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# How to Evaluate the STEM Curriculum in Spain?

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**Abstract:** There is a wide demand for professionals related to the science, technology, engineering and mathematics (STEM) field; nevertheless, the number of students is decreasing every day, and the presence of women is also scarce. Within the Spanish context, different programs are promoting measures for STEM skills' development; however, they are neither collected nor evaluated under a common umbrella. For that reason, it seems appropriate to investigate the possibilities of carrying out a STEM certification, involving the management and teaching practice of secondary and high school education centers. The present work has developed an evaluation instrument based on the work by The Friday Institute for Educational Innovation from the North Carolina State University (USA). The model proposed looking at obtaining a high-quality STEM Center certification in the Spanish context, seeking to guarantee that the efforts made are systematically collected and evaluated in a common framework. This model includes an evaluation rubric with 5 dimensions and a series of indicators, classifying the centers in 4 levels of development. The aim is to provide a framework to establish, monitor and guide their STEM culture development with a global perspective, counting with the entire educational community, working on STEM skills in a transversal manner.

**Keywords:** STEM education; skills; secondary school; high school; certification; reference framework



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## 1. Introduction

Despite the fact that various studies indicate the existence of a wide demand for professionals linked to the science, technology, engineering and mathematics field, known as STEM [1–4], the number of University students who choose a degree and develop their professional careers within this field is smaller every day, specially in Western countries [5]. In addition, the presence of women in these degrees and professions is scarce [6]. In the coming years, STEM skills appear as an essential requirement for employability.

In education, the term "STEM" is starting to have a great impact on both teaching and learning processes [7]. Obtaining the advantage of the added value of technology in education [8] requires both resources [9] and prepared teachers for its pedagogical use [10], where complementary teaching methodologies support ways to motivate the students [11]. This situation has not gone unnoticed; educational authorities and policy makers are promoting measures that allow both training and development of STEM skills [5,6,12].

However, in the Spanish context, most of the initiatives have started inside educational centers, responding to enthusiastic teachers' initiatives or being part of experimental innovation projects. For this reason, they have not counted, in general, on governmental support. Internationally, there have been initiatives, such as the one from the community for science education in Europe named Scientix, (http://www.scientix.eu/), or the UK National STEM Centre (https://www.stem.org.uk/), that are promoting research and innovation from an exploratory focus [13]; or even initiatives coming from bigger institutions such as the European Centre for Women and Technology (ECWT) and the European Institute for Gender Equality (EIGE) [6].

Since government involvement is increasing, both internationally and within the Spanish authorities, and the development of measures and plans to promote positive attitudes and competencies towards the STEM world is growing as well, it seems relevant to clarify and specify the levels which the educational centers would go through before being considered as an educational center that works and develops STEM skills.

The present paper proposes a reference instrument that gives place to a STEM Certification or Recognition for the educational centers. The aim of the work carried out is to:

- Develop a reference instrument that enables the development of a certification model for secondary and high school education centers in relation to their STEM curriculum. In order to achieve the aim, a series of objectives are also highlighted:
- Analyze the current situation of STEM education in Spain and the development of STEM proposals in educational centers.
- Analyze the main existing certifications in educational centers nationwide, as well as the procedures for obtaining them.
- Make visible the possibilities offered by rubrics as an assessment tool.

### *1.1. Science, Technology, Engineering and Mathematics (STEM) Education as a Strategic Focus*

Although the economic and social results of investments in education have been proven [14], we have seen how they have not grown in the same way as investments in other fields. In this regard, education has been in tow, trying to respond to both present and future challenges that society is facing. The United States' National Science Foundation in the mid-1990s firstly developed the STEM skill concept. Along these lines, STEM education looks towards the relationship of the four disciplines. The idea behind is that competencies to approach complex challenges (creative-thinking and critical-thinking) understood as skills, together with a strong foundational literacy (e.g., scientific, cultural, digital) and socio-emotional skills (e.g., social awareness) can help in the acquisition of students' abilities [12].

Reviewing the investments and plans developed in countries with higher economic and social development than the Spanish context, a large part of them have been investing in skills' development related to STEM [3,15,16]. However, it has been also questioned if investments are aligned with the means to achieve those goals [17].

These investments have been justified by the economic and social model reconversion of many of these countries. At a European level, the demand for STEM professionals has been increasing; nevertheless, the supply of STEM graduates is insufficient to meet this demand. The European Center for the Development of Vocational Training (CEDEFOP) pointed out in 2014 that the demand for professionals in STEM subjects of 8% between 2014 and 2025, being this percentage much higher than the average 3% of all occupations [18]. In Spain, according to 2015 data from CEDEFOP, we are below other countries in relation to VET (vocational education) graduates in STEM sectors, being less than 25%, when the European average is 30.8% [19]. The relevance of VET in STEM subjects is crucial, since by 2025, around 46% of occupations in STEM subjects will require a VET qualification according to CEDEFOP forecasts [18].

#### STEM Education in Spain

The community for science education in Europe named Scientix published in 2018 the "STEM Education Policies in Europe" report, gathering information from 14 European countries, including Spain, providing information on STEM education policies and practices in each of these countries [20]. With regard to Spain, the report indicates how the Government included STEM education as one of its priorities, focusing on its development through the integration of teacher training courses. Currently, the Ministry of Education and Vocational Training highlights "Increasing STEAM vocations, especially in girls" as one of the 10 challenges that the Spanish educational system must face, adding the competence in Arts. This proposal is included within the objective "Modernize the educational system" in the proposed Organic Law 2/2006, of 3 May, on Education, known as LOMLOE [21]. The previous proposal responds to the Spanish situation, where currently only 28% of women choose a STEM University career, being below the mean percentage of the Organization for Economic Cooperation and Development–European Union (OECD-EU) member states [22]. This situation requires a decisive impulse that allows an improvement in the use of instrumental technology, capable of promoting female empowerment. This objective is in line with the United Nations 2030 Agenda of the Sustainable Development Goals: "Achieve Gender Equality and empower all women and girls".

At the regional level, the report by the Scientix Observatory about education practices in Europe [20], pointed out how certain autonomous communities in Spain, such as Galicia or Catalonia had begun to introduce STEM education guides in teacher training programs. The intention of these communities is that teachers have a solid pedagogical training applied to STEM fields, highlighting its relevance as a key element. Also, they look towards the incorporation of policies that promote a global approach from childhood towards STEM skills.

Other autonomous communities, such as Castilla y León have developed experimental projects as "TIC STEAM" or "Ingenia Secundaria" educational innovation project, seeking the application of programming techniques and robotics, making use of information and communication technologies [23]. However, the vast majority are still developed outside this governmental umbrella and most of it, with a gender focus as "STEM Talent Girl" (https://talent-girl.com) or "Poderosas" (https://www.poderosas-tech.es), which contribute directly and indirectly to the development of STEM competencies.

### *1.2. Certifications in the School Context*

The main purpose of this work is related to the proposal of a certification or recognition for those centers that prove their commitment to the development of STEM skills and vocations. In this regard, it is necessary to understand the current panorama on the existing certifications and accreditations in Spanish educational centers, as well as their purpose, their characteristics and the procedure to obtain them.

In general, certifications in the educational field arise from the hand of quality management models. A certification is received after the school center and/or its programs have achieved certain satisfactory standards in a quality assessment process. A competent entity has previously defined those standards with a focus on guaranteeing the quality [24].

Guillén Vivas [25] points out that differences exists in terms of the reasons why an institution looks towards obtaining different accreditations or certifications. Thus, in the USA, these accreditations are linked to obtaining federal and state resources, as well as generating trust within the population. In Europe, a large part of the accreditation and certification processes arise from the educational convergence process to rethink the existing differences in each country, seeking the development of a model that, while keeping diversity, guarantees overall system quality. What is more interesting about certifications is that they can act as a lever for improvement when used as a working guidance that goes beyond a specific moment [26].

Certifications, therefore, are a quality assurance system that favors the competitiveness of educational centers, granting higher levels of trust to parents, students and teachers.

#### Certifications in Spanish Schools

Currently, there are different kinds of certifications in the Spanish educational context. The schools can accredit their performance in various areas, such as the environment and healthy living promotion, or the integration of information and communication technologies (ICT). These areas allow the identification and recognition of different efforts from the educational center to successfully implement actions with a positive effect on the teaching-learning process, identification of the educational community with the center and management. In this sense, they act as a tractor element within the educational context in which they are implemented. In the following paragraphs, a series of them are going to be highlighted. Choosing them is the result of their relevance and their evaluation process, mentioning the most significant for the purpose of the present study.

(1) Eco-schools: the green flag: an international program whose objective is to promote environmental education for Early Childhood, Primary and Secondary Education. Currently, the program is present in 67 countries, covering a network of more than 50,000 schools. In Spain, it counts with around 600 eco-schools (more information can be found at http://www.ecoescuelas.org/). The achievement of the "Green Flag" certifies that the centers have reached certain goals. For example, they have an Environmental Committee, they have passed an eco-audit, and they count with an Action Plan with concrete works based on the results of the eco-audit, among others. The eco-audit process [27] is relevant for our work, as it is carried out through a "Yes/No/Sometimes" questionnaire grouped around five sections: Policy and environmental management of the center; General administration and purchasing policy; Teaching activity/Classrooms; Dining room/Kitchens; Gardens and other common areas; forming a total of 93 questions that must be completed by the Center's Environmental Committee. An example of these questions is: Do you consider environmental education to be integrated in the curriculum and in teaching? This type of assessments allows a wide margin of subjectivity, as there is no opportunity to compare with other centers or have any knowledge of what authorities are considering as integration of environmental education, for example.

(2) Quality label "Healthy Life": a recognition for the educational centers that promote the learning of health in the educational field, including the assumption of healthy living practices and physical education that allow adequate personal and social development. It is regulated by national legislation [28]. In order to obtain the "Healthy Life" label, the educational centers must present a technical report focused on promoting healthy life habits, linked to any of the aforementioned lines. In this sense, it is not indicated how the review procedure is carried out, neither the criteria in which this accreditation is obtained, assuming that the commission simply verifies the documentation provided to assess the educational centers' suitability to obtain the label, letting again a wide margin of subjectivity.

(3) CoDiCe TIC-Certification of the level of digital competence of educational centers: ICT competences have probably been the most relevant ones, as they have been driven by demand from educational and professional sectors, highlighting the effectiveness derived from the technological provision and implementation in the educational field [29–34]. Different initiatives have emerged for its certification [35–39]. Within the Spanish context, CoDiCe TIC is of special relevance to the present work, since our STEM certification model is partially based on its motivation and structure. CoDiCe TIC is regulated by regional legislation [40], and delves into three dimensions: the pedagogical dimension, including processes and content; the organizational dimension, focused on management and development; and the technological dimension, encompassing the infrastructure and the digital security. The certification seeks a model based on the digital competence of the center under the European Framework for Organizations with Digital Competence (DigCompOrg), seeking the promotion of digitally competent organizations, promoting effective learning in the digital age [41]. In essence, the procedure for obtaining the certification consists of two steps: (1.) Carrying out a self-assessment questionnaire in which the center assesses the degree of implementation of ICT. The questionnaire consists in two parts, one that requires the trajectory evaluation and experience of ICT integration within the center. This is executed by collecting plans, experiences, activities and projects carried out related to ICT. The second part is based on a reflection on the ICT integration degree in different areas: Management, organization and leadership; Teaching and learning processes; Training and professional development; Evaluation processes; Contents and curricula; Collaboration, networking and social interaction; Infrastructure; Security and digital trust. (2.) Verification by an external technical team of the self-assessment reports.

Once the evaluation process is passed, the center will obtain certification according to the degree of digital competence, ranging from the "Initial" level, meaning that the center is developing a process in relation to the ICT integration, to the "Excellent" level, which indicates that the center has structured and systematized a coordinated process related to the integration of ICT, proving its ICT maturity.

When constructing the instrument for the present work, a thorough review of the proposal included in the CoDiCe TIC was carried out since, as seen in our review, STEM skills and education have an intrinsic connection with access to technologies. Moreover, in most cases, the initiatives developed by the Administrations are included within the policies for ICT promotion and integration of educational centers and curricula. In this sense, the CoDiCe TIC certification is of great value, as it gathers relevant dimensions allowing the study of the center competence as a whole. However, the self-assessment questionnaire is based on a 1–10 scale, leaving room for self-interpretations, added to the lack of reference, since there are no explanations attached to the quantitative scale, serving as an example the following question: "The general organization of the center has defined its school technological context and scope" (Yes/No).

(4) STEMadrid: a pioneer plan from the government of Madrid (Spain) launched in 2018/2019. The aim is to reinforce the interest of young people towards scientific-technical studies, by incorporating STEM education methodologies. The plan is focused on increasing teachers' training in STEM methodologies through courses, seminars and dissemination of good practices. It seeks the development through education of attractive STEM projects through active methodologies that motivate the participation of students, especially within women. The plan has two steps: (1) different activities and methodologies with a strong STEM character have to be included by the center in its educational project; (2) the plan is presented and evaluated by an external committee. One of the main assets of this plan is that the centers that have obtained the certification will work as mentors for other centers, allowing them to have a reference to achieve the STEMadrid certification. Together with it, the plan highlights the relevance that the contact with the professional sector may have, including technological centers and social networks as key factors for the establishment of a STEM mentality. More information can be found at http://educacionstem.educa.madrid.org/.

### *1.3. Rubric as an Evaluation Instrument*

The utilization of rubrics in the educational field has been increasing in recent years, mainly because it has shown great potential when conducting evaluations [42]. If things are going to be measured, it is necessary to understand them [43]. Rubrics are an instrument that favors transparency in verification processes, working with explicit, detailed and public criteria.

In general terms, rubrics assess performances [44]. One way to assess performance is through monitoring and measuring processes. Different indicators or dimensions are synthesized in a rubric, where a series of characteristics that imply the achievement of a certain level of development are properly described. In this way, the level of achievement or performance is set before a specific task or an innovation program or, for example, the accreditation of the established competencies or skills [44,45].

To summarize, rubrics have the capacity of getting closer between strategies and goals, as they set, in advance, what is going to be evaluated, either a competence, the students' development, or an organization performance. We are, therefore, facing an ideal instrument to carry out an evaluation of the learning process, with the capacity of giving informative feedback [46].

Rubric Design as an Instrument for STEM School Certification

The rubric is intended to be a reference or an orientation, and not a single model. It is an instrument that provides a standard in a context where variability and differentiation are the norms. The potential of rubrics for evaluating the functioning of an organization has been widely studied [47–49], where two key components are present: criteria and gradations of quality [46], concluding that assessing performance and getting informative feedback is decisive for the organization's own success. This success is what the present investigation seeks to evaluate. For that, a deep understanding of the "structures and conditions that precede, anticipate, or predict excellence in performance" [50] (p. 28) is needed.

Our proposal is conceived as an institutional rubric, that is, an instrument that would serve as a reference or guide for the educational centers that bet on carrying out the STEM institutional accreditation proposed by the administration. With this rubric, the centers can have a reference and a clear line of development of its STEM curriculum. In this way, subjectivity bias would be limited and a global vision of the center's situation around its STEM maturity could be given.

The rubric presented here took as a starting point the proposal developed by The Friday Institute for Educational Innovation [51]. The tool is developed as a strategic one to support schools and authorities to enhance STEM education, looking toward the provision of rich learning environments [52]. The attributes contained in such proposal, described different qualities of successful STEM programs. Such attributes (e.g., communication of a STEM program, project-based learning) contain key elements structured in a four-item scale, from "early" to "model". The attributes were identified and gathered by the North Carolina Department of Public Instruction, USA. The idea behind it is that authorities can implement such a proposal through the North Carolina State Board of Education. Such a tool was used within the "Golden Leaf Foundation STEM Initiative" (www.goldenleaf.org), focused on supporting successful models that have the capacity to improve STEM teaching and learning practices. The interest for the present research is on the initiative based on building the evaluation-capacity of schools. Such an initiative used the tool to gain feedback from North Carolina STEM education leaders. The recommendations were incorporated in the tool. With the new results, the tool was sent online to the principals of participating schools. A total of 230 schools fulfilled the rubric proposal. The data were analyzed through descriptive statistics and comparisons by school-level [52,53]. With this basis, the design was completed and adapted based on the bibliographic review, the revision of the national and regional existing evaluations and certifications included in the previous paragraphs, and after interviewing a series of teachers who are experts on the subject within the national context. Most of the rubric indicators refer to aspects related to cognitive development. However, indicators collected in the rubric (see Table 1) such as "teamwork", "collaboration between teachers" and "vibrant STEM culture", collect domain areas linked to physical and emotional aspects as well as inter- and intrapersonal, social, and cultural components.

STEM skills and education have an intrinsic connection with access to technologies. For that reason, a thorough review of the proposal included in the CoDiCe TIC certification from the region of Castilla y León, Spain, was carried out when constructing the present rubric [40]. The COVID-19 pandemic has evidenced that not all the population has the same possibilities of access to technological resources, and not all educational centers have the sufficient resources to alleviate this digital challenge. The above questions have led to the inclusion of specific indicators regarding access to technologies, as well as other dimensions of "School Culture" which we consider essential due to its inclusive nature, involving the community and institutional environment.

The integration of STEM subjects demands a strategic approach [5]. In the same way that the integrated approach looks for connections between STEM subjects, this model seeks to connect the different areas of the center and society, in order to achieve an integrated STEM center.

**Table 1.** Science, technology, engineering and mathematics (STEM) rubric dimensions: information about indicators, degrees of development and scores.

| Dimensions | Indicators | Degrees of Development | Score |
|---|---|---|---|
| 1. Curricula integration (CI) | 1.1. Comprehensive project design.<br>1.2. Teamwork.<br>1.3. Use of digital technology by students.<br>1.4. Diversity in the types of evaluation.<br>1.5. Integral adviser | Early<br>Under development<br>Ready/Qualified<br>Model | 6–11<br>12–17<br>18–23<br>24 |
| 2. Teacher training (TT) | 2.1. Collaboration between teachers.<br>2.2. Teacher learning and development.<br>2.3. Format and structure of teacher learning. | Early<br>Under development<br>Ready/Qualified<br>Model | 3–5<br>6–8<br>9–11<br>12 |
| 3. Infrastructure and equipment (IE) | 3.1. Spaces for project development.<br>3.2. Access to technologies. | Early<br>Under development<br>Ready/Qualified<br>Model | 2–3<br>4–5<br>6–7<br>8 |
| 4. School culture (SC) | 4.1. Continuous improvement informed by data.<br>4.2. "Vibrant" STEM culture.<br>4.3. Attention to diversity.<br>4.4. Communication strategy. | Early<br>Under development<br>Ready/Qualified<br>Model | 4–7<br>8–11<br>12–15<br>16 |
| 5. Management and organization (MO) | 5.1. General instruction.<br>5.2. Strategic staff for STEM.<br>5.3. STEM Education Plan. | Early<br>Under development<br>Ready/Qualified<br>Model | 3–5<br>6–8<br>9–11<br>12 |

## 2. Methods

The purpose of the present instrument is to evaluate the level of integration of STEM competencies in the center from a macro perspective, which will guide the centers and teachers in the implementation and development of activities that allow students to acquire STEM competencies.

A construct validation process has been developed taking as reference the proposal of McCoach, Gable and Madura [54]. For this, a study has been carried out on its theoretical definition, specification of dimensions and indicators, as well as its representation. Furthermore, a review of the existing evaluation proposals and their categorization has been carried out with the intention of making the proposal in accordance with the established context.

The design is based on the work carried out by the Friday Institute for Educational Innovation [51], belonging to the North Carolina State University, USA, together with a review of the current certifications existing in the Spanish context, from where we have worked to elaborate an instrument that allows quantifying the level of progress of the Spanish secondary and high-school centers in relation to the integration and development of STEM skills. The adaptation to the Spanish context is of extreme relevance to elaborate a contextualized and acceptable proposal for administrations and educational centers.

## 3. Results

The first part of the instrument, the rubric, is intended to be carried out by different members of the educational center, e.g., a panel of evaluators, and not by just one person, as is usually done in current processes. After the completion of the rubric, the competent administration would audit the results. To do this, each center will provide to the administration evidence proving compliance with the level of development indicated in each indicator. If the administration validates the information, the center would obtain a "Certification" according to the accredited degree of development, taking as a reference the characteristics/indicators of the rubric.

The rubric has 4 degrees of development: "Early"; "Under development"; "Ready/Qualified"; "Model", with five dimensions. Each of these dimensions has a different number of indicators, which are collected in Table 1. In each dimension, a degree of development will be obtained depending on the indicators' scores. In the event that the level of development in each of these indicators is different, a degree of development of the dimension will be considered in accordance with the weighted score.

The centers must collect a series of documentary evidence that allows accrediting the achievement regarding the indicators collected in the rubric. This evidence will be at the disposal of the corresponding administration, which will articulate the appropriate measures for reviewing and verifying the information. This certification includes the four stages following the same procedure, specifying the level of development in each of the dimensions (Table 2).

**Table 2.** STEM rubric: degrees of development according to total scores.

| Dimensions | Degrees of Development | Total Score |
|---|---|---|
| 1. Curricula integration (CI)<br>2. Teacher training (TT)<br>3. Infrastructure and equipment (IE)<br>4. School culture (SC)<br>5. Management and organization (MO) | Early<br>Under development<br>Ready/Qualified<br>Model | 6–11<br>12–17<br>18–23<br>24 |

The evaluation instrument for the STEM certification proposal is presented in Appendix A. "Proposal for a rubric certification for secondary and high school education centers in relation to their STEM curriculum", where 5 tables corresponding to the different dimensions, are explained. In Table A1 we have provided the "Curricula integration" dimension and its 5 indicators. In Table A2, the "Teacher training" dimension is shown together with the 3 corresponding indicators. Table A3 shows the dimension corresponding to "Infrastructure and equipment" and the 2 corresponding indicators. Table A4 present the "School culture" and its four indicators are presented. Finally, Table A5 provides the "Management and organization" dimension, composed by 3 indicators. The original document is elaborated in Spanish, and it has been translated to English for the purposes of the journal.

## 4. Discussion

Through the review that has been carried out, it has been verified that there is a wide variety of accreditations, certifications or seals regarding ICT matters, inclusion of healthy life, environment, among others. These certifications can help to clarify the educational offer, giving guidance by which a certain center has offered. They favor the development of programs, strategies and commitments around them, and, at the same time, they guide the economic investments made in the corresponding areas [25]. Its use may serve to guarantee the quality of a program, process or institution, acting as a guidance tool [26].

The proposal developed in the present work is intended to articulate a system that helps, within a common framework, to detect existing deficiencies and opportunities in the school in terms of implementing STEM skills. The work will allow the establishment of measures that may be able to solve those deficiencies and identify opportunities, favoring a global curriculum development that integrates the acquisition of skills related to the STEM field. This way, the intention is to ensure equal educational opportunities for students from different centers, taking into account their context, regardless the situation or characteristics of each individual center.

In this regard, a certification model that makes use of a rubric as part of the instrument has been chosen, departing from the norm in terms of the instruments that are currently being proposed. The reviewed literature and certifications show that most of the accreditations recommend the use of dichotomous response questionnaires (Yes/No) to collect information. The school management teams usually answer this type of questionnaires that hold important biases, leaving a wide margin for subjectivity of the personnel who fill them out. Moreover, they do not have the capacity to give a clear orientation of what is required as a "model" center in the evaluated area. In other cases, what is a requisite is the submission of a series of documentation from the center accredited by an external agent, leaving again room for subjectivity and temporality of the actions, since no evidence is required to verify the effectiveness and continuity of the measures that have been proposed in order to obtain the certification. Taking into account the revised certifications, obtaining them implies the development of good practices.

To counteract the above, our proposal for a certification model for secondary and high school education centers in relation to their STEM curriculum, consists of two phases. The first one has an internal character, where the educational community is involved. The second phase, of an external nature, is developed by the competent administration, allowing the information verification provided by the center, as well as its scope and validity.

In this way, it could be affirmed that, with the use of the present rubric, the development process is oriented and the commitment of the educational community is favored with the inclusion of a STEM curriculum within the educational project of the center.

The rubric developed in this work favors the project evaluation presented by the center from a global perspective. The intention is to deepen the level of commitment, knowledge and acceptance of the project by the entire educational community. Thus, in addition to having a series of indicators aimed exclusively to the roles and actions of teachers, the management team and students, indicators are also collected seeking to have a deeper understanding of the knowledge, commitment or acceptance of families and the context or environment that frames the center and the project.

It is important to note that the use of the rubric is not only intended to collect information that allows a subsequent analysis in order to obtain a certification, but also that the impact of the project look toward becoming part of the center's own hallmarks, having as well a direct and positive impact on teaching practice. Thus, it is intended as a transversal approach to STEM skills from all subjects, with a precise reflection both in the Educational Project of the Center and in the Syllabus of the different subjects. Obviously, it is not intended that all subjects or all units contribute in the same way to the acquisition and development of these STEM skills. However, from our perspective, STEM skills are related to a series of qualities and capacities that put the students at a clear advantage in their educational development, as well as in their professional environment and personal lives. It is recommended to approach the evaluation of STEM competences acquisition by students from a holistic perspective, which includes obtaining cognitive and learning skills with which teachers are more familiar. However, it also requires the inclusion of soft skills and socio-emotional skills as resilience, self-regulation and other personal attributes that are essential for the full development from a personal and professional point of view of students.

In a similar way to the Spanish certification CoDiCe TIC on digital competence [39], the research looks toward a model based on the competence of the center, the STEM one in this case. Therefore, it is also sought that the center and the project do not conform an isolated entity to their context, looking for points of encounter between the actions undertaken in the classroom and the needs that exist in the environment in which the students develop. These meeting points will also favor the recognition of the learning functionality, in such a way that the students will see that what is learned in class has an application in the solution of close or local problems in their surrounding environment. This fact is fundamental, since we consider that this transfer of learning will awaken their interest in the STEM field and, therefore, could favor the increase of motivation towards these types of studies and professions [13].

The most relevant limitation to the present study is the test and implementation in real scenarios within the Spanish context, first in Spain and later on in other Spanish-speaking countries. The above is going to be developed in a second phase, being able to refine the rubric and the accreditation process. Due to the COVID-19 emergency situation, this second phase has not yet been carried out, although we hope to be able to carry it out as soon as possible.

## 5. Conclusions

The inclusion of a STEM certification model in educational centers would guarantee that the efforts made are systematically collected and evaluated with a common instrument in the Spanish context. In this line, the present recognition will value the commitment of the educational community as a whole, recognizing the work carried out by the management team, the teachers and the students. This will also provide the Spanish Ministry of Education with valuable information that would allow structuring the existing needs in each educational center. It will also allow better planning regarding the required investments in order to solve their deficiencies.

Both educators and educational policymakers recognize the value of technology for educating [8], however, resources have been considered as one of the main barriers to technology integration [9]. To gain the advantage of that added value of technology, it is necessary to make sure that teachers are prepared for pedagogical use of technology, [10], highlighting the need to link infrastructure investments and teachers' pedagogical training [29]. For example, the provision of elements such as a 3D printer can have a positive impact on the development of the STEM curriculum; however, its provision does not add any value. For this, it is necessary to train teachers so that they have the proper tools that enable the educational use of programs and technologies, being capable of putting into practice pedagogical proposals that allow the development of students' skills. The infrastructure and teacher training tandem makes a clear difference in the motivation of teachers to implement these tools in STEM curriculum development.

Finally, we want to point out that the characteristics of the designed instrument and the proposed accreditation process will favor the establishment of a formative accreditation/evaluation model, which extends the culture of internal evaluation that occurs in the centers. The proposed model not only serves for the Spanish context, its development structure could guide or help countries or regions with a similar starting situation. In addition, it will contribute to generating a greater impact in the educational project of the center, and will positively affect the professional development of teachers, as well as the students' training through the acquisition and development of STEM skills.

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## Appendix A. Proposal for a Rubric Certification for Secondary and High School Education Centers in Relation to Their Science, Technology, Engineering and Mathematics (STEM) Curriculum

**Table A1.** Curricula integration.

| **1. Curricula Integration** | | | | |
|---|---|---|---|---|
| | **Early** | **Under Development** | **Ready/Qualified** | **Model** |
| 1.1. Comprehensive project design | 1.1.1. Within the educational program for the development of the STEM curriculum, there are no situations that allow the creation and design of an investigation or experiment; create and complete a phase of the engineering design process; create and complete a phase of computational thinking, etc. | 1.1.1. Within the educational program for the development of the STEM curriculum, a single project is proposed throughout the course that allows: the creation and design of an investigation or experiment; create and complete a phase of the engineering design process; create and complete a phase of computational thinking, etc. | 1.1.1. Within the educational program for the development of the STEM curriculum, two projects are proposed throughout the course that allow: the creation and design of an investigation or experiment; create and complete a phase of the engineering design process; create and complete a phase of computational thinking, etc. | 1.1.1. Within the educational program for the development of the STEM curriculum, at least one project per quarter is proposed throughout the course that allow: the creation and design of an investigation or experiment; create and complete a phase of the engineering design process; create and complete a phase of computational thinking, etc. |
| 1.2. Teamwork | 1.2.1. In the STEM curriculum, teamwork is not contemplated with individualized and group learning segmentation. | 1.2.1. In the STEM curriculum, teamwork is collected with an individualized and group learning segmentation. | 1.2.1. Teamwork with individual and group segmentation is used regularly in classroom activities. | 1.2.1. Teamwork with individual and group segmentation arises naturally when the teacher proposes challenges to the group. |
| 1.3. Use of digital technology by students | 1.3.1. In the educational program of the STEM curriculum, the opportunity to identify, evaluate and use appropriate digital tools and resources by the students, is not included for the development of competencies. | 1.3.1. One project per year is included in the educational program of the STEM curriculum, as an opportunity to identify, evaluate and use appropriate digital tools and resources by the students, for the development of skills. These competencies are related to: creative opportunities; critical thinking; problem resolution; exploration of relevant topics; communication of ideas; and collaboration, using for example, spreadsheets, analysis or software, etc. | 1.3.1 Two projects per year are included in the educational program of the STEM curriculum, as an opportunity to identify, evaluate and use appropriate digital tools and resources by the students, for the development of skills. These competencies are related to: creative opportunities; critical thinking; problem resolution; exploration of relevant topics; communication of ideas; and collaboration, using for example, spreadsheets, analysis or design software, etc. | 1.3.1. At least one project per quarter is included in the educational program of the STEM curriculum, as an opportunity to identify, evaluate and use appropriate digital tools and resources by the students, for the development of skills. These competencies are related to: creative opportunities; critical thinking; problem resolution; exploration of relevant topics; communication of ideas; and collaboration, using for example, spreadsheets, analysis or design software, etc. |
| 1.4. Diversity in the types of evaluation | 1.4.1. The STEM curriculum includes the development of conceptual content. | 1.4.1. In the STEM curriculum there is a greater presence of conceptual content over procedural ones. | 1.4.1. The STEM curriculum is balanced between conceptual and procedural content. | 1.4.1. In the STEM curriculum, the development of procedural content is favored looking forward to the acquisition of conceptual content. |
| | 1.4.2. Active learning methodologies are not prioritized in the development of the STEM curriculum. | 1.4.2. In the development of the STEM curriculum, active learning methodologies are included. | 1.4.2. Active learning methodologies are used in the STEM curriculum. | 1.4.2. The STEM curriculum is based on active learning methodologies. |
| | 1.4.3. Exam results within the STEM projects have a weight of at least 75% of the evaluation. | 1.4.3. 33% of the evaluation of STEM projects is continuous-formative. | 1.4.3. There is a balance in the evaluation of STEM projects between the continuous-formative evaluation and the final evaluation. | 1.4.3. 66% of the evaluation of STEM projects is continuous-formative. |
| 1.5. Integral advise | 1.5.1. The school guidance department does not provide the students with information about STEM-related professions and degrees, and their potential for employability. | 1.5.1. The school guidance department provides the students with general information about professions and degrees related to the STEM field, however, it does not include their potential for employability. | 1.5.1. The school guidance department provides students with specific information on professions and degrees related to the STEM field, however, it does not include their potential for employability. | 1.5.1. The school guidance department provides the students with specific information linked to the context and their potential, about professions and degrees related to the STEM field, including their potential for employability. |
| | 1.5.2. The school guidance department does not count with individualized academic and career counseling with students in the STEM field. | 1.5.2. At least once a year, the school guidance department carries out individualized academic and career counseling work with students on the STEM field. | 1.5.2. The school guidance department conducts several individualized sessions with information about the STEM field. | 1.5.2. The school guidance department organizes numerous individualized sessions. They are focused on the students' characteristics, with special emphasis on STEM professions that can be adjusted to their profile. |

**Table A2.** Teacher training.

| **2. Teacher Training** | | | | |
|---|---|---|---|---|
| | **Early** | **Under Development** | **Ready/Qualified** | **Model** |
| 2.1. Collaboration between teachers | 2.1.1. 33% of the centre's teaching staff participate in a project per quarter that addresses the STEM curriculum in a transversal way. | 2.1.1. Between 34% and 50% of the centre's teaching staff participate in a project per quarter that addresses the STEM curriculum in a transversal way. | 2.1.1. Between 51% and 75% of the centre's teaching staff participate in a project per quarter that addresses the STEM curriculum in a transversal way. | 2.1.1. More than 75% of the centre's teaching staff participate in a project per quarter that addresses the STEM curriculum in a transversal way. |

**Table A2.** *Cont.*

| 2. Teacher Training | | | | |
|---|---|---|---|---|
| | Early | Under Development | Ready/Qualified | Model |
| 2.2. Teacher learning and development | 2.2.1. Time, support, and resources for professional learning are available for one of the following 4 topics for all STEM teachers: -project-based instructional practices, requiring students to integrate content and design, conduct investigations and experiments, and analyze results; -connect educational content with real-world problems and career paths; -promote design-based thinking among students; -provide opportunities for practical learning for students, including the use of instruments to collect data, environment interaction and manipulation of physical objects.<br>2.2.2. Time, support and resources are provided for STEM teachers to develop their own knowledge in the fields of: science, technology, engineering, and others (for example, teachers have time to learn about recent developments in the field of genetics or robotics). This time is available to less than 20% of the teachers which participate in the STEM curriculum.<br>2.2.3. Less than 20% of STEM teachers participate every two years, in at least one applied learning experience to increase their STEM knowledge (e.g., fairs, competitions, European projects, company visits, etc.) | 2.2.1. Time, support, and resources for professional learning are available for 2 of the following 4 topics for all STEM teachers: -project-based instructional practices, requiring students to integrate content and design, conduct investigations and experiments, and analyze results; -connect educational content with real-world problems and career paths; -promote design-based thinking among students; -provide opportunities for practical learning for students, including the use of instruments to collect data, environment interaction and manipulation of physical objects.<br>2.2.2. Time, support and resources are provided for STEM teachers to develop their own knowledge in the fields of: science, technology, engineering, and others (for example, teachers have time to learn about recent developments in the field of genetics or robotics). This time is available to a percentage between 21% and 65% of the teachers participating in the STEM curriculum.<br>2.2.3. Between 21% and 65% of STEM teachers participate every two years, in at least one applied learning experience to increase their STEM knowledge (e.g., fairs, competitions, European projects, company visits, etc.) | 2.2.1. Time, support, and resources for professional learning are available for 3 of the following 4 topics for all STEM teachers: -project-based instructional practices, requiring students to integrate content and design, conduct investigations and experiments, and analyze results; -connect educational content with real-world problems and career paths; -promote design-based thinking among students; -provide opportunities for practical learning for students, including the use of instruments to collect data, environment interaction and manipulation of physical objects.<br>2.2.2. Time, support and resources are provided for STEM teachers to develop their own knowledge in the fields of: science, technology, engineering, and others (for example, teachers have time to learn about recent developments in the field of genetics or robotics). This time is available to a percentage between 66% and 85% of the teachers participating in the STEM curriculum.<br>2.2.3. Between 66% and 85% of STEM teachers participate every two years, in at least one applied learning experience to increase their STEM knowledge (e.g., fairs, competitions, European projects, company visits, etc.) | 2.2.1. Time, support, and resources for professional learning are available for the following 4 topics for all STEM teachers: -project-based instructional practices, requiring students to integrate content and design, conduct investigations and experiments, and analyze results; -connect educational content with real-world problems and career paths; -promote design-based thinking among students; -provide opportunities for practical learning for students, including the use of instruments to collect data, environment interaction and manipulation of physical objects.<br>2.2.2. Time, support and resources are provided for STEM teachers to develop their own knowledge in the fields of: science, technology, engineering, and others (for example, teachers have time to learn about recent developments in the field of genetics or robotics). This time is available to at least 86% of the teachers participating in the STEM curriculum.<br>2.2.3. At least 86% of STEM teachers participate every two years, in at least one applied learning experience to increase their STEM knowledge (e.g., fairs, competitions, European projects, company visits, etc.) |
| 2.3. Format and structure of teacher learning | 2.3.1. Teacher training for STEM education is designed around the goals and initiatives of the center.<br>2.3.2. Mentoring. Less than 50% of teachers experience one of these forms of professional learning annually: peer work, lesson study, peer feedback, coaching, design, action research, and/or mentoring.<br>2.3.3. Less than 50% of teachers participate in professional learning in STEM educational instruction and/or STEM instructional leadership. | 2.3.1. Teacher training for STEM education is designed after identifying the needs of the group by the management team of the center.<br>2.3.2. Mentoring. At least 50% of teachers experience one of these forms of professional learning annually: peer work, lesson study, peer feedback, coaching, design, action research, and/or mentoring.<br>2.3.3. 50% of teachers participate in professional learning in STEM educational instruction and/or STEM instructional leadership. | 2.3.1. Teacher training for STEM education is designed after the needs of the group as a whole have been identified, using, for example, surveys, evaluations, classroom tasks, etc.<br>2.3.2. Mentoring. All teachers experience one of these forms of professional learning annually: peer work, lesson study, peer feedback, coaching, design, action research, and/or mentoring.<br>2.3.3. 75% of teachers participate in professional learning in STEM educational instruction and/or STEM instructional leadership. | 2.3.1. Teacher training for STEM education has been designed based on the self-identified learning needs of the participants, as well as through secondary data (for example, surveys, assessments, classroom tasks, etc.).<br>2.3.2. Mentoring. Less than 50% of teachers experience two or more of these forms of professional learning annually: peer work, lesson study, peer feedback, coaching, design, action research, and/or mentoring.<br>2.3.3. All teachers participate in professional learning in STEM educational instruction and/or STEM instructional leadership. |

**Table A3.** Infrastructure and equipment.

| 3. Infrastructure and Equipment | | | | |
|---|---|---|---|---|
| | Early | Under Development | Ready/Qualified | Model |
| 3.1. Spaces for Project development | 3.1.1. Classrooms are not designed for STEM activities.<br>3.1.2. The arrangement of the furniture is fixed (continuous row) | 3.1.1. There are shared spaces for activities such as computing, technology and STEM.<br>3.1.2. The arrangement of the furniture in these shared spaces allows working in groups, providing certain flexibility (furniture is not anchored). | 3.1.1. There are STEM spaces in the center.<br>3.1.2. There are classrooms prepared for STEM work, allowing modifications, for example, in the arrangement of furniture, project work, etc. | 3.1.1. All classrooms are enabled for STEM work.<br>3.1.2. All classrooms are prepared for STEM work, allowing, for example, the arrangement of furniture, project work, etc. |

**Table A3.** *Cont.*

| | **3. Infrastructure and Equipment** | | | |
|---|---|---|---|---|
| | **Early** | **Under Development** | **Ready/Qualified** | **Model** |
| 3.2. Access to technologies | 3.2.1. There is basic material regarding computer equipment that is common for the entire center. The internet connection must guarantee the resources operability. | 3.2.1. The center has computer equipment for each student. There is also common use material, such as, for example, boards with microcontrollers (Arduino UNO type) and basic electronic elements (led diodes, switches, resistors, etc.). The internet connection must guarantee the resources operability. | 3.2.1. The center has computer equipment for each student. There is also common use material, such as 3d printers, laser cutters, microcontrollers (Arduino UNO type) and basic electronic elements (led diodes, switches, resistors, etc.). There are also project-specific materials, such as Arduino kits (Arduino Education Starter kit, Arduino DUE and NANO boards). The internet connection must guarantee the resources operability. | 3.2.1. The center has computer equipment for each student. There are a variety of common resources depending on the educational needs and the interests of teachers and students, including 3d printers, laser cutters, microcontrollers (Arduino UNO type) and basic electronic elements (led diodes, switches, resistors, etc.). There is also specific materials for projects, such as Arduino Education Starter kit, Arduino DUE and NANO boards, Arduino Engineering kit Rev2, Arduino Science Kit Physics, pneumatics, hydraulics and mechanics kits. The internet connection must guarantee the resources operability. |
| | 3.2.2. The center does not have any type of planning in terms of technological-didactic equipment based on educational needs. | 3.2.2. The center replaces the basic material when it is considered appropriate, without having any kind of planning in terms of technological-didactic equipment based on educational needs. | 3.2.2. The center replaces the material in a systematic way, however, there is no planning in terms of technological-didactic equipment based on educational needs. | 3.2.2. The center plans the technological-didactic equipment based on educational needs, seeking constant improvement. |

**Table A4.** School culture.

| | **4. School Culture** | | | |
|---|---|---|---|---|
| | **Early** | **Under Development** | **Ready/Qualified** | **Model** |
| 4.1. Continuous improvement informed by data | 4.1.1. No data sources are collected or analyzed in order to track/measure STEM Education Plan strategies and outcomes. | 4.1.1. Only qualitative scores from test results are used as data sources to track/measure STEM Education Plan strategies and outcomes. | 4.1.1. The qualitative marks of the exams are complemented with at least one qualitative (for example, data from classroom observation, monitoring of student participation, monitoring of teacher participation, data from surveys, interviews, etc.) to track/measure strategies and the results of the STEM Education Plan. | 4.1.1. The qualitative marks of the exams are complemented with several qualitative ones (for example, classroom observation data, student participation monitoring, teacher participation monitoring, survey data, interviews, etc.) to track/measure strategies and results of the STEM Education Plan. |
| | 4.1.2. The results of the STEM Education Plan activities are not collected or analyzed. | 4.1.2. The results of the STEM Education Plan activities are collected but not analyzed. | 4.1.2. The bi-annual adjustments of the STEM Education Plan are made based on the analysis of the results, seeking continuous improvement of the center (for example, adjusting professional development offers, changing schedules, acquiring new materials, increasing goals for student participation in STEM groups, goals for student learning growth, etc.) | 4.1.2. The annual adjustments of the STEM Education Plan are made based on the analysis of the results, seeking continuous improvement of the center (for example, adjusting professional development offers, changing schedules, acquiring new materials, increasing goals for student participation in STEM groups, goals for student learning growth, etc.) |
| | 4.1.3. There is no internal debate in the school board and faculty about the importance of measures regarding student-learning growth, except the measures of student achievement. | 4.1.3. There is a demand by the educational community to value the measures regarding student-learning growth, in addition to the measures of student achievement. | 4.1.3. The educational community agrees to promote the development of learning strategies in the student beyond quantitative performance. | 4.1.3. The development of learning strategies and competencies is prioritized over the quantitative obtaining of good grades. |
| | 4.1.4. The school does not support the use of formative and summative assessments created by teachers to measure growth in student learning throughout the year. | 4.1.4. The school supports the use of formative and summative assessments created by teachers to measure growth in student learning throughout the year. | 4.1.4. The school supports with dedicated resources the use of formative and summative assessments created by teachers to measure growth in student learning throughout the year. | 4.1.4. The school prioritizes and supports, with dedicated resources, the use of formative and summative assessments created by teachers to measure growth in student learning throughout the year. |

**Table A4.** *Cont.*

| | 4. School Culture | | | |
|---|---|---|---|---|
| | **Early** | **Under Development** | **Ready/Qualified** | **Model** |
| 4.2. "Vibrant" STEM culture | 4.2.1. There is no indication of a school culture in the center that encourages innovation in STEM by students. | 4.2.1. A school culture of the center is nascent, in which teachers, administrators, students and school stakeholders constantly encourage innovation in STEM by students. | 4.2.1. A school culture of the center is in process, in which teachers, administrators, students and school stakeholders constantly encourage innovation in STEM by students. | 4.2.1. There is a core school culture in which teachers, administrators, students, and school stakeholders constantly encourage innovation in STEM by students. |
| | 4.2.2. There is no indication of a school culture in the center in which teachers feel supported to take teaching risks and try new approaches for the benefit of student learning. | 4.2.2. There is an incipient school culture in the center in which teachers feel supported to take teaching risks and try new approaches for the benefit of student learning. | 4.2.2. The school culture of the center is in the formative phase in which teachers feel supported to take teaching risks and try new approaches to benefit student learning. | 4.2.2. There is a school culture of the center in which all teachers feel supported to take teaching risks and try new approaches for the benefit of student learning. |
| | 4.2.3. There is no evidence of a school culture advertising high-quality student work in STEM. | 4.2.3. There is an incipient school culture at the center that advertises high-quality student work in STEM. | 4.2.3. The school culture of the center that advertises high-quality student work in STEM is in a formative phase. | 4.2.3. There is a core school culture in which high-quality student work in STEM is constantly being publicized, including ongoing exhibits in the school or in other forums. |
| | 4.2.4. There is no communication from the board about the vision on STEM education. | 4.2.4. The vision for STEM education is communicated by the board both in faculty and school council meetings. | 4.2.4. The vision on STEM education is present in the meetings of the pedagogical coordination commission. | 4.2.4. The board collaborates and promotes a positive vision about STEM education to the entire educational community. |
| 4.3. Attention to diversity | 4.3.1. The educational community does not foster a culture of inquiry, creativity and attention to diversity. | 4.3.1. Signs are beginning to be detected regarding the educational community fostering of a culture of inquiry, creativity and attention to diversity. | 4.3.1. The Educational Project of the Center includes measures to promote a culture of inquiry, creativity and attention to diversity. | 4.3.1. There is a general culture of inquiry, creativity and attention to diversity throughout the center. |
| | 4.3.2. The center does not have measures of attention to diversity in place that allow access to the STEM curriculum. | 4.3.2. The STEM curriculum includes measures that favor the integration of students with functional diversity. | 4.3.2. Students with functional diversity receive specific attention for the development of the STEM curriculum. | 4.3.2. The STEM curriculum allows the adaptation of materials, content and procedures to meet the educational needs of students. |
| 4.4. Communi -cation strategy | 4.4.1. The board does not have one-way communication (e.g., websites, newsletters) and/or two-way tools (e.g., social media, webinars, and meetings) about STEM educational activities. | 4.4.1. There is one-way communication (e.g., websites, newsletters) by the board about STEM educational activities. | 4.4.1. The board establishes one-way communication channels (e.g., websites, newsletters) and/or two-way ( e.g., social media, webinars, and meetings) about STEM educational activities. | 4.4.1. There are one-way (e.g., websites, newsletters) and two-way ( e.g., social media, webinars, and meetings) communication channels about STEM educational activities used by people participating in the STEM curriculum (management team, teachers, students, etc.) |

**Table A5.** Management and organization.

| | 5. Management and Organization | | | |
|---|---|---|---|---|
| | **Early** | **Under Development** | **Ready/Qualified** | **Model** |
| 5.1. Integral instruction | 5.1.1. At least 33% of all teachers provide two learning opportunities per year, in which a project is developed between traditionally STEM subjects with subjects from other fields, requiring an integration of learning. | 5.1.1. Between 34% and 50% of all teachers provide two learning opportunities per year, in which a project is developed between traditionally STEM subjects with subjects from other fields, requiring an integration of learning. | 5.1.1. Between 51% and 75% of all teachers provide two learning opportunities per year, in which a project is developed between traditionally STEM subjects with subjects from other fields, requiring an integration of learning. | 5.1.1. More than 75% of all teachers provide two learning opportunities per year, in which a project is developed between traditionally STEM subjects with subjects from other fields, requiring an integration of learning. |
| 5.2. Strategic staff for STEM | 5.2.1. The center does not yet have a STEM Education leader who does not belong to the management team. | 5.2.1. The center has at least one STEM Education leader who does not belong to the management team; however, that person does not have specific time to develop the coordination work. | 5.2.1. The center has at least one STEM Education leader who is not on the leadership team and has at least 25% of their time allocated to STEM education. | 5.2.1. The center has at least one STEM Education leader who is not on the leadership team and has at least 50% of their time allocated to STEM education. |
| | 5.2.2. The school has no channels to identify teacher leaders for STEM education. | 5.2.2. The school has informal channels to identify teacher leaders for STEM education. | 5.2.2. The school has informal channels to identify and promote current and future teacher leaders for STEM education. | 5.2.2. The school has formal channels to identify and promote current and future teacher leaders for STEM education. |
| 5.3. STEM Education Plan | 5.3.1. The management team is taking the first steps in the development of a STEM Education Plan that will be integrated into the Center's Educational Project. | 5.3.1. The management team has gathered a STEM Education Plan in the Educational Project of the Center, including general references to issues listed in the STEM School Progress Rubric. | 5.3.1. The management team has gathered a STEM Education Plan in the Educational Project of the Center. The STEM Education Plan explicitly includes the 5 areas of the STEM School Progress Rubric. | 5.3.1. The management team has gathered a STEM Education Plan in the Educational Project of the Center. The STEM Education Plan comprehensively details how the 5 areas of the STEM School Progress Rubric are developed. |
| | 5.3.2. The management team is in the process of building an advisory council that can provide information on STEM education issues. | 5.3.2. In the creation of the STEM Education Plan within the School Improvement Plan, information and acceptance was obtained from an advisory council made up of at least one student, a teacher and an administrator. | 5.3.2. During the elaboration of the STEM Education Plan within the School Improvement Plan, information and acceptance was obtained from an advisory council consisting of at least one student, a teacher, an administrator, a parent, and one business/ industry professional. | 5.3.2. During the elaboration of the STEM Education Plan within the School Improvement Plan, information and acceptance from an advisory council was obtained from at least one student, a teacher, an administrator, a parent, a business/industry professional, and one university. |

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