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## New functional model of research skills in social problem solving

### Abstract

*The research was oriented to determine the functional influence of the investigative competences in the abilities to solve social problems. The work was located in the positivist paradigm, quantitative approach, substantive type, non-experimental design, causal correlation. The sample (141 individuals) was obtained by simple random sampling. Four instruments were used; subjected to content validity and reliability by Cronbach's alpha and KR-20. The results were obtained by the asymptotic free distribution method, also called weighted least squares method; they allowed to establish structure models. concluding that there was a significant functional influence of the investigative skills on the skills for solving social problems.*

**Keywords:** investigative skills, social skills, problem solving, metacognition

### Introduction

Research skills can currently be assumed as the transversal axis in higher studies since they facilitate the training of competitive professionals with the capacity to respond effectively to the dizzying advances of the current situation (Buendía, Zambrano and Insuasty, 2018). The development of these competencies includes facing a series of disadvantages such as autonomous learning, critical thinking, innovation, research, among others, which are considered fundamental tools for the formation of professionals with the capacity to learn to learn (Tobón, 2015). For all the above reasons, León, Risco and Alarcón (2018) affirmed the importance of developing competencies so that teachers can implement a research environment to strengthen training innovation and increase

their expertise and, thus, encourage research skills in their students.

In accordance with UNESCO's proposal (2009), university education is based on research with an interdisciplinary perspective that contributes to the sustainability of development, peace and well-being as well as to the fulfilment of human rights. The above reflects the ideal of a higher education system; however, it is necessary to know the reality of the Peruvian university, which for many years was governed by University Law 23733 which, in article 23, showed the obtaining of the bachelor's degree automatically, the requirement was the approval of the minimum number of credits to access such right or, failing that, the approval of the qualified professional practice; to obtain the degree, it was decided to develop a thesis or take an

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exam of professional sufficiency. In the particular case of the Faculty of Education of the Universidad Nacional Mayor de San Marcos (FE-UNMSM), as with other faculties of the same institution, it was recorded that 80% of the graduates obtained their degree through the professional sufficiency exams, a percentage that is clearly higher than the number of graduates who carried out thesis work or scientific research; Therefore, the performance of an exam became one of the main causes of the deficiency in the development of research skills and scientific production in both students and teachers of the aforementioned Faculty (Núñez y Vega, 2011).

In the current context, the new University Law 30220 is in force, which, in article 48, sets forth the development of research as the work of any university, whether public or private, since the primary function of higher education institutions is the production of knowledge and the improvement of technologies in accordance with the national reality, among other aspects; therefore, teachers, students and graduates are the vital body of the research process in their study centres or in national or global research networks. At present, in order to obtain the bachelor's degree, a research paper must be approved; at the same time, to obtain the professional degree, a thesis must be submitted. As a response to these requirements, the FE-UNMSM promotes the training of educators with consistent pedagogical and disciplinary knowledge, with a critical and investigative attitude, since it has been demonstrated that, by means of training in research, future educators can deepen their knowledge, their autonomous and attitudinal intelligentsia to problematize their educational context and find alternative solutions (Buendía et al., 2018).

A quality of life is achieved in a society that has human talent trained in higher institutions with the capacity to generate knowledge and to instruct creative and innovative disruptive professionals. The FE-UNMSM resumes its social role in an environment that seeks the production, generation and dissemination of knowledge as well as quality training of students able to meet demands and needs both public and private. For this reason, it is essential to develop skills that promote the integrality of the student through the union of knowledge, skills and attitudes, which lead to develop skills to identify alternative solutions and address the demanding problems of society, always acting under the primacy of ethics.

### **Complex approach to research skills**

The complex approach to research competencies involves complicated processes of performing activities and programs with both competence and ethics, which allow for individual self-realization, improvement of the quality of life and socio-economic development with a sustainable balance in the environment (Gutiérrez, 2015). According to Tobón (2015), the mentioned approach comprises four types of knowledge: to be, to do, to know and to live together; being these, fundamental to develop tasks and/or to solve problems; all this from the point of view of metacognitive processing, continuous improvement and commitment with ethics. Estrada (2014), for his part, highlighted six elementary considerations: processes, complexity, performance, suitability, metacognition and ethics. The metacognitive process has an integrative character over the other aspects in relation to the development of research competencies considered as complex processes due to their implication in the articulation and application as opposed to human knowledge and dimensions (Estrada, 2014).

For the development of research competencies, it is essential to develop complex thinking skills: flexibility, hologrammatics, dialogic and metacognition; in addition to opting for appropriate behavior that makes it possible to take advantage of opportunities to face uncertainty (Salazar and Tobón, 2018). The complexity of this thinking lies in its multidimensionality since its dynamic evolution (order-disorder-reorganization) gives the individual the full development of his personal skills, leading him to interact effectively with his environment in the constant search for alternative solutions to the challenges of his reality (Fragoso, 2019; Martínez, Tobón y López, 2018; Rodríguez y Pérez, 2017; Fuentes, 2016; Baroughi, & ZAREI, 2013).

### **Research skills in university education**

The research competence is the grouping of skills, aptitudes, attitudes and knowledge of the students, aimed at the development of research work (García and Aznar, 2019; Sánchez, Reyes and Mejía, 2018; Álvarez, Pérez and Durand, 2019) for the acquisition of the bachelor's degree. In this regard, the following competencies should be taken into account:

(a) Cognitive skills. Buendía et al. (2018) conceived them as the capacities to understand, comprehend, examine, compare and value approaches, innovations and methodologies, which allow teachers to

develop specific skills and to face disadvantages.

(b) Procedural skills. These competencies are translated into the ability of the researcher to use diverse techniques in research (Salazar and Tobón, 2018; Torres, 2016; Puspitasari, et al, 2019); which means skills to execute, identify, expose, and activate the essential functions of research work effectively.

(c) Communication skills. According to Sime and Rivero (2014), they allow the researcher to demonstrate his/her ability to generate and disseminate knowledge through his/her research, whether verbal or digital. Torres (2016) conceptualized them as a function initiated by the scholar to exchange experiences to conceptual and procedural demands and, through this, to be able to implement solutions to possible inconveniences in their environment (Buendía et al., 2018, Marrero y Pérez, 2013).

Sime and Rivero (2014) stated that research skills allow the identification of the problem and its possible solution as well as the writing, argumentation and mastery of information, results and conclusions regarding practical situations in their environment. Likewise, García and Aznar (2019) referred to the fact that training future teachers in research skills will allow them to face challenges and demands corresponding to education, consolidating a scenario of academic reflection and assuming the commitment to generate professionals with skills that will allow them to face socio-cultural and labour demands. In order to obtain these competences, accurate teaching methods are required that allow students to use research tools and precise knowledge. In order to achieve this, an integral, interdisciplinary and transversal structuring of the curriculum is needed, which will make it possible to address and provide solutions to the social environment; in addition, it is a priority to train students in research skills that lead to the analysis and attention of social problems. Marrero and Pérez (2013) developed research skills in higher education, thanks to the functionality of its axes, which cross the curriculum completely, articulating it in a systematic and holistic way to the respective disciplines and subjects. Álvarez et al. (2016)

Dealt with the aspects of the methodology for the formation of research competencies, delimiting the theoretical conception that is represented in the pedagogical model (during the formative route of said competency) which admits the organization of the formative process by means of the specific conditions of the center of study, the preparatory level of its educators and the level of development of the subjects in order to potentiate the research

activity through cognitive formation, institute abilities, develop the expression of values and transform the student's behavior with the route to science and research.

### ***Problem-solving skills***

According to Loibl, Roll and Rummel (2017), these skills are the set of cognitive-behavioral activities that allow the individual to discover or develop alternative solutions or effective ways to face everyday problems. In turn, it is made up of the following variables:

(1) Definition and statement of the problem: it allows the collection of relevant and objective data about the problem and the projection of achievable objectives to solve it.

(2) Generation of alternatives: it allows the generation of solution possibilities since the multiplicity of possibilities allows opting for the most effective solution.

(3) Decision making: it allows the evaluation of possible solutions and the choice of the one that allows the consolidation of the proposed goal, maximizing the positive effects and reducing the adverse ones.

(4) Implementation and validation of the resolution: it allows the evaluation of the results obtained and their effectiveness.

The aspects proposed allow for the establishment of a range of diverse activities with concrete and specific objectives. According to the approach, if the four variables are managed effectively, the researcher will be able to implement the solution of the problems in an adequate and satisfactory way. Similarly, Galindo et al. (2016) indicate that an effective solution to problems would be related to a high probability of feeling positive emotions and psycho-emotional well-being, while an incorrect solution would be associated with the opposite result.

On the other hand, Velasco and Cardeñoso (2017) indicate that rational problem solving comprises a group of cognitive and advantageous operations to effectively face disadvantages; among these are the definition of the problem, the proposal of alternative solutions, decision making and the analysis of results. The goal of the problem definition is to delimit the reasons why a specific event becomes problematic and, in this way, to detail a set of objectives that will allow to guide the mechanisms for the achievement of solutions (Graesser, 2018). On the other hand, problem-solving skills focus on two relevant aspects:

(a) The functional dimension. This dimension contemplates a series of positive orientations towards problems since it is a constructive way of solving them. It is related to the general disposition of:

(1) Valuing the disadvantage as a "challenge" (an opportunity for benefit).

(2) Considering that the disadvantage can be solved (optimistic expectations).

(3) Confidence in one's own ability to successfully deal with the problem (self-efficacy).

(4) Considering that successful resolution requires time, dedication, sacrifice and persistence.

(5) Confronting problems before avoiding them; that is, a positive attitude to face the problems before avoiding them.

(b) The dysfunctional dimension. By its nature, it comprises four elements:

(1) Definition and formulation of problems. Its objective is the assessment of the problematic situation and, with it, the establishment of an objective or objectives that can be achieved, since this process is key since it offers the possibility of generating relevant solutions that contribute to decision-making and to the validation of the resolution of the problem.

(2) Generation of alternatives. A process that consists of the definition of the inconvenience, posing various possibilities for overcoming difficulties and achieving the goal. To do this, after considering the possibilities, the possible effects for or against them must be predicted and the most viable one decided upon, taking into account the mitigation of adverse aspects.

(3) Decision-making. A process that plays a fundamental role in the search for viable solutions to social problems, since it allows for the discrimination of possible alternative solutions in order to choose the one or the ones that are most appropriate to the difficulties within a real context.

(4) Implementation and verification of solutions this is a key process that facilitates the evaluation of the selected solution through the implementation of a series of estimation processes that allow the effect of the solution taken to be weighed.

**Methodology**

This study, epistemologically, is framed in the positivist paradigm, under the quantitative approach, using the hypothetical-deductive method, of non-experimental character due to the neutrality against the deliberate manipulation of the variables (Hernández y Mendoza, 2018). The causal correlation design was used since it allows the study of the relationship between facts and phenomena both observable and measurable (variables) in order to identify the degree of influence and, thus, determine the level of relationship between the study variables. The

population consisted of 223 students belonging to the FE-UNMSM School of Vocational Education, who studied the thesis subjects. The representative sample was obtained by simple random probability sampling and was made up of 141 students from the aforementioned vocational school.

Two techniques were used for data collection: survey and observation. Three instruments were also used for the research skills variable: (i) the observation card, which allowed for the recording of observed data regarding research, procedural and communicative skills; (ii) the interval scale test for the cognitive skills dimension and; (iii) the questionnaire for the problem-solving skills variable. The instruments were subjected to content validity in order to support the level at which the scores represent the measure of the character or attribute that is supposed to be assessed; in other words, the theoretical construct (Hernández and Mendoza, 2018). The reliability of the instruments was obtained by means of a pilot test using Cronbach's alpha statistics and KR-20. The instruments used presented high reliability as can be seen in the values of Table 1.

**Table 1.**  
Is of reliability of factors affecting task-based learning.  
*Analysis of the reliability of research competencies and social problem-solving skills.*

Variable 1	Alfa Cronbach	ofN elements	of
<i>Research skills</i>	,822	59	
<i>Dimension 1</i>	KR 20	N	of elements
Cognitive skills	,780	31	
<i>Dimension 2 y 3</i>	Alfa Cronbach	deN	of elements
Procedural Competences	,799	19	
Attitudinal competences	,886	9	
Variable 2	Alfa Cronbach	deN	of elements
Social Problem solving	,992	70	

Source: Pilot test database

**Results with free asymptotic distribution (structural model)**

The statistical method of weighted least squares, also known as the method of free asymptotic distribution, is used when there is no normality in the data; likewise, it is essential that the model contains qualitative variables or attribute variables; therefore, we work with

poly-coric, polyseric and tetracoric matrices. There are many structure models, in addition to the theoretical model of the study (Medrano and Muñoz, 2017).

$$F_{wls} = (1/2) \text{tr} \{ [S - \Sigma(\theta)] V^{-1} \}^2$$

Functions of the method of adjustments of the asymptotic distribution estimation

**Table 2.**

*Coefficients of the structural model of the influence of research competencies on social problem-solving skills*

Relation	Coefficient	Standardized Coefficient	S.E.	Sig.
F2: Social problem-solving skills ← F1: F1: Research skills	2,844	,979	,365	***
z1: Cognitive research skills ← F1: F1: Research skills	1,000	,805		
z2: Procedural research capabilities ← F1: F1: Research skills	1,275	,821	,117	***
z3: Communicative research skills ← F1: F1: Research skills	1,262	,825	,115	***
m1: Functional ← F2: Social problem-solving skills	1,000	,878		
m2: Disfunctional ← F2: Social problem-solving skills	,945	,971	,086	***

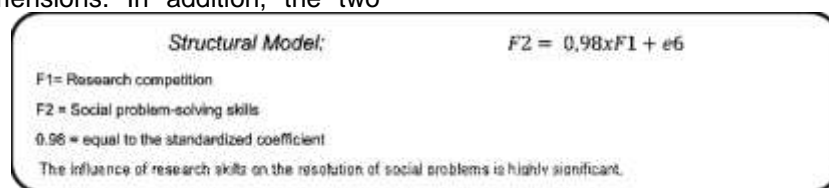
Source: Data base

According to the data provided by Table 2, it was found that a strong positive and significant influence of research competencies on social problem-solving skills occurred in FE-UNMSM students (.979). The dimensions of research skills explain the variable in a unifactorial way, with positive and high standardized factor loads (0.805; 0.821 and 0.825, respectively), appreciating a relationship between the errors of the dimensions cognitive research skills and procedural research skills, which indicated that there is something indirect in common that links both dimensions. In addition, the two

dimensions of social problem-solving skills explain the variable in a unifactorial way, with positive and high standardized factor loads (.878 and .971, respectively), being highly influenced by research skills.

Measurement models: (z1 = 0.81xF1 + e1); (z2 = 0.82xF1 + e2); (z3 = 0.82xF1 + e3); (m1 = 0.88xF1 + e1); (m2 = 0.97xF1 + e5)

- F1: Research skills
- z1: Cognitive research skills
- z2: Procedural research capabilities
- z3: Communicative research skills
- F2: Problem solving skills
- m1: Functional
- m2: Disfuncional



**Figure 1.**

*Standardized coefficients of the structural model of the influence of research competencies on social problem-solving skills in students in the study sample*

Research skills influence the social problem-solving skills of university students by 98%. If they construct research projects in a rigorous manner; that is, following the parameters of the scientific method, then they will be prepared to solve problems that arise in their work and personal environment. We can explain that such influence at 98% makes functional skills improve at 88%. From this, we

can predict that research skills influence functional social skills by developing in students the cognitive, behavioral and emotional skills for problem attention.

If research skills influence social problem solving at 98%, then dysfunctional skills such as the ability to define a problem, generate alternatives, make decisions, implement and verify solutions will be developed at 97%.

In order to produce 98% of the influence of research competencies on social problem solving, we had the contribution of cognitive research skills (81%), procedural and communicative skills (82%).

This indicates that university students who have theoretical knowledge (learning to know), procedural skills (learning to do) and the attitudes and social skills to discern them (learning to be) will contribute in the future to the solution of social problems.

According to Table 3, it was observed that there was a strong positive and significant influence of research competencies on the functional dimension of social problem solving skills. Likewise, the three dimensions corresponding to research skills explain the variable in a unifactorial way, with positive and

high-standardized factorial loads (0.755; 0.891 and 0.912, respectively).

In addition, the three indicators of the functional dimension of social problem-solving skills explain the variable in a unifactorial way, with positive and high standardised factorial loads (0.792; 0.692 and 0.807, respectively), appreciating indirect relationships, first between errors in cognitive and emotional skills and second between errors in emotional and behavioural skills, indicating that there is something indirect in common that links both indicators.

**Table 3.**

*Coefficients of the structural model of the influence of research competencies on the functional dimension of social problem-solving skills.*

Relation	Coefficient	Standardized Coefficient	S.E.	C.R.	Sig.
F2: Functional dimension of social problem solving skill ← F1: Research skill	2,235	1,021	,219	10,195	***
z1: Cognitive research skills ← F1: Research skill	1,000	,755			
Z2: Procedural research capabilities ← F1: Research skill	1,494	,891	,129	11,583	***
M3: z3: Communicative research skills ← F1: Research skill	1,507	,912	,143	10,558	***
m11: Cognitive skills ← F2: Functional dimension of social problem solving skills	1,000	,792			
m12: Emotional skill ← F2: Functional dimension of social problem solving skills	1,280	,692	,115	11,133	***
m13: Behavioral skill ← F2: Functional dimension of social problem solving skills	1,263	,807	,085	14,878	***

Source: Data Base

Structural Model:

$$F2 = 1,02 \times F1 + e7$$

$$1,02 \times F1 + e7$$

Measurement models: (z2 = 0,89x F1 + e2); (z3 = 0,91x F1 + e3); (m11 = 0,79x F1 + e4); (m12 = 0,69x F1 + e5); (m13 = 0,81x F1 + e6).

F1: Research skills

z1: Cognitive research skills

z2: Procedural research capabilities

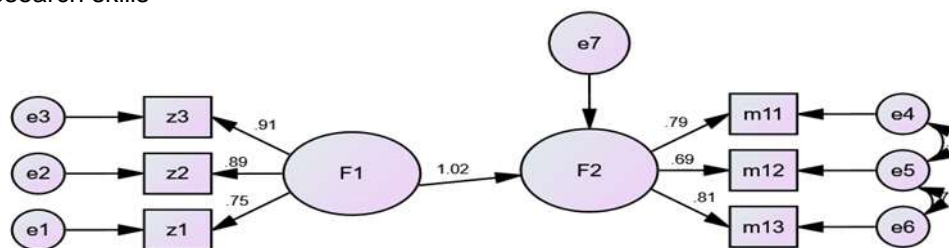
z3: Communicative research skills

F2: Functional problem-solving skills

m11: cognitive problem-solving skills

m12: emotional problem-solving skills

m13: behavioral problem-solving skills



**Figure 2.**

*Standardized coefficients of the structural model of the influence of research skills on the functional dimension of social problem-solving skills in students in the study sample.*

The influence of research competencies is significantly high on functional problem-solving skills. This influence is due to the presence of cognitive research skills (75%), procedural research skills (89%) and communicative research skills (91%). It can be stated that the greater the presence of procedural and communicative abilities, the better the functional skills.

The significant influence of research skills on functional abilities also had an impact on cognitive abilities when solving problems (81%), on emotional abilities when solving problems (69%) and on behavioral abilities when solving problems (79%).

In relation to the above, it could be stated that the research skills allowed students to have theoretical knowledge about the problem, its identification, the expansion of knowledge after investigation and theoretical support. Likewise, this aspect contributed to

**Table 4.**

*Coefficients of the structural model of the influence of research competencies on the dysfunctional dimension of problem-solving skills*

Relation			Coefficient	Standardized Coefficient	S.E.	C.R.	Sig.
F2: Dysfunctional dimension of social problem-solving skills	←	F1: Research skills	1,923	,887	,163	11,804	***
z1: Cognitive research skills	←	F1: Research skills	1,000	,964			
z2: Procedural research capabilities	←	F1: Research skills	1,278	,954	,093	13,803	***
z3: Communicative research skills	←	F1: Research skills	1,084	,770	,099	10,934	***
m21: Problem definition skills	←	F2: Dysfunctional dimension of social problem-solving skills	1,000	,893			
m22: Skills for generating alternatives	←	F2: Dysfunctional dimension of social problem-solving skills	1,313	,939	,076	17,222	***
m23: Decision-making skills	←	F2: Dysfunctional dimension of social problem-solving skills	1,099	,922	,045	24,671	***
m24: Implementation skills and solution verification	←	F2: Dysfunctional dimension of social problem-solving skills	1,217	,973	,056	21,846	***

Source: Data Base

Structural model:  $F2 = 0,89 \times F1 + e8$

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the control of emotions and behavior management when facing a problem.

From these results, it can be estimated that students who carry out research will be prepared to face a problem from the cognitive, emotional and behavioral point of view.

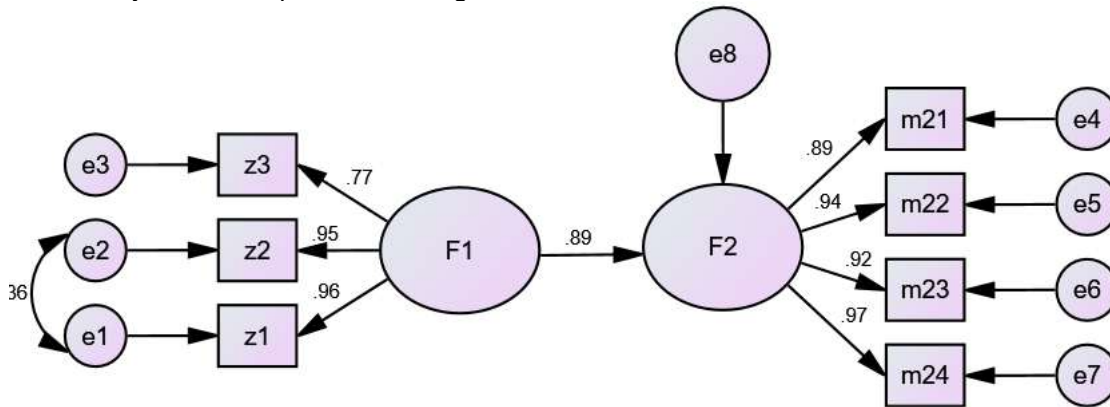
From Table 4, a strong positive and significant influence of research skills on the dysfunctional dimension of social problem solving skills was observed.

Similarly, the three dimensions corresponding to research skills explain the variable in a unifactorial way, with positive and high-standardized factorial loads (0.964; 0.954 and 0.770, respectively), appreciating indirect relationships between the errors of cognitive research skills and procedural research skills, indicating that there is something indirect in common that links both indicators.

In addition, the four indicators of the dysfunctional dimension of social problem-solving skills explain the variable in a unifactorial way, with standardized positive and high factor loads (0.893; 0.939; 0.922 and 0.973, respectively).

Measuring models: ( $z1 = 0.96 \times F1 + e1$ );  
 ( $z2 = 0.95 \times F1 + e2$ ); ( $z3 = 0.77 \times F1 + e3$ );  
 ( $m21 = 0.89 \times F1 + e4$ ); ( $m22 = 0.94 \times F1 + e5$ );  
 ( $m23 = 0.92 \times F1 + e6$ ); ( $m24 = 0.97 \times F1 + e7$ ).  
 F1: Research skills.  
 z1: Cognitive research skills.  
 z2: Procedural research skills.  
 z3: Communicative research skills.  
 F2: Dysfunctional problem-solving skills

m21: skills in defining or identifying a problem.  
 m22: skills in generating alternatives to a problem.  
 m23: skills to make decisions about a problem.  
 m24: solution implementation and verification skills.



**Figure 3.** Standardized coefficients of the structural model of the influence of research skills on the dysfunctional dimension of problem-solving skills in students in the study sample.

According to the structural model, we can observe the value of ,89 as a standardized coefficient in Figure 3, which allowed us to affirm the significant influence between research competencies and dysfunctional problem-solving skills due to the contributions of the dimensions cognitive research skills (96%), procedural research skills (95%) and communication skills (77%).

From what we have observed, we can state that what contributes best to dysfunctional skills is having theoretical knowledge hand in hand with research know-how (theory and practice).

The influence of research skills on dysfunctional skills (80%) is reflected in the skills in the definition or identification of a problem (97%), skills to generate alternatives to a problem (92%), skills for decision making in the face of a problem (94%) and skills for implementation and verification of the solution (89%); with which we can predict that students who developed research skills will be able to identify social problems without difficulty, as well as implement aspects of improvement for their attention and implementation.

**Discussion**

According to the results obtained in the present study, research competencies influenced 98% of the students' social problem-solving skills as long as they generated research projects in a rigorous way, under the parameters of the scientific method.

This is consistent with Fuentes (2016), who concluded that social science research employs decision making in the face of the uncertainty involved in solving complex problems. Based on the above, it was concluded that if the protocols of the scientific method are developed in the design of research, there will be the capacity to solve personal problems and this will allow the resolution of social problems in the institutions where they are carried out.

It should be considered that 98% of the influence of research skills on the resolution of social problems is due to the contribution of cognitive research skills (81%) contributing to the solution of problems. This aspect is reinforced by Torres (2016), who concluded that the focus on competencies and their methodologies give new meaning to learning, privileging cognitive processes (perception, attention, comprehension, intelligence and language), cognitive skills (interpretation, argumentation and proposal) and problem solving with meaning for students. Therefore, it could be stated that if a competency-based approach develops cognitive ability (learning to know) inserted in research competencies, it will allow students to identify problems and, from this, have greater certainty in the choice of solution strategies.

From the results obtained, a considerable influence of the research competences (69%) was evidenced in relation to the emotional skills when solving problems since it is fundamental to develop security, self-esteem and autonomy as features or qualities of the



researcher. This aspect is supported by the work of Fragoso (2019), who demonstrated that the emotional element is the generator of the sensation of enjoyment or dislike of a project, given that this aspect influences the level of motivation when carrying out research work. Likewise, a positive attitude on the part of the inexperienced researcher encourages the analysis and generation of better ideas; the more effective resolution of problems in a project; increased acceptance of diverse points of view (if working in a team); a decrease in the tendency to draw erroneous conclusions; and better tolerance of possible inconveniences. In order to integrate the emotional and affective components in the scientific work, we must recognize that research, besides being an activity that requires a strong intellectual effort, is an emotional process, according to Fonseca de Rocca and Prieto de Alizo (2010).

The results of the research allowed recognizing that the research competences influenced the behavioral skills when solving problems (79%) since at the moment of identifying a problem the student tends to adopt actions or reactions, forming his/her behaviors progressively in the multiple interactions that occur. Marrero and Pérez (2013), who concluded that research, confronted this aspect and its formative contribution to students is fundamental since society needs creative people with the capacity to develop an individual research attitude in order to obtain excellent work performance with successful results that achieve a better quality of life in response. Future teachers need appropriate behavior for the attention of the following students. If the institution of higher education were concerned with integrating research skills into the preparation of students, it would undoubtedly be contributing to the formation of responsible and disciplined professionals who cooperate in the personal and social formation of the next generation.

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