

<https://doi.org/10.23913/ride.v14i28.1766>

Scientific articles

Evaluación de proyectos académicos de investigación en el bachillerato: desarrollo de una rúbrica integral

***Evaluation of Academic Research Projects in the Baccalaureate: Development of
a Comprehensive Rubric***

***Avaliação de projetos de pesquisa acadêmica no ensino médio: desenvolvimento
de uma rubrica abrangente***

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Resumen

Los proyectos académicos desempeñan un papel crucial en el bachillerato porque proporcionan a los estudiantes conocimientos para interpretar, discutir y presentar resultados, así como para fortalecer sus habilidades, destrezas y actitudes para diseñar, desarrollar e implementar investigaciones científicas. Con este objetivo en mente, se diseñó y validó una rúbrica, basada en instrumentos existentes, para evaluar proyectos académicos. Los expertos que revisaron y mejoraron la rúbrica realizaron sugerencias que demuestran que la mayoría de los ítems cuentan con valores de V de Aiken superiores a 0.80, por lo que se modificaron dos ítems que no alcanzaron el valor óptimo en cuanto a su pertinencia y redacción. Durante la aplicación de la prueba a

estudiantes y profesores, se obtuvo coeficientes de confiabilidad alfa de Cronbach de 0.934 y de 0.927, respectivamente. En conclusión, los elementos que conforman la rúbrica son pertinentes para su utilización en la evaluación de proyectos de investigación. Su desarrollo y validación garantizan una herramienta eficaz para medir y evaluar el desempeño de los estudiantes en el ámbito académico del bachillerato.

Palabras clave: competencias, educación, evaluación, socioformación.

Abstract

Academic projects play a crucial role in high school by providing students with the knowledge to interpret, discuss, and present results, as well as strengthening their abilities, skills, and attitudes to design, develop, and implement scientific investigations. With this objective in mind, a rubric was designed and validated to evaluate academic projects, based on existing instruments. The experts who reviewed and improved the rubric made suggestions that showed that most of the items had Aiken's V values greater than 0.80, improving two items that did not reach the optimal value in terms of their relevance and writing. During the application of the test to students and professors, Cronbach's Alpha reliability coefficients of 0.934 and 0.927 were obtained, respectively. In conclusion, the elements that make up this rubric are relevant for its use in the evaluation of research projects. Its development and validation guarantee an effective tool to measure and evaluate the performance of students in the academic field of the baccalaureate.

Keywords: competences, education, evaluation, socioformation.

Resumo

Os projetos acadêmicos desempenham um papel crucial no ensino médio porque proporcionam aos alunos conhecimentos para interpretar, discutir e apresentar resultados, bem como fortalecer suas habilidades, habilidades e atitudes para projetar, desenvolver e implementar investigações científicas. Com este objetivo em mente, foi desenhada e validada uma rubrica, com base em instrumentos existentes, para avaliar projetos acadêmicos. Os especialistas que revisaram e aprimoraram a rubrica fizeram sugestões que demonstram que a maioria dos itens possui valores de Aiken V superiores a 0,80, portanto foram modificados dois itens que não atingiram o valor ideal em termos de relevância e redação. Durante a aplicação do teste aos alunos e professores, foram obtidos coeficientes de confiabilidade alfa de Cronbach de 0,934 e 0,927, respectivamente. Conclui-se que os elementos que compõem a rubrica são relevantes para a sua utilização na

avaliação de projetos de pesquisa. Seu desenvolvimento e validação garantem uma ferramenta eficaz para medir e avaliar o desempenho dos alunos na área acadêmica do ensino médio.

Palavras-chave: competências, educação, avaliação, socioformação.

Fecha Recepción: Julio 2023

Fecha Aceptación: Diciembre 2023

Introduction

The General Directorate of the Baccalaureate of the Ministry of Public Education (SEP) (2013) established in the 2009-2010 school year the principles of the Comprehensive Reform of Higher Secondary Education (RIEMS), for which it considered the subject Methodology of the Research as an axis for the construction of interdisciplinary work. Later, in 2017, four transversal axes were determined for the same subject: social, environmental, health and reading skills, which are applied throughout high school.

The Research Methodology subject aims to develop basic generic and disciplinary competencies in social sciences in students by promoting interdisciplinary and transdisciplinary reflection, analysis and interpretation of historical processes and local problems (SEP, 2017), although it is also related with all disciplinary fields due to its holistic approach. According to the learning evaluation guidelines of the Educational Reform (SEP, 2017), research must be developed as a process in which students critically understand what is happening in their social context and act to transform it. In other words, they must be aware of what they want to investigate and how to conduct the investigation.

In this context, the academic research project emerges as a document that, according to Barber (2008), reflects a creative and organized process, which represents a way of planning and systematizing research. The document emphasizes the need for students to have a well-structured plan based on a study topic that complies with organization and structure protocols, as well as execution guidelines. Therefore, in high school, students must apply research to achieve meaningful learning as a tool for learning how to learn, as well as present an orderly and methodical approach to addressing a research problem.

The research project is a documentary expression of the research process, which—according to Barber (2008)—is defined as the opportunity to share ideas about a problem and use it as a starting point to explore the chosen topic, evaluating its relevance, scope, importance and the resources necessary for its development. Academic research projects must present contextual issues to students so that they can identify areas of research and uncertainty. From there, the search for new knowledge should be encouraged to facilitate autonomous learning.

In high school, therefore, students should be encouraged to build new knowledge on their own so that they discover their own abilities and skills to select a topic, collect information, evaluate their progress and detect areas for improvement. In this way, the teacher becomes a facilitator and motivator who provides research techniques to improve learning.

Ferres *et al.* (2015) highlight the challenge of using research to develop inquiry and problem-solving skills in students within an academic context. They also address the issue of reliable project evaluation and the need for formative evaluation. These are problems that teachers face when evaluating research projects using rubrics (López *et al.* , 2016).

In this sense, some instruments have been identified for the evaluation of academic projects in high school. Among the most relevant is the rubric “Practical Test Assessment Inventory” (NPTAI) proposed by the baccalaureate system of the University of Catalonia (Ferrés *et al.* , 2015). This instrument aims to evaluate skills related to understanding based on inquiry competencies (NCI), which allows students to be placed in five intervals: 1) inquirer, 2) insecure inquirer, 3) incipient inquirer, 4) pre-scientific and 5) unscientific. The rubric focuses on seven categories of inquiry: 1) problem identification or question formulation, 2) hypothesis formulation, 3) variable identification, 4) research planning, 5) data collection and processing, 6) analysis of data and obtaining reasoned conclusions, and 7) meta reflection. However, this instrument does not specifically address academic research projects in high school.

On the other hand, Cortés *et al.* (2015) propose a rubric to evaluate written works that, although it focuses on essays and papers, includes fundamental elements for the development of research projects. However, their proposal does not establish specific criteria to evaluate students' achievement levels, which generates a lack of objectivity. The rubric evaluates five aspects: a) structure, b) content, c) organization, d) writing and spelling, and e) presentation, assigning scores of 10, 30, 30, 20 and 10 points, respectively.

Another contribution is from Sáiz Manzanares and Bol Arreba (2014), who developed a rubric based on Bloom's taxonomy to measure levels of performance from insufficient (level 1) to excellent (level 4). On the other hand, Raposo and Martínez (2014) carried out a quasi-experimental study to investigate the differences in educational evaluation by including feedback as a guide to evaluate products, considering the research project as a final work with the aim of improving the teaching process. learning. They applied a rubric to measure performance levels, for which they considered 0 as insufficient and a maximum of 5 as excellent; In addition, they took into account the characteristics of the student's context to measure performance achievements. However, its rubric lacks validity and reliability studies for its application in high school.

The rubric developed by Llanos and Luna (2017) to evaluate research skills in the Nursing Baccalaureate of the National University of Trujillo considers the following aspects: 1) title, 2) introduction, 3) objectives, 4) literature review, 5) methodology, 6) results and 7) discussion. These aspects are evaluated at four levels: insufficient, basic, intermediate and advanced. However, this rubric is specific to the field of nursing and addresses all relevant aspects of academic research in general.

In Mexico, the closest contributions to evaluating academic projects were identified: Corral (2020) proposes an analytical essay evaluation; Ortega *et al.* (2014) focus on higher-level research projects; Kral (2013) presents an evaluation for thesis research projects and the Autonomous University of the State of Hidalgo (UAEH) (2019) addresses the evaluation of documentary research.

It is relevant to mention that the sources consulted on the implementation of rubrics in high school focus more on the importance and development of rubrics in general than on proposals validated specifically for high school. Furthermore, some of the sources found lack the necessary support as they are not supported by educational institutions, authors or educational approaches.

Therefore, the need arises to propose a tool that allows the evaluation of the development of competencies in high school students (Verano *et al.* , 2016) through the design of “Rubrics to evaluate academic research projects.” This will be a relevant and practical instrument to evaluate the projects prepared by high school students.

Established goals

- Design an instrument that allows evaluating academic research projects prepared by high school students in the Research Methodology subject, in accordance with the socio-formative approach contemplated in the educational reform.
- Validate the content of the rubric through the judgment of experts, who will determine the relevance and wording of each item considering the 5 levels of the socio-formative taxonomy.
- Analyze the validity and reliability of the instrument by applying Aikeen's V.

Thus, the evaluation of academic research projects in high school is a challenge that requires valid and reliable instruments. Although some rubrics and evaluation criteria have been proposed, more research is needed to develop appropriate instruments that comprehensively evaluate students' research competencies and skills. Furthermore, it is important to consider feedback as part

of the assessment process to improve learning and the development of research skills in high school.

Methodology

An instrumental study was carried out that encompasses all studies related to the development of tests and devices, including their design, adaptation and analysis of their psychometric properties (Prieto and Delgado , 2010), based on the classification proposed by Montero and León (2005). To analyze the face validity and reliability of the instrument, the following stages were followed: 1) design of the instrument, 2) review by experts, 3) application of the test to a pilot group, and 4) expert judgment to make improvements to the instrument. instrument and begin the reliability analysis.

The design of the instrument was carried out using an analytical rubric, following the proposal of Tobón *et al.* (2010) from the socio-formative approach. The adoption of this approach is based on its ability to integrate the guiding principles of educational transformation, involving students and teachers. The rubric was designed with the purpose of evaluating the products of the project, using indicators to measure levels of mastery and determine the achievement of competencies in students.

Bartholomew *et al.* (2014) and Cano (2015) maintain that rubrics favor a systematized evaluation and contribute to a better understanding of the learning process, through self-assessment and peer evaluation, common practices in higher secondary education that involve the active participation of students. students in the objective measurement of performance and encourage continuous improvement.

The rubric consists of 12 items that evaluated the following aspects: documentary record, cover, introduction, theoretical framework, project phases, resources, results, conclusions, sources, annexes and APA standards. In addition, five levels of performance are considered: preformal, receptive, decisive, autonomous and strategic, which represented levels of mastery from *very low* to *very high* . Like Escobar and Cuervo (2008), three experts participate in reviewing the coherence, wording, and relevance of each item, and observations are considered to improve the instrument.

To characterize the participants, the Sociodemographic Factors Questionnaire (CIFE) (2015) was used. The test was applied to a pilot group made up of 7 students and 6 teachers from Ciudad Azteca High School. The students had developed academic research projects in the subject

of Research Methodology during the first semester, while some professors have experience in research at the undergraduate level.

To characterize students and teachers, the CIFE (2015) sociodemographic factors questionnaire was used. Content validity was evaluated through the participation of 10 expert judges in review, design and/or validation of research instruments. The Aiken V relevance index (Penfield and Giacobbi, 2004) was applied to determine if the magnitude of the coefficient was greater than the minimum acceptable threshold to conclude about the content validity of the items. The role of the experts was to provide suggestions to improve the instrument, which are presented in Table 1, mainly in relation to the wording of the items.

Table 1. The 12-item analytical rubric with a socio-formative focus

Judge	Item	Suggestion	Item/descriptor improvements
1 and 8	1	The documentary record is an instrument to systematize the information that is reviewed. The descriptors would have to refer clearly to the type of documents reviewed, to the number of sources considered as a minimum, to the classification of sources according to different criteria: type of document, year of publication, language in which it is written, geographic location of origin. , etc. I suggest directing the question towards the importance of conducting documentary research	<i>Preformal level</i> : The documentary record on board some sources without considering their validity <i>Resolution level</i> : The onboard documentary record includes textual and non-textual citations of articles considering the technical data <i>Autonomous level</i> : The documentary record presents a minimum of 5 textual citations from validated sources considering technical data. <i>Strategic level</i> : The documentary record links state-of-the-art textual quotes from 10 sources considering a database of the last 5 years
8 and 10	2	I suggest that the question be directed towards the preparation of the cover page based on what is established in APA standards. It confuses the cover aspect. What is the relationship of the cover to the research and the course itself?	<i>Preformal level</i> : The cover indicates only the research topic <i>Receptive level</i> : The cover identifies the title of the topic and the author of the research <i>Resolution level</i> : The cover complies with the title, authors and data of the institution. <i>Autonomous level</i> : The cover integrates title, authors, email and institutional data <i>Strategic level</i> : The cover complies 100% with institutional characteristics and in accordance with APA ^{6th edition} standards .

1 and 10	3	Probably the verb should not be 'identify', but 'expose', since the self-assessment would have to be about the introduction that the researcher has written. The introduction also says what the text presents	<i>Receptive level</i> : The introduction defines a social research problem in a simple way and without theoretical foundation. <i>Resolution level</i> : The introduction includes the background, problems, objectives and justification of a social problem in a general way with environmental situations.
1 and 8	4	The wording of the descriptors must respond to a gradation that goes beyond the simple use of any of the verbs of the socio-formative taxonomy. There needs to be consistency in the criteria used to assess the dimension. For the theoretical framework, the structure, conceptual, historical, normative components, etc., related concepts and other elements should be considered. Item 4 I suggest changing the word “in what way” to “what aspects does it consider...”	<i>Preformal level</i> : In the theoretical framework it is observed that the information is about the topic without considering the problem of context <i>Resolution level</i> : In the theoretical framework, it uses information considering a problem in the community context. <i>Autonomous level</i> : The theoretical framework considers sources of validity according to the documentary record, considering a social problem of the context. <i>Strategic level</i> : In the theoretical framework it links the information from the documentary record considering validated sources according to the context problem investigated.
1	5	Like the previous items, it is necessary to clarify what the dimension that is intended to be evaluated consists of and in this case also the evidence to which the instrument is applied. If the evidence is the document in which a project is presented, the descriptors would have to express the characteristics that the text presents, not the actions of the researcher such as 'I list', 'I explain', 'I carry out'	Project phases 5.- To what degree do you link the phases of the methodological project from the delimitation of the topic, problem statement, hypothesis, objectives, theoretical framework, justification, analysis of results, conclusions, sources, annexes and glossary? <i>Preformal level</i> : The methodology lists only the phases of the research without considering their connection and order. <i>Receptive level</i> : The methodology organizes the information and relates the phases of the research in a general way <i>Resolution level</i> : The research process complies with the linking of the project phases considering the proposed research methodology. <i>Autonomous level</i> : The research process explains how the phases of the project are linked, correctly relating the research and relating them as part of the research design.

			<i>Strategic level</i> : In the research, I link the phases of the project and clearly present how they relate to each other as part of the research design .
1	6	It is necessary to specify the evidence that is intended to be evaluated.	Resources 6.- To what degree do you rely on resource management to prepare the project? <i>Receptive level</i> : The research project simply defines only the resources for the development of the research project. <i>Resolution level</i> : The research project describes a work schedule considering the equipment and resources necessary for the development of the research project.
1	7	A research project does not contain results, since it is only a presentation of the process that will be carried out.	<i>Resolution level</i> : Explains the quantitative and qualitative results and relates them in a general way without considering the context in which they are developed. <i>Autonomous level</i> : Explains the quantitative and qualitative results, analyzing the relationship between them in a reflective manner about the problems faced in their social context. <i>Strategic level</i> : Link quantitative and qualitative results to develop a work proposal that promotes the solution of the problem within the social context addressed.
1	8	A research project cannot offer conclusions in the terms expressed in the descriptors.	<i>Preformal level</i> : Lists the information obtained without considering the research process carried out <i>Receptive level</i> : The conclusions describe a problem that is outside the research context addressed. <i>Resolution level</i> : The conclusions present a proposal that allows generating solutions to the problem within the context addressed. <i>Autonomous level</i> : The conclusions reflexively explain the problems faced in the social context analyzed.
1 and 3	9	Review the congruence of the descriptors, especially the use of verbs. In the very high level option, consider 100% APA 6a format. edition	Sources 9.- How do you format the sources for preparing references for a research project? <i>Preformal level</i> : Indicates source references without considering the format for APA style references ^{6th} edition

			<p><i>Responsive level</i> : I organize source references in a format other than APA 6th edition standards</p> <p><i>Autonomous level</i>: Formulates the references of the sources according to the format of the APA standards</p> <p><i>Strategic level</i> : Structure source references using the APA 6th edition format correctly.</p>
1 and 3	10	Check the congruence of descriptors, especially verbs Very high level response option, wording: "to the results" and consider APA standards 100%	<p><i>Preformal level</i> : Presents the annexes without establishing a relationship with the research data .</p> <p><i>Receptive level</i> : Cite the annexes without considering the order of the Information and coherence of the research results considering another standard different from the APA 6th edition</p>
1 and 6	eleven	Check the congruence of the descriptors, especially with regard to verbs Maybe I would take it for granted understanding the academic level of the participants.	<p>Writing and spelling</p> <p>11.- How do you present the project, taking care of the writing and spelling standards?</p> <p><i>Preformal level</i> : Presents redundant writing, without considering spelling rules</p> <p><i>Receptive level</i> : Records information in clear writing, without considering spelling.</p> <p><i>Resolution level</i> : Respect the structure and coherence in each paragraph, respecting basic writing and spelling.</p> <p><i>Autonomous level</i>: Explains the information coherently, considering relevant wording and respecting spelling rules.</p> <p><i>Strategic level</i> : Project coherent and relevant writing using spelling rules that allow understanding of the content</p>
1 and 10	12	Gradation in percentage is sufficient. In this case, as in previous ones, the verbs recommended in the socio-formative taxonomy do not make a substantial contribution to the descriptor. You had already asked about APA standards. Perhaps you can add some writing, coherence or cohesion to the document... or talk about originality (non-plagiarism), etc.	<p><i>Preformal level</i> : Use your own style adapting different reference standards</p> <p><i>Responsive level</i> : I organize the project using standards other than APA standards.</p> <p><i>Resolution level</i> : I respect APA standards according to the cohesion of the document.</p> <p><i>Autonomous level</i>: I develop the project respecting APA standards in style and original writing</p> <p><i>Strategic level</i> : I correctly use APA 6th edition standards when preparing research projects to avoid plagiarism.</p>

Source: self made

Subsequently, a second application of the instrument was carried out to a pilot group composed of 7 students and 6 teachers to evaluate the understanding of the instructions, items and descriptors. These aspects were evaluated using the satisfaction questionnaire with the instrument (CIFE, 2018). To estimate reliability, Cronbach's alpha coefficient was used, according to Cervantes (2005) and Quero (2010). In the case of the group of students, the coefficient was 0.934, while for the teachers it was 0.927.

In this study, an evaluation was carried out with the aim of improving the writing of the instrument, replacing complex terms with simpler ones that were understandable for students and teachers. Likewise, we sought to reorient the dimensions of the instrument towards the academic research project in high school, following the suggestions received. The review carried out by the expert judges was essential to improve the instrument, especially in terms of the relevance and wording of each of the items.

In relation to relevance, improvements were made in the second and ninth items. Item two focused on preparing the cover page in accordance with APA standards, and the levels related to the cover page were defined as part of the research process. In item nine, the description was improved by changing "References" to "Sources" and the correct use of APA 6th edition format was ensured.

In terms of wording, the experts felt that improvements should be made to most items, as shown in the table. For example, in item one reference was made more clearly to the sources consulted. In items three and four, the descriptors and the use of verbs from the socio-formative taxonomy were improved at each of the levels. In item five, "Methodology" was changed to "Project Phases" and the dimension that was intended to be evaluated was classified, so that the descriptors reflected the characteristics of the text. In item six, "Administration" was replaced by "Resources" to specify the evidence that was intended to be evaluated in each of the descriptors. In items seven and eight, the descriptors were improved. In item ten, the congruence of the descriptors is improved. In item eleven, "Attachments" was changed to "Writing and spelling", and the congruence of the descriptors and verbs used was reviewed. In item 12, the percentages for the levels were modified and the wording and handling of verbs in the descriptors were improved.

The content validity of the analytical rubric was evaluated using Aiken's V test. The analysis of the evaluation in terms of relevance and wording made it possible to verify the content validity for the majority of the proposed items and descriptors (Aiken's $V > 0.80$). However, it was observed that item two (Cover) and item nine (References) did not reach adequate values in Aiken's V. In

this sense, the expert judges made the following observations for item two: greater relevance in the relationship of the cover with the research and direct its preparation in accordance with the APA style writing standards. Regarding item nine, it was suggested to review the congruence of the descriptors and the correct use of verbs, in addition to considering the very high level as 100% when using the APA 6th edition format.

After the process of expert review, application of the pilot test and expert judgment, the final version of the instrument called “Rubric for evaluating academic research projects” was presented.

Results

The objective of the study was to develop an evaluation instrument for academic research projects at the high school level (high school). Based on expert review (Table 2), the application of a pilot test and expert judgment (Table 3), an analytical rubric was generated to evaluate (Table 4) the performance of students in research projects.

Table 2. Instruments to evaluate research work in Mexico

Author	Aim	Components
Corral (2020)	Evaluate an analytical essay	1) Structure; 2) problem; 3) analysis; 4) conclusion and 5) spelling.
Ortega, Romero and Guzmán (2014).	Evaluate the development of a research project at a higher level	1) Title and outline of the thematic contents; 2) summary; 3) introduction; d) theoretical framework or reference; 4) statement of the research problem; 5) method; 6) results; 7) discussion and conclusion and 8) references based on APA criteria.
Kral (2013).	Evaluation of the thesis research project	1) Statement of the problem; 2) critical evaluation of the literature (theoretical framework); 3) methodology; 4) results and conclusions and 5) APA writing, style and format.
UAEH (2019)	Documentary research evaluation	1) Structure; 2) data collection; 3) Information; information organization; 4) writing and 5) APA sources.

Source: self made

As previously mentioned, the experts who reviewed the rubric proposed adjustments, showing (Table 3) that the majority of the elements have Aiken V values greater than 0.80. Two elements were modified to improve their relevance and wording. When applying the test to students and teachers, high Cronbach's alpha reliability coefficients were obtained: 0.934 and 0.927, respectively. In summary, the components of the rubric are relevant for evaluating research

projects. Its development and validation ensure an effective tool to measure and assess the academic performance of students at the high school level.

Table 3. Suggestions for improving the instrument from experts

Judge	Expert suggestion by ítems	Observations
1	Item 1 For writing and grammar reasons	Improvements are made regarding the description of the levels to correct valid words and coherence of the writing
	Item 5 Correct grammatical agreement	
	Item 6 Resolve grammatical errors from the question to the answer options	
	Item 7 Resolve various grammatical problems, agreement errors and spelling mistakes	
	Item 8 Correct the word "investigated"	
	Item 9 Correct "How you do it"	
	Item 12 Several questions have already been asked about APA	
2	Item 2 They propose improving the structure of the sentence and the use of punctuation marks.	Improvements are made regarding the description of the levels to correct valid words and coherence of the writing Improvements are made in wording and in the clarity of the item to define In item 9 the descriptors are improved
	Item 4 It was recommended to verify the wording in the way of referring to who applies the form to have greater consistency with the other items.	
	Item 5 Check spelling	
	Item 6 Review in detail the question, as well as the descriptors for the different levels of performance proposed	
	Item 9 This item is difficult for me to evaluate, since on the one hand it refers to the selection of sources or references and the levels mention not their selection but their format in APA 6th edition.	
3	Item 5 It is not clear what the "linkage" of the methodological phases refers to	The improvement is made to the item from the structure, since the project phases item is modified as a methodology, as well as improving the writing.
	Item 6 The wording of the question should be improved	

Source: self made

This involved a comprehensive evaluation that validated knowing how to know, knowing how to do, knowing how to live together, and knowing how to be.

In this sense, the development of rubrics (Table 4) was proposed as a pedagogical innovation that allowed students to measure their performance and improve the way they develop academic research projects.

In Mexican education, there is a need to give greater relevance to research projects at the high school level (high school) and not just focus on theoretical knowledge, but rather promote research practice. Regarding the reliability of the instrument, Cronbach's alpha coefficient was used as a measure of internal consistency.

Table 4. Rubric to evaluate academic research projects

RUBRIC TO EVALUATE ACADEMIC RESEARCH PROJECT					
Aimed at specialists in the evaluation of educational projects and general high school students taking the subject of research methodology.					
Questions (indicators)	Preformal	Receptive	Resolute	Autonomou s	Strategic
	Performance without management of notions or procedures	Mechanical performance with basic notions	Basic performance. The essentials apply.	Performanc e with analysis, criteria and argumentati on	Performance with leadership, connection, interdisciplinaryity and linkage of knowledge
Quality	Very bad	Bad	Acceptable	Well	Excellent
1.- Documentary record	The documentary record addresses some sources without considering their validity	The documenta ry record cites some valid sources without considerin g the technical data	The documentar y record addresses textual and non-textual citations of articles considering the technical data	The documenta ry record presents a minimum of 5 textual citations from validated sources considering technical data.	The documentary record links textual quotes from the state of the art 10 sources considering database of the last 5 years
Weighing:	0 point	0 point	0.5 points	0.75 points	1 points
2. Cover	The cover indicates only the	The cover identifies the title of the topic and the	The cover complies with the title, authors and	The cover includes title, authors, email and	The cover complies 100% with institutional characteristics

	research topic.	author of the research.	data of the Institution	institutional data	and in accordance with APA 6a standards. edition.
Weighing:	0 point	0 point	0.5 points	0.75 points	1 points
3. Introduction includes background, problem, objectives and justification	The introduction addresses a problem outside the context of your community	The introduction defines a social research problem in a simple way and without theoretical foundation .	The introduction includes the background , problems, objectives and justification of a social problem in a general way with environmental situations.	The introduction argues the background , problem, objectives and justification of a problem according to the proposed methodology.	The introduction correctly links all the background, problem, objectives and justification of the contextual social problem according to the proposed methodology.
Weighing	0 point	0 point	0.5 points	0.75 points	1 points
4. Theoretical framework	In the theoretical framework it is observed that the information is about the topic without considering the context problem.	In the theoretical framework, information on the research topic is recorded without considering the contextual problem of its community.	In the theoretical framework it uses information considering a problem of community context.	The theoretical framework Consider sources of validity according to the registry documentary considering a social problem of the context	In the theoretical framework, it links the information from the documentary record considering validated sources according to the context problem investigated.

Weighing:	0 point	0 point	0.5 points	0.75 points	1 points
5. Methodology Change by Project phases	The methodology I list only the phases of the investigation without considering their connection and order.	The methodology organize the information and relate the phases of research in general	The research process complies with the linking of the project phases considering the methodology of the proposed research a.	The research process explains how the phases of the project are linked, correctly relating the research and relating them as part of the research design.	On the research Makes the linking of the project phases and I clearly present how they relate to each other as part of the research design.
Weighing	0 point	0 points	0.5 points	1 points	2 points
6. Administratio n (schedule, team, resources, etc.). Resources	The administrati on of resources for the developme nt of the project only considers the developme nt time.	The research project simply defines only the resources for the developme nt of the research project.	The research project describes a work schedule considering the equipment and resources necessary to carry out the research project.	The research project explains the way in which it manages all the resources for the developme nt of the research project in the order requested.	The research project links all the resources that will be used to develop the project, considering the inputs, equipment and complete work schedule.
Weighing	0 point	0 points	0.5 points	0.75 points	1 points
7. Results	Only quantitative and qualitative	The quantitative and qualitative	Explain the quantitative and	Explains the quantitative and qualitative	I link the quantitative and qualitative results to

	results are listed in a confusing manner	results are described without relating them to each other outside of a real context.	qualitative results and I relate them in a general way without considering the context in which they develop.	results, analyzing the relationship between them in a reflective manner about the problems faced in their social context.	develop a work proposal that promotes the solution of the problem within the social context addressed.
Weighing:	0 point	0 point	0.5 points	0.75 points	1 points
8. Conclusions	Lists the information obtained without considering the research process carried out	The conclusions describe a problem that is outside the research context addressed.	The conclusions present a proposal that allows generating solutions to the problem within the context addressed.	The conclusions reflexively explain the problems faced in the analyzed social context.	The conclusions link together the way in which the solution to the social problem can be promoted within the context in which the research was carried out.
Weighing:	0 point	0 point	0.5 points	0.75 points	1 points
9. References Sources	Indicate source references without considering the format for APA 6a style references. edition	I organize source references in a format other than APA 6a standards. edition	Classify source references according to the format established in APA standards	Formulate source references according to the APA format.	Structure source references using the APA 6a format. editing correctly.

Weighing:	0 point	0 point	0.5 points	0.75 points	1 points
10. Annexes	They present the annexes without establishing a relationship with the research data .	<i>Cite</i> the annexes without considering the order of the Information and coherence of the research results considering a standard other than APA 6a. edition .	Categorize the annexes according to the references with the results and considering APA standards in 60%	<i>Exemplify the results of the research in the annexes, considering the APA 6th standards. Editing at 80%</i>	<i>Link the annexes to the results of the research considering APA 6th standards. 90% edition</i>
Weighing:	0 point	0 point	0 point	0 point	0 point
11. Annexes Writing and spelling	It presents redundant writing, without considering spelling rules	Record the information in clear writing, without considering spelling.	Respect the structure and coherence in each paragraph, respecting basic writing and spelling.	Explains the information coherently, considering relevant wording and respecting spelling rules.	Project coherent and relevant writing using spelling rules that allow understanding of the content
Weighing:	0 point	0 point	0.5 points	0.5 points	0.5 points
12.APA Standards	Use your own style by adapting different reference standards .	I organize the project using standards other than APA standards.	I respect APA standards, respecting the cohesion of the document.	I develop the project respecting APA standards in style and	I correctly use APA 6th standards. Editing in the preparation of research projects to

				original writing.	avoid plagiarism.
Weighing:	0 point	0 point	0.5 points	0.5 points	0.5 points
Assessment		Achievements	Note	Suggestions	
Self appraisal					
Co-evaluation					
Heteroevaluation					

Source: self made

Discussion

It is important to mention that Parra *et al.* (2015) determined the importance of promoting the development of sustainable competencies in students, teachers and managers to solve problems in social contexts and generate alternative solutions through innovation and research projects. In this sense, the rubric is proposed as a tool to clearly establish the conditions that the tasks and scoring standards must meet, which serves to unify the evaluation criteria of the students' work, as Sánchez *et al.* (2016) mentioned it at the time. In addition, we sought to measure the level of performance and competencies achieved by students in the development of academic research projects, which coincides with what was stated by Gatica Lara and Uribarren-Berrueta (2012).

Evaluation is considered essential to obtain evidence about learning (Martínez, 2016). Therefore, the analytical rubric designed in the study allows the students' performance to be assessed comprehensively and to identify the level and way in which they can improve their mastery in different aspects of the research project. Also highlighted is what Gatica Lara and Uribarren-Berrueta (2012) rightly mention about the importance of students themselves carrying out a self-assessment to recognize their strengths and weaknesses and improve their performance.

In this regard, there are similarities with Arenas and Gómez (2013) regarding evaluation, since this should focus on supervising the performance of students against set goals, which would have to be related to problems of the context in which they live to put test knowledge, skills, abilities and values.

On the other hand, experts with experience and track record in the area were selected to ensure the relevance of the instrument and make necessary modifications (Garrote and Del Carmen, 2015), an appropriate strategy to evaluate teaching materials and guarantee the quality of content (Barroso and Cabero , 2013). In this sense, it is established that a value equal to or greater than 0.80 indicates a good degree of internal consistency in the instrument (Ledesma, 2004), so it can be stated that the developed instrument is relevant to evaluate research projects carried out by students. high school and diagnose the level of achievement achieved in the subject of research methodology. However, the importance of reviewing and improving the questions and response options is highlighted to achieve high validity and reliability in the evaluation instruments (Sáiz Manzanares and Bol Arreba , 2014).

Conclusion

The present study allowed the development of an analytical rubric to evaluate academic research projects at the high school level. In addition, an instrument was designed to evaluate academic research projects prepared by high school students in the subject of Research Methodology, in accordance with the socio-formative approach contemplated in the educational reform, which serves to promote sustainable competencies, carry out comprehensive evaluations and provide feedback to students. Likewise, the need to give greater relevance to research projects in high school and the importance of having reliable and valid instruments to evaluate them is highlighted.

Future lines of research

Future lines in the evaluation of academic research projects in high school, with a focus on the development of a comprehensive rubric, can address a series of important areas from the validation and improvement of rubrics. This will facilitate the collection of empirical data on the effectiveness of rubrics in project evaluation and the identification of opportunity areas in which they can be improved.

In addition to this, a new development of personalized rubrics can be investigated that adapt to the specific needs and objectives of each research project. This may involve developing tools and approaches that allow educators to create custom rubrics for their students.

On the other hand, this research allows us to develop and establish indicators to evaluate transversal skills, such as critical thinking, effective communication, problem solving and

creativity, which are increasingly important in current education. Therefore, technology can be included to facilitate the exploration and evaluation of academic research projects in high school and the development of applications or online platforms that allow students to present their projects to evaluators using rubrics more efficiently.

Addressing the evaluation of academic research projects in high school will impact the long-term academic and professional success of students. This, in fact, may include tracking graduates to measure their performance in higher education and in their careers. Therefore, they can be designed inclusively to accommodate different learning styles, abilities, and student backgrounds, which can also promote equity and quality in assessment.

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Table 5. Dimensions and questions of the instrument

Dimensions	Instrument questions
Documentary Record	1. To what degree do you carry out the documentary record to validate the research?
Front page	2. To what degree do you prepare the cover of a research project according to the learning goals of the course?
Introduction	3. To what degree do you identify if the introduction addresses a problem that includes the background, problem, objectives and justification in the development of the project seeking to improve your learning?
Theoretical framework	4. In what way do you develop the theoretical framework for investigating a contextual problem?
Methodology	5. To what degree do you link the phases of the methodological project from the delimitation of the topic, problem statement, hypothesis, objectives, theoretical framework, justification, analysis of results, conclusions, sources, annexes and glossary?
Resources	6. To what degree do you manage the resources for the development of the project?
Results	7. To what degree do you link the quantitative and qualitative results to develop a work proposal that promotes the solution of the social problem within the context in which the research was carried out?
Conclusions	8. To what degree do you draw up the conclusions of a research process?
Sources	9. How do you make the references of the sources are selected for the development of a research project?
Annexes	10. How do you organize the annexes to present results of the research project?
Annexes	11. How do you present the project, taking care of the writing and spelling standards?
APA rules	12. How do you use APA standards to prepare a research project?

Source: self made

Table 6. Sociodemographic data of the experts

Trial 3 experts	
Sex	100% men
Roles	66% teachers 34% managers
Last level of study	PhD: 100%
Areas of professional experience	34% -Educational technology 33% -Environment 33% -Teaching
Number of years of professional experience	66% - 20 34% -15
Number of years of teaching experience	66% - 7 34% -15
Number of articles published in the area	34% -12 33% -19 33% -25
Number of books published in the area	34% -0 33% -3 33% -5
Number of book chapters published in the area	66% - 5 34% -0
Number of papers published in conference proceedings or in proceedings of scientific events	34% -8 33% -10 33% -16
Experience in the review, design and/or validation of a specific research instrument	100% experience

Source: self made

Table 7. Sociodemographic data of the pilot group of students and teachers

Characteristics	Pilot group 7 students	Pilot group 6 teachers
Sex	86% men 14% women	50% men 50% women
Average age in years	15.2	40.83
Residence area	Ecatepec, Edo. from Mexico	100% Ecatepec, Edo. from Mexico
Residential area	100% urban	100% urban
Average years of study	13 years	17% master's degree 67% bachelor's degree 16% technical training
Socioeconomic level	29% good 71% acceptable	18 years

Source: self made

Table 8. Judges' competence data

N Judges 10	Sex	Men Women	40% 60%
	Roles	Teachers Managers	fifty % fifty %
	Last level of study	master's degree Doctorate	40% 60%
	Areas of professional experience	Teaching Organizational processes Quality of higher education and curriculum Training Atmosphere	60% 10% 10% 10% 10%
	Number of years of professional experience	Average	20.1
		Standard deviation	9.64
	Number of years of teaching-research experience (average)	Average	10.2
		Standard deviation	6.33
	Number of articles published in the area	Average	6.4
		Standard deviation	3.9
	Number of books published in the area	Average	0.7
		Standard deviation	1.26
	Number of book chapters published in the area	Average	1.4
		Standard deviation	1.36
	Number of papers published in conference proceedings or in proceedings of scientific events	Average	13.3
		Standard deviation	16.06
	Experience in the review, design and/or validation of a specific research instrument	Yeah	100%

Source: self made

Table 9. Degree of satisfaction of the pilot group of students and teachers

items	Students				teachers			
	Low grade	Acceptable grade	Good grade	Excellent Degree	Low grade	Acceptable grade	Good grade	Excellent degree
What was the degree of understanding of the instrument instructions?	-	43%	43%	14%	-	33%	fifty %	17%
What was the degree of understanding of the questions or items?	-	43%	43%	14%	-	3.4 %	33%	33%
What was the degree of satisfaction with the instrument?	-	43%	57%	-	17%	17%	33%	33%
What is the degree of relevance of the questions?	-	57%	29%	14%	-	17%	33%	fifty%

Source: self made

Table 10. Suggestions for improving the instrument by the pilot group of students and teachers

Cluster	Suggestions	Observations
Students	The recommendation was oriented toward the value of each level of achievement.	It was considered to improve the rubric
Teachers	The recommendation was that there be more reading comprehension, and they considered that it is a good method to implement it in the subject, and this can motivate students more. A professor considered a low degree of satisfaction with the instrument because he does not consider himself an expert on the research topic.	It was considered to improve the rubric

Source: self made

Table 11. Validity data of the instrument with Aiken's V and average of the 12 items

	Relevance			Drafting	
	V for Aiken	half		V for Aiken	half
Item 1	0.8333333333	3.50		0.8333333333	3.50
Item 2	0.6666666667	3.00		0.8333333333	3.50
Item 3	0.8666666667	3.60		0.8333333333	3.50
Item 4	0.8666666667	3.60		0.8666666667	3.60
Item 5	0.8666666667	3.60		0.8333333333	3.50
Item 6	0.8000000000	3.40		0.8333333333	3.50
Item 7	0.8000000000	3.40		0.8000000000	3.40
Item 8	0.8333333333	3.50		0.8333333333	3.50
Item 9	0.7666666667	3.30		0.8000000000	3.40
Item 10	0.8000000000	3.40		0.8666666667	3.60
Item 11	0.8666666667	3.60		0.8333333333	3.50
Item 12	0.8666666667	3.60		0.8333333333	3.50

Source: self made

Contribution Role	Author(s)
Conceptualization	Isaías de Jesús Díaz Maldonado (main) Saúl Ortiz Calderón (support)
Methodology	Isaías de Jesús Díaz Maldonado (main) / Benjamín Gómez Ramos (support)
Software	DOES NOT APPLY
Validation	Isaías de Jesús Díaz Maldonado (main / Benjamín Gómez Ramos (support)
Formal Analysis	Isaías de Jesús Díaz Maldonado (support)/ Benjamín Gómez Ramos (main)
Investigation	Isaías de Jesús Díaz Maldonado (main / Benjamín Gómez Ramos (support) / Jorge Saúl Ortiz Calderón (support)
Resources	Saúl Ortiz Calderón (principal)
Data curation	Isaías de Jesús Díaz Maldonado (main) / Benjamín (support) Gómez Ramos / Saúl Ortiz Calderón (support)
Writing - Preparation of the original draft	Isaías de Jesús Díaz Maldonado v
Writing - Review and editing	Isaías de Jesús Díaz Maldonado (main)
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Fund acquisition	Isaías de Jesús Díaz Maldonado (main) / Benjamín Gómez Ramos (support) / Saúl Ortiz Calderón (support)