (bilateral)	Sig,700	,692	,501	,694	,065	,450	,659

Note: a. grouping variable: gender sig = significance level

The data in Table 6 shows ( $p > .05$ ), leading to the conclusion that there are no significant differences in Complex Thinking Self-Efficacy and its dimensions based on the gender of the

participants. The same situation is observed in Table 5, where the average traits of the study variables and their dimensions do not differ significantly if the participants are male or female.

**Table 7**

*Percentage and frequency of participants according to the categories of Perceived Self-Efficacy.*

Categories of Perceived Self-Efficacy	Percentage of participants according to the categories of perceived self-efficacy.	Frequency of participants according to the categories of perceived self-efficacy.
Low	34.6	188.0
Medium	32.0	174.0
High	33.4	181.0
Total	100.0	543.0

Table 7 shows that 34.6% are located in the low category, 32% in the medium category and 33.4% in the high category.

**Table 8**

*Percentage and frequency of participants according to the categories of Complex Thinking and its dimensions.*

Categories	% PSA	Fi PSA	% CA	Fi CA	% A Con	Fi A Con	% SA	Fi SA	% Cr	Fi Cr	% CT	Fi CT
Low	42.0	228.0	42.5	231.0	34.1	185.0	41.8	227.0	39.6	215.0	34.1	185.0
Medium	34.1	185.0	26.0	141.0	36.6	199.0	25.0	136.0	30.8	167.0	34.4	187.0
High	23.9	130.0	31.5	171.0	29.3	159.0	33.1	180.0	29.7	161.0	31.5	171.0
Total	100.0	543.0	100.0	543.0	100.0	543.0	100.0	543.0	100.0	543.0	100.0	543.0

Note: % = Percentage Fi = Frequency PSA = Problem Solving Analysis AC = Critical Analysis A Con = Conceptual Analysis SA = Systemic Analysis Cr = Creativity CT = Complex Thinking

Table 8 shows that the highest percentage of participants have a low level in analysis and problem solving, systemic analysis, creativity and critical analysis, while 36.6% have a medium level in conceptual analysis and 34.4% in general in complex thinking.

## Discussion

Correlation analyses confirm that there is a statistically significant, moderate and positive relationship between self-efficacy and complex thinking and its dimensions. These results mean that the more the surveyed students face reality by employing reflective, strategic and creative thinking (Flores, 2020), the greater their ability to successfully execute their academic and personal activities, trust and highlight their achievements, and adapt their procedures and activities to solve problems (Bandura, 1995). Likewise, the use of creative thinking, the analysis of the demands of the environment from a critical point of view, the openness to ideas and the consideration of all aspects of reality in a holistic or systemic way are related to the knowledge and confidence that students have in their abilities, which leads them to believe that they can perform the tasks entrusted to them efficiently and effectively. The results

presented are along the same lines as those proposed by Sánchez (2010), where the importance of autonomy, reflexivity and confidence in the capabilities of future professionals is highlighted (Betancourth and Cerón, 2017), so higher education institutions must ensure that students learn to regulate their thoughts and actions effectively and efficiently, appealing to their learning autonomy. The complex thinking approach implies the consideration of a series of alternatives and perspectives of problematic situations, so the importance of ICTs and their use becomes important for the stimulation of this variable (Velducea *et al.*, 2019).

In the predictability analysis, complex thinking was found to be a predictor of the variance of the variable Self-efficacy in 17.6% of the observed cases; furthermore, the dimension Problem-Solving Analysis is a predictor of the variance of the variable Self-efficacy in 19.6% of the observed cases. It is clear from these data that the presence of a reflective way of thinking, open to different perspectives, both reflexive and strategic in the percentage of the surveyed students indicated above, necessarily leads to a positive variance in the knowledge and confidence they feel in their abilities, to the effective and efficient execution of the tasks given to them. This situation is reinforced by the approach of Sandres (2011), in which the use of autonomous learning, goal setting and strategy monitoring necessarily optimize the performance of individuals. Likewise, a high level of self-efficacy, thanks to the presence of complex



thinking, helps people to determine precisely the type of activities they must develop to respond to complicated situations, increases the intensity of efforts to achieve goals and saves time (Bandura, 1995).

The university curriculum must consider the stimulation of complex learning in the dimensions of autonomy, creativity, critical, conceptual and systemic analysis (Gonzales, 2014). Since, in order to face the labor and social demands of a globalized context, it is necessary to have people who take responsibility and are autonomous in their learning and in the confidence and effectiveness of their abilities. In the same vein, Asakereh and Yousouf (2018), in the context of Iran, found no relationship between reflective thinking, self-esteem and self-efficacy, opening the debate that the social and cultural reality of both Iran and Peru may be involved in the connection that reflective thinking and complex thinking have with self-efficacy. It is important to note that both countries have significant religious roots, which may explain the difference in results. It should be noted that Hyytinen *et al.* (2018) also found no connection between critical thinking and self-efficacy in Finnish students. In contrast, Phan (2007) found in U.S. students that approach to learning and reflective thinking was a superficial predictor of self-efficacy; no studies were found between both variables in the Latin American context.

Gratacós *et al.* (2021) found a strong relationship between the three variables and that the presence of the Motivation and Social dimensions of Resilience predicted the variance of self-efficacy in teachers, which leads to reflect on the importance of considering that complex thinking and other variables such as resilience help to improve students' abilities to face challenging situations and that teachers, by stimulating these variables, can also involve their students in the development of these variables.

In the analysis of perceived self-efficacy, it was found that 66% of the students are located in the medium and high category versus 34% in the low category; in the complex thinking variable, 68% are located in the medium and high levels and 32% in the low level; in addition, no significant differences by gender are evidenced in the

variables studied. This implies that it would be necessary to review to what extent the curricular programs of university careers allow the development of these variables, taking into account their human condition and making feasible the approach to the complexity of university life and the dissipation of the uncertainty that tinges the students' experiences. These discontinuities provoke uncertainty, dissatisfaction and a mismatch between expectations and achievements in students (Bustamente *et al.*, 2018). Likewise, Albarracín (2021), according to the diagnostic analysis on the results of complex thinking, reveals a need for change in the didactic strategy, which is perceived as conventional and very traditionalist.

In this learning context, it is important to consider changes in terms of content and strategies so that students are able to think about the problems of their contextual reality in a complex manner and in all their multi-dimensionality, being able to develop creative and innovative processes with their approach through the strengthening of self-efficacy.

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