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An instrument to assess the research culture in formative processes: the validation of the instrument*

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ABSTRACT

Universities seek to contribute to strengthening the research capacity of their students for the creation of new knowledge in a constantly changing society. In this scenario, strengthening the research culture among teachers and students is considered a key factor contributing to the consolidation of a researcher. Therefore, this study aims to establish the validity of the research instrument called Res-Cul, which aims to assess the personal research culture immersed in an educational process at the undergraduate level. Res-Cul considers attitudes and values towards research, knowledge about research with a methodological approach, and practices towards research at the university. The method used was the validation of content in the opinion of 9 experts, and Kendall's W concordance coefficient to measure the reliability of these judgments. The results show that the items in the Res-Cul instrument are valid and reliable for the purposes mentioned. In order to continue consolidating the validity of the instrument, in the following steps, the instrument is piloted with potential users.

CCS CONCEPTS

• Social and professional topics • User characteristics • Cultural characteristics

KEYWORDS

Research culture, Quantitative instrument, Validation, Attitudes, Research, Educational innovation.

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1 Introduction

Research is the vehicle for creating new knowledge and is recognized by societies as a key factor in promoting development. This phenomenon has impacted the educational environment through universities, which aim to contribute to strengthening the research capacity of their students. The formation of research competencies must include three interrelated components: methodological-reflexive, motivational, and communicative [1]. However, it has been identified that on some occasions the positioning that institutions give to research is inappropriate, since they don´t consider attitudes toward research as part of the process of consolidation of a research culture [2]. Faced with this situation, an instrument is needed to measure the culture of research in order to understand, from those involved in the teaching-learning process (teachers and students), the meaning attributed to research practice.

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This study aims to present the content validation of a research instrument to assess the personal research culture immersed in a formative process. The instrument considers attitudes and values towards research, knowledge about research with a methodological approach and practices towards research and is designed to be applied in any educational context at a higher level. The validation of content was the result of the judgment of 9 experts.

The structure of the present study contemplates the theoretical-conceptual support with respect to the formation for the competence in investigation, the research culture, and the instruments found in literature that contemplate its valuation. Subsequently, the research method is described, integrating the participants, the description of the instrument and the procedure performed. Finally, the results and discussion according to the findings found in the study are presented.

2 Conceptual framework

2.1 Formation for research competence

Over the years the educational field has tried to adapt to the needs of society. Consequently, universities have oriented their paradigms to the changes in society, going from medieval universities based on the agricultural society, to modern universities based on the industrial society, to the current universities based on the knowledge society [3]. The knowledge-based society bases its development on information and the creation of knowledge, in which knowledge reflects structural aspects, and information reflects communication aspects [4]. Universities integrate education for research as a means to promote the creation of knowledge, since it is considered a fundamental component of the cognitive structure of modern society [5], which seeks to train professionals to build useful knowledge in a society that demands new answers to social, political and economic questions [6]. Therefore, universities have the responsibility to establish the bases of research to form seedbeds that in the future can become researchers that have a positive impact on society.

In this scenario, higher level institutions aim to link research to their training processes through educational innovation. Educational innovation is a new value proposition that implies changes and improvements for educational environments [7, 8]. Among these proposals we can identify in the universities: a) research-led teaching, b) research-tutored teaching, c) research-oriented teaching, and d) research-based teaching [9]. In research-led teaching, students know and learn according to current research in the discipline. Research-tutored teaching promotes that students learn about the processes and results of research, through critical discussion of scientific documents, with the aim of understanding existing work, and then write their own. In research-oriented teaching, students participate in ongoing research to acquire methodological skills. Finally, through research-based teaching, students put into practice their research competence by developing their own projects [10]. Studies have identified that students benefit from these initiatives by acquiring a better understanding of their discipline and feeling more motivated to participate in research activities [11]. The type of strategies employed by the teacher is mainly according to the degree of linkage between research and the educational process.

Each university integrates and analyzes the development of research competence in its students from various approaches. However, the training processes must include methodological-reflexive, motivational and communicative components [1]. With respect to the communicative components, the dissemination of research is identified mainly by the universities as a key factor in research competence, which is given through academic production in written and oral form [12]. On the other hand, from the dissemination of research, specifically in the published literature, problems have been detected in research methodology, highlighting the need to strengthen methodological competencies in educational processes. Finally, with respect to the motivational components, there are studies that demonstrate that there is a significant relationship between student motivation and the development of research competence [14] [15]. In spite of the importance of research methodology and students' motivational factors, the analysis of the development of research competencies in students tends to focus on communicative aspects through the evaluation of scientific production.

2.2 Research culture

The research culture can be analyzed from two perspectives: the institutional research culture, and the personal research culture. The institutional research culture is the culture of research support in which the institution contributes with incentives to promote its development [16], with strategies such as multidisciplinary collaboration for training and research [17]; while the personal research culture considers the meaning that the student or teacher gives to the research in an implicit and explicit way [18], through the set of values, beliefs and practices [19]. Analyzing the personal research culture allows us to integrate the value that the student attributes to research, with a view to promoting its professional practice.

The strengthening of the research culture in students is a key factor that contributes to the consolidation of a future researcher. The effectiveness of education, in terms of research, depends on the intention of students to use their research competences in their future professional practice [20], therefore, students' attitudes towards research should be

considered to guide the design of formative strategies. In some universities the research culture is based on scientific production, through the pressure of publishing high-level academic documents [21], distorting the true meaning of research, with respect to the creation of knowledge for the benefit of society [22][23]. Students are apathetic to participate in research because the true value of research isn´t recognized, since in most cases it remains only on paper and benefits only the researcher. The development of research competence should be based on the value of creating new knowledge for the benefit of society.

Based on these findings in the literature, the following are the conceptual definitions that support the content of the instrument to assess the culture of personal research in the framework of an educational process at the undergraduate level:

- Values and attitudes toward research: This are the importance attributed to research according to the usefulness or satisfaction of some need [25], the disposition toward its development [26], and the evaluation of the effectiveness of developing research [27].
- Research knowledge: This refers to what the subject knows or believes to know about the research [2] with a focus on research methodology according to its three approaches: mixed, qualitative, and quantitative [28].
- Research practices at the university: This measures the pedagogical strategies used that offer students the opportunity to develop their research competencies [6] according to the following categories research-led teaching, research-tutored teaching, research-oriented teaching y research-based teaching [29] [30].

2.3 Measuring instruments for research culture and research competences

In the literature, the study of research culture is analyzed from various approaches. Among the studies that address the issue of research culture, those that base research culture on scientific production predominate, for example, the article *Analysis of research culture and scientific production in a national university* considers research culture as a pillar for scientific production [31]; the article *Exploring the Research Culture in an Educational Faculty in Malaysia* analyzes research culture in the framework of scientific production, as a key indicator for accountability regarding university performance [32]; and the article *Research Productivity in Top-Ranked Schools in Psychology and Social Work: Does Having a Research Culture Matter?* analyzes scientific production in universities and its relationship with the research culture [33].

On the other hand, there are other studies that analyze the influence of the institutional culture in fostering research development [16, 34], the training strategies to promote the research culture in students [35], and with respect to the benefits obtained from the research culture in a disciplinary area [36]. These studies on the analysis of the research culture have provided interesting data, opening the possibility of a study that seeks to analyze the research culture from the value attributed by the teacher or student in a training process.

Given the emerging study of research formation and specifically through the research culture approach, there are scarce quantitative instruments that approach its study. In this regard, Table 1 shows the instruments that contributed as a preamble to the design of the Res-Cul instrument. With respect to the study of research culture, the Research capacity and culture (RCC) tool [37] offers an analysis of the research culture in relation to research capacity at various levels: individual, team, and organizational; and the Questionnaire about roles of research in teaching, identifies the research culture of teachers with respect to beliefs and perceptions of the role of research in university teaching [38]. On the other hand, the culture of research is analyzed from the perspective of attitudes toward research in university students in the Questionnaire: Attitude toward research in university students [39] and the Instrument to evaluate the attitude toward formative research in students [40]. Finally, the instruments Adaptation of the F-Komp questionnaire [41] and R-Comp [9] offer an approach to the research culture from knowledge and practices to research.

Table 1. Instruments of research culture

Reference	Instrument	Type of instrument	Dimensions
[37]	Research capacity and culture (RCC).	Likert Scale.	-Research capacity at individual level. -Research capacity at team level. -Research capacity at organizational level.
[38]	Questionnaire about roles of research in teaching.	Likert Scale.	-Creative disposition. -Critical disposition. - Students' research interests. - Research skills. - Reflection on the research. - Current research in the

			field. - Students as participants.
[39]	Questionnaire: Attitude towards research in university students.	Likert Scale.	- Research skills. - Positive appreciation. - Obstacles to research. - Negative appreciation.
[40]	Instrument to evaluate the attitude towards formative research in students.	Likert Scale.	- Cognitive. - Affective. - Behavioral.
[41]	Adaptation of the F-Komp questionnaire.		- Knowledge of the content. - Methodological skills. - Evaluation and implementation of research. - Ethical issues.
[9]	R-Comp.		- Competencies in reviewing the status of the research. -Methodological skills. - Competences in reflecting on the results of the research. - Communication skills. - Competences of knowledge of the content.

2.4 Instrument to validate

According to the literature review on the concepts and instruments mentioned above, the instrument Valuation of the Research Culture in Formative Processes at Undergraduate Level (Res-Cul) was designed, which has three dimensions and a total of 33 items. The objective of the instrument is to collect information about the research culture of teachers and students involved in a learning process at a higher level. The first dimension is composed of 9 items associated with values and attitudes towards research that measure the importance that the individual gives to research, the attitude towards research, and the attributes that the individual possesses to develop research; the second consists of 12 items about knowledge about research development from a methodological approach: quantitative, qualitative, and mixed; and the third dimension has 13 items related to research training from the strategies of research-led teaching, research-tutored teaching, research-oriented teaching, and research-based teaching. Res-Cul is a Likert-type questionnaire with 4 levels, 4: Strongly agree, 3: Agree, 2: Slightly agree, 1: Disagree. Table 2 presents the dimensions of the instrument and the associated items.

Table 2. Instrument's items

#	Items
	Values and attitudes towards research
1	I recognize that research is a vehicle for the sustainable development of a country that must be promoted through education.
2	I consider that research is not useful to me because it has no relation to my educational practice.
3	All professionals should know how to do research.
4	I like to train myself to develop research skills.
5	I dislike carrying out activities related to research.
6	I often find myself consulting scientific publications.
7	I feel that I have the necessary knowledge to develop a research project.
8	If I had more time, I would like to publish more scientific articles.
9	I consider that my economic resources limit my research development.
	Knowledge of research development
10	The objective of qualitative research is to achieve a holistic view of the phenomenon or situation to be studied.
11	I understand the difference between qualitative approaches: grounded theory and ethnography.
12	I know how to analyze qualitative data through category designation.
13	I have used qualitative research for the development of some research.
14	The objective of quantitative research is to achieve a generalizable explanatory theory.
15	I understand the difference between differential statistics and descriptive statistics.
16	I know how to perform a descriptive statistical analysis through software.
17	I have used the quantitative methodology for the development of some research.
18	Mixed research combines qualitative and quantitative research to understand a phenomenon.
19	I understand the difference between a sequential mixed design and a concurrent mixed design.
20	I know how to perform an inferential statistical analysis using a software.

21	I have used the mixed methodology for the development of some research.
	Formation for research
22	I use specialized databases to search for scientific publications on a topic of study.
23	I consider that the topics to be studied can be updated from recent empirical research.
24	When investigating a topic of study, I discard articles that have been published more than 10 years ago.
25	To perform essays related to a topic I investigate and analyze scientific texts.
26	I am able to critically analyze the content of a research article.
27	I can easily identify the structure of scientific publications.
28	I participate in the research of others because I want to learn about research methodology.
29	I do not feel prepared to develop my own research project, so I participate in group projects.
30	I participate in ongoing research projects to familiarize myself with the procedure.
31	I write about research I have done.
32	I have the capacity to develop personal research projects.
33	I find it easy to ask specific research questions.

3 Method

Validating the Res-Cul instrument means demonstrating that the instrument measures what it claims to measure. In addition to the conceptual framework supporting the design of the instrument, it is necessary to have empirical evidence to confirm the validity of the measurements [42]. Therefore, among the tests of validity of an instrument, content validation was selected, which analyzes the relevance of the instrument's content with respect to the construct to be measured [43]. The method used was expert judgment, which implies that a group of experts in the field evaluate the content of the instrument [44]. The validation was carried out using the Expert Judgment Template [45], which analyzed the criteria of clarity, coherence, relevance and sufficiency of the items with a quantitative connotation, in addition to considering the qualitative observations made on some items for potential improvement.

Subsequently, the reliability of the results obtained was analyzed according to Kendall's W concordance coefficient. This coefficient measures the degree of association between the results provided by the judges, a high value of W informs that the experts are applying the same standards in assigning each value [46]. This indicator was selected because the results were collected through an ordinal scale [42].

3.1 Participants

The quality of the content validation is determined by the characteristics of the experts who made up the group. Therefore, the selection of the experts was given according to the academic background of the experts: master or doctorate and their minimum experience of 5 years in: communication, education, research methodology, humanities or in educational evaluation. It is recommended that the group of experts be composed of a minimum of 5 experts [45], so that the 9 experts who participated were considered enough to issue the conclusions.

3.2 Instruments

The instrument used to develop the content validation procedure was the Expert Judgment Template [45], which establishes for each category: clarity, coherence, relevance and sufficiency 4 values, 1: Not fulfilling the criterion, 2: Low level, 3: Moderate level and 4: High level. Figure 1 shows the rubric with each of the categories and the indicators to designate each level.

Criteria	1. Not fulfilling the criterion	2. Low level	3. Moderate level	4. High level
Clarity The item is easily understood, i.e. its syntax and semantics are adequate.	The item is not clear.	The item requires significant modification or a very large modification in the use of words according to their meaning or by their arrangement.	A very specific modification of some of the items in the reagent is required.	The item is clear, has semantics and adequate syntax.
Coherence The item is logically related to the dimension or indicator you are measuring.	The item is not logically related to the dimension.	The item has a tangential relationship with the dimension.	The item has a moderate relationship with the dimension you are measuring.	The item is completely related to the dimension you are measuring.
Relevance The item is essential or important, i.e. it must be included.	The item can be removed without affecting the measurement of the dimension.	The item has some relevance, but another item may be including its measurement.	The item is relatively important.	The item is very relevant and should be included.
Sufficiency Items belonging to the same dimension are sufficient to obtain the measurement of this dimension.	The items are not sufficient to measure the dimension.	The items measure some aspect of the dimension, but don't correspond to the total dimension.	Some items must be increased in order to fully evaluate the dimension.	The items are sufficient.

Figure 1: Content validation rubric

3.3 Procedure

The procedure to carry out the data collection was through an online questionnaire. An invitation was made by email where 9 experts evaluated the questionnaire, its trajectory is reflected in Table 3. The judges assigned a value according to the clarity, coherence, relevance and sufficiency of the items in the instrument and issued observations if they considered it necessary.

Table 3. Expert's trajectory

Expert	*Discipline*	*Institution*	*Experience*
1	Educational Innovation.	Tecnologico de Monterrey, Mexico.	5 years.

2	Communication.	Rey Juan Carlos University, Spain.	14 years.
3	Humanities, Ethics and Gender Studies.	Tecnologico de Monterrey, Mexico	14 years.
4	Strategy and Education.	Tecnologico Nacional de México.	28 years.
5	Educational Technology.	Universidad Veracruzana, Mexico.	20 years.
6	Strategic management	Tecnologico de Monterrey, Mexico	10 years.
7	Teacher Training	University of Cantabria, Spain.	21 years.
8	Educational technology	Tecnologico de Monterrey, Mexico	10 years.
9	Educational innovation, research methodology, educational evaluation	Freelance	42 years.

The results analysis process was carried out through descriptive statistics to obtain information about the main characteristics of the dimensions analyzed. The mean of the answers of all the judges for each one of the items was obtained with the following weighting: clarity 20%, coherence 30% and relevance 50% [47]. In addition, the standard deviation was calculated to know the dispersion of the responses with respect to each reagent.

Finally, to validate the reliability of the results obtained, Kendall's Concordance Coefficient W was calculated through SPSS software, which provided the significance level and the value of W. When the significance level is lower than 0.05 it is concluded that there is significant agreement between the values assigned by the judges, and when W approaches 1 it means greater strength of the agreement [45].

4 Results

As mentioned above, the data collected were analyzed using descriptive statistics to identify the main characteristics of each dimension with respect to their mean and standard deviation. Table 4 shows the summarized results according to the weighted average (clarity 20%, consistency 30% and relevance 50%) of the values assigned by the experts to each reagent, together with the sufficiency by each dimension and the dispersion of these results (standard deviation).

Dimension	Item	Mean	Standard deviation	Dimension	Item	Mean	Standard deviation
Values and attitudes toward research	1	3.66	0.53	Research practices at the university	22	3.52	0.96
	2	3.36	1.04		23	3.24	1.18
	3	3.37	0.89		24	3.30	1.02
	4	3.78	0.44		25	2.89	1.45
	5	3.33	1.02		26	2.96	1.42
	6	3.56	0.92		27	2.96	1.42
	7	3.77	0.43		28	2.96	1.42
	8	3.22	1.26		29	3.18	1.24
	9	3.16	1.16		30	3.33	1.16
	Sufficiency	3.22	1.00		31	3.41	1.05
Research knowledge	10	3.14	1.05		32	3.39	1.04
	11	3.57	0.64		33	3.29	1.24
	12	3.31	1.05		Sufficiency	3.12	1.16
	13	3.41	1.01				
	14	3.27	1.06				
	15	3.53	1.01				
	16	3.56	1.01				
	17	3.80	0.42				
	18	3.37	1.09				
	19	3.83	0.39				
	20	3.78	0.44				
	21	3.80	0.42				
	Sufficiency	3.19	0.96				

According to the results shown in the Values and Attitudes towards Research dimension (items 1 to 9), it is observed that the assessment of clarity, coherence, and relevance ranges from 3.16 to 3.78, while sufficiency showed a result of 3.22, with a standard deviation of between 0.44 and 1.26. The Research knowledge dimension (items from 10 to 21), like the previous dimension, is located mainly towards a high level content assessment with a range of 3.14 to 3.83, sufficiency tends towards the moderate, and the deviation is in a range of between 0.39 and 1.09. Finally, the Research Practices at the University dimension tends towards a moderate score with values from 2.89 to 3.52, with a sufficiency of 3.12 and a deviation that goes from 0.96 to 1.45.

With respect to the reliability of the results, the following hypotheses were formulated according to Kendall's W concordance coefficient:

H0: The average ranges assigned by the 9 experts are independent, not consistent.
H1: There is significant concordance between the average ranges assigned by the 9 experts.

Table 5 shows the results of the W Kendall concordance coefficient obtained through the SPSS program. According to these results, the H0 hypothesis is rejected since the significance level was less than 0.05.

Tabla 5. Kendall's Coefficient of Concordance

Indicator	*SPSS result*
Kendall´s W	.162
Asymp. Sig	.047

5 Discussion

Since the experts' judgment was made with the objective of consolidating the validity of the instrument, it was chosen as a quality criterion that the items should be greater than 3 with a standard deviation of less than 1.5. Based on these criteria, the analysis was carried out which allowed us to arrive at the following findings based on the conceptual framework of this study.

Information about individual values and attitudes is assessed positively in the analysis of the research culture. The results of Table 4 show that the dimension values and attitudes towards research is valued at a high level since all its items have a weighted average above 3 with a standard deviation of less than 1.26. These results are consistent with the studies analyzed, which show that there is a significant relationship between student motivation and the development of research competence [14, 15], and that attitudes toward research are part of the process of consolidating a research culture [2]. Among the experts, the importance of considering the meaning that the individual denotes to research in order to design formative strategies that consolidate that value towards the creation and application of knowledge for the benefit of society is recognized.

The participant's appreciation of the research methodology knowledge is valued by experts as a high level content to measure the research culture. The results of Table 4 show that the averages of the reagents for the Research knowledge dimension had a high score with a maximum value of 3.83 and a standard deviation lower than 1.10. The need to strengthen the research methodology in the training processes is evidenced in the published literature [13]. Therefore, through the empirical evidence it is inferred that it is necessary for the individual through this instrument to reflect on the importance of adequate methodology to develop research.

The teaching-research linkage is moderately valued by experts in the analysis of the research culture in a formative process. As shown in Table 4, the dimension of Research practices at the university shows that some of its items obtained the lowest score, with 2.89 and 2.96, mainly in the indicator that analyzes the training strategies with respect to research-tutored teaching. This type of teaching promotes the critical analysis of scientific documents to identify research processes and results with the aim of understanding their structure [10]. Therefore, it can be inferred that research-tutored teaching is little valued as a training process for the development of research competence, since knowledge is not put into practice, but remains at the level of analysis.

The content of the items that made up each dimension is adequate. According to Table 4, the criterion of sufficiency for each dimension analyzed was higher than 3. Therefore, it is necessary to analyze the relevance of including more items with respect to the extent of the instrument.

The Res-Cul instrument is useful for assessing the research culture within the framework of a higher level formative process. According to the results of Kendall's W concordance coefficient shown in Table 5, it is observed that the significance level is less than 0.05, so it is deduced that there is a significant association between the results provided by the judges, with a concordance strength of 0.162 in relation to the use of the same standards contemplated by the experts to assign each value [46]. Therefore, it is demonstrated that the data obtained from the validation of the Res-Cul instrument are reliable

6 Conclusion

In conclusion, this research shows that the content of the items that conform the Res-Cul instrument was validated by the experts with a score that tends to high, so it is corroborated that the items measure the research culture in the framework of a higher education formative process. In addition, it was demonstrated that there is a significant concordance between the experts' valuations, which gives solidity to the validation carried out.

However, areas of opportunity were detected, especially with respect to the Research Practices at the University dimension, in addition to the criterion of sufficiency, which implies the inclusion of items to strengthen the content of each dimension. Res-Cul is an instrument that is in the process of experimentation, so the result of this validation will be subjected to the improvements identified and will continue in the process of validation through other strategies such as piloting with potential users.

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