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## CHEMISTRY AND THE NEW HIGH SCHOOL IN PRACTICE: AN OVERVIEW OF SCHOOLS IN THE MOUNTAIN REGION OF ESPÍRITO SANTO

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**Abstract:** The present work aimed to analyze, through qualitative documentary bibliographic research, the offer of In-depth Training Itineraries in state schools in Espírito Santo, discussing how this scenario can impact the teaching-learning of the Chemistry subject. It was observed that most schools offer one or two in-depth studies, taking into consideration, their structures, and not the students' real intentions, which can result in gaps in scientific learning.

**Keywords:** New High School; Training Itineraries; Chemistry teaching.

## INTRODUCTION

The various changes that have occurred in society in recent decades and the concern about low learning rates, evidenced in large-scale assessments in recent years (CÁSSIO; GOULART, 2022), triggered the reforms currently being experienced in education, through a differentiated curriculum for the "New Secondary Education" (NEM). Due to Law 13,415/2017, which amended, among others, Law No. 9,394, of December 20, 1996 (National Education Guidelines and Bases Law - LDB), all states of the federation had to rethink their curricular matrices, organizing the NEM into two parts: Basic General Training and Training Itineraries (BRASIL, 2017).

Among the legal frameworks, Resolution No. 03, of November 21, 2018, of the National Education Council stands out, which updates the National Curricular Guidelines for Secondary Education. With the aim of forming the subject in its entirety, expressed by values, physical, cognitive and socio-emotional aspects, its 5th Article deals with the construction of the student's "life project" as a "strategy for reflection on the school trajectory in the construction of personal dimensions, citizen and student professional" (BRASIL, 2018, p. 01). The same article

also deals with respect for human rights, understanding the diversity and reality of subjects, environmental sustainability, among other guiding principles. (BRAZIL, 2018).

This reform aims to organize a curriculum in a more flexible way, with the student being the protagonist of their learning through interdisciplinary teaching, which integrates disciplines into areas of knowledge. Basic General Training, guided by the National Common Curricular Base (BNCC), defines the learning objectives of secondary education in four areas of knowledge: I - languages and their technologies; II - mathematics and its technologies; III - natural sciences and their technologies; IV - applied human and social sciences (BRASIL 2017).

Training Itineraries refer to the deepening of one or more curricular areas, as well as technical-professional training itineraries. The Ministry of Education, through decree number: 1,432 of December 2018, defined the objectives of the itineraries, which are:

- Deepen learning related to general skills, Areas of Knowledge and/or Technical and Professional Training;
- Consolidate the comprehensive training of students, developing the autonomy necessary for them to carry out their life projects;
- Promote the incorporation of universal values, such as ethics, freedom, democracy, social justice, plurality, solidarity and sustainability; It is
- Develop skills that allow students to have a broad and heterogeneous worldview, make decisions and act in the most diverse situations, whether at school, at work, or in life. (BRASIL, 2018, p.02).

With such changes, all Brazilian states organized their curricula in order to meet such demands, based on their realities.

The New Curriculum of Espírito Santo, or “New Capixaba Curriculum” brings, as its concepts, the commitment to inclusive education, the autonomy of the subject and the integral education of the student. Therefore, the Training Itineraries were prepared seeking to develop general and specific skills, associated with four structuring axes: Scientific Research, Creative Processes, Mediation and Sociocultural Intervention and Entrepreneurship (ESPÍRITO SANTO, 2020).

The Secretary of Education of the State of Espírito Santo – SEDU/ES, in line with the documents that guide the construction of the New Curriculum, organized the Training Itineraries into two parts: the Integrating Components, which are offered from the 1st grade of the NEM, composed through the subjects of Elective, Life Project and Guided Study (common to all Training Itineraries) and the Deepening of the Training Itinerary, which focuses on deepening knowledge in one or more than one Area of Knowledge.

Deepening begins in the 2nd grade, continuing in the 3rd grade of the NEM. The In-depth Training Itineraries (AIF) relating to Regular Education can be seen in table 01, prepared from the SEDU website “Novo Ensino Médio Capixaba” (ESPÍRITO SANTO, 2022).

Regarding the area of Natural Sciences in High School, the New Capixaba Curriculum was designed with the purpose of giving new meaning to Science teaching, with the aim of making teaching more intriguing, rethinking learning in an integrated way that can contribute to the student’s comprehensive training, improving knowledge based on skills, from a more dynamic and autonomous point of view, enabling the student to expand their understanding of life, the planet and the Universe, in addition to fostering “the ability to reflect, argue and propose solutions and face personal and collective challenges”.

(ESPIRITO SANTO, 2020, p.02)

In the High School stage, the Capixaba Curriculum proposes three thematic fields for the area of Natural Sciences: Matter and Energy; Life and Evolution; Earth and Universe. (ESPIRITO SANTO, 2020). Furthermore, it brings three Specific Competencies (CE) for the area of Natural Sciences and its technologies for High School, presented in table 02.

With all the curricular changes aimed at training the subject through the development of skills and abilities, the usual way in which subjects were offered in schools also underwent changes. With regard to the workload of the Chemistry subject, which, in the previous curriculum, was offered in the three years of High School (distributed over 80 hours per year, totaling 240 hours at the end of the cycle), at NEM, it was reduced to one total of 160 hours, in Basic General Training, being offered only in the 1st and 2nd series. Similar reductions also occurred in the disciplines of Biology, Physics, Geography and History, Sociology and Philosophy, giving “space” for new disciplines in the “Training Itineraries”. (ESPIRITO SANTO, 2022).

Thus, the present work aims to carry out a survey of the AIF offered in state schools of the Regional Education Superintendence (SRE) of Afonso Cláudio, mountainous region of Espírito Santo, and from this, promote a reflection between what was foreseen in previous studies and the current reality of schools, in the second year of NEM implementation. We also seek to describe the presentation of the Chemistry subject in the new Curricular Guidelines and how it is included in the AIF, as well as discuss possible impacts on the teaching-learning process of this subject.

Deepening	Training Itineraries
Deepening the Areas of Knowledge	- Digital Media: Languages in Action (MID) - Financial and Tax Education (EFF); - Earth, Life and Cosmos (TVC); Modernization, Social Transformation and Environment (MOD).
Deepening between two Areas of Knowledge	- Humanities and Socio-Environmental Relations (HUM); - Socioliterary Narratives: Literature, Art and Human Sciences Describe the World (NAR); - Sport, Science and its Languages (ESP).
Deepening between all Areas of Knowledge	- Renewable Energy and Energy Efficiency (ENE); - Teaching Aspirations (ASP).
Technical and professional training	- Integrated Secondary Education (EMI). 42 technical courses are offered in the catalogue. This work covers the following courses: Internet Computing (IPI); Agriculture (AGP), Agribusiness (AGR); Administration (ADM) and Environmental Technician (MEI).

Table 01: AIF offered by NE

Source: Adapted by the author, 2023.

Specific Competence	Description
CE01	Analyze natural phenomena and technological processes, based on interactions and relationships between matter and energy, to propose individual and collective actions that improve production processes, minimize socio-environmental impacts and improve living conditions at a local, regional and global level.
CE02	Analyze and use interpretations about the dynamics of life, the earth and the cosmos to develop arguments, make predictions about the functioning and evolution of living beings and the universe, and support and defend ethical and responsible decisions.
CE03	“Investigate problem situations and evaluate applications of scientific and technological knowledge and their implications in the world, using procedures and languages typical of Natural Sciences, to propose solutions that consider local, regional and/or global demands, and communicate their discoveries and conclusions to audiences varied, in different contexts and through different media and digital information and communication technologies (TDIC)”

Table 02 – CE – Natural Sciences Area.

Source: Espírito Santo, 2020, p 03.

CITY /SCHOOL	AIF	CITY /SCHOOL	AIF
AFONSO CLÁUDIO		CONCEIÇÃO DO CASTELO	
EEEFM José Roberto Christo	ENE	CEEFMTI Elisa Paiva	ESP
EEEFM José Giestas	ENE	EEEFM Profª Aldy Soares Mercon Vargas	MID HUM
EEEFM Maria De Abreu Alvim	ENE	LARANJA DA TERRA	
EEEFM Elvira Barros	EFF	EEEM Sobreiro	MOD
EEEM Mata Fria	ENE	EEEFM Joaquim Caetano De Paiva	HUM
EEEFM José Cupertino	MID ESP	EEEFM Luiz Jouffroy	ENE MID
CEEFMTI Afonso Claudio	EMI.IPI ENE	DOMIGOS MARTINS	
BREJETUBA		EEEFM Ponto do Alto	NAR
EEEFM Leogildo Severiano de Souza	MOD	EEEFM Pedra Azul	HUM
EEEFM Marlene Brandão	MOD	EEEFM Teofilo Paulino	EFF ESP EMI.IPI
EEEFM Fazenda Campores	MOD	EEEFM Gisela Saloker Fayet	ENE EMI.AGR
EEEFM Alvaro Castelo	EMI.ADM	SANTA MARIA DE JETIBÁ	
EEEFM Sao Jorge	EMI.AGP EFF	EEEFM Frederico Boldt	MID
VENDA NOVA DO IMIGRANTE		EEEM Francisco Guilherme	MOD
Domingos Perim	NAR	EEEFM Alto Rio Possmoser	ESP HUM
EEEFM Fioravante Caliman	ESP MID EMI. IPI	EEEFM São Luis	MID ENE
		EEEFM Graca Aranha	EMI . A D M EMI.MEI MID

Table 03 – AIF by school - SRE de Afonso Claudio.

Source: Prepared by the author, 2023.

1 <sup>a</sup> grade	
Thematic Unit	Knowledge Object
Matter and Energy	- Properties of materials and substances- Structure of matter and atomic models
	- Radioactivity
Life and Evolution	- Inorganic Functions
Earth and Universe	- Chemical bonds
	- Chemical Transformations
	- Structure and properties of organic compounds
2 <sup>a</sup> grade	
Matter and Energy	- Stoichiometric Calculation
Life and Evolution	- Solutions
Earth and Universe	- Chemical Kinetics
	- Chemical balance
	- Thermochemistry
	- Electrochemistry

Table 04: Objects of Knowledge – NEM – Chemistry Discipline

Source: Prepared by the author, 2023.

Itinerary	Subject	Course load in 2nd grade	Course load in 3rd grade
Earth, Life and Cosmos;	From micro to macro: Is chemistry in everything?	3 classes	5 classes
Sport, Science and their Languages;	Chemistry and Sport	2 classes	3 classes
Renewable Energy and energy efficiency	Matter and Energy	-	3 classes
Teaching Aspirations	Science by Investigation	-	3 classes

Table 05 – Disciplines related to the teaching of chemistry, by training itinerary

Source: Prepared by the author, 2023.

## MATERIAL AND METHODS

The present work presents itself as a bibliographic and documentary research, prepared from data collected from already published materials, such as books, magazines, theses, laws, documents, among others, (GIL, 2017), related to the reform of the New High School.

The bibliographic survey was carried out using digital platforms such as the Capes Theses and Dissertations Catalog and the Capes Periodicals Portal, using the descriptors “New Secondary Education”; “Depths”; “Chemistry”, “Curriculum” and “Training itinerary”.

Through online documents from SEDU – SEPLA – GEA (Evaluation Management), data was collected regarding the AIF offered by high schools in the state public network of Espírito Santo. Only schools belonging to the seven municipalities that are part of the Afonso Claudio SRE were selected. Using this data, a demonstrative table was created with all the schools researched and their respective AIF.

The State Education Network of the state of Espírito Santo is divided between eleven Regional Education Superintendencies, namely: Afonso Cláudio, Barra de São Francisco, Cachoeiro de Itapemirim, Cariacica, Carapina, Colatina, Guaçuí, Linhares, Nova Venécia, São Mateus and Vila Velha (ESPÍRITO SANTO, 2023).

Afonso Cláudio's SRE covers seven municipalities in the mountainous region of the state, namely: Afonso Cláudio, Conceição do Castelo, Laranja da Terra, Brejetuba, Venda Nova do Imigrante, Domingos Martins and Santa Maria de Jetibá. They are considered small cities, varying between 11 thousand and 42 thousand inhabitants (IBGE, 2021).

In total, 29 high schools are accounted for, one of which, the State School of Elementary and Secondary Education (EEEFM) Fazenda

Emilio Schroeder, offers Rural Education using the Alternation Pedagogy method (not being counted for the analysis).

The research that gave rise to this article was submitted to the Research Ethics Committee (CEP), and approved, and the approval data can be checked using the opinion number: 5.770.099 and CAAE: 63457722.1.0000.5072.

The analysis presents a qualitative approach, using data collection without numerical measurements to identify or refine research questions during interpretation (SAMPIERI, COLLADO; LUCIO, 2013).

## RESULTS AND DISCUSSION

It can be inferred that the proposal for the “In-depth Catalog of Training Itineraries”, as it is called by SEDU, would be interesting, as long as most of them were offered by schools, ensuring that each student chooses the in-depth study that best fits their expectations for the future. However, according to Article 13 of CEE-ES Ordinance Number: 5,666/2020, published on November 30, 2020, “educational networks and institutions must guarantee the offering of more than one training itinerary in each municipality, in different areas, allowing students to choose” (ESPÍRITO SANTO, 2020, p.04), taking into consideration, among other criteria, the capacity of institutions and networks.

In Table 03, the AIF offered by each school belonging to Afonso Claudio's SRE are presented.

From the above, it can be observed that, in practice, institutions offer one, two, at most three of these In-depth Studies, mainly in small schools in the interior of the State. In Afonso Claudio's SRE, it is observed that 61% of institutions offer only one AIF, and of these, only 24% opted for the “Renewable Energy and Energy Efficiency” itinerary, which covers all areas of knowledge. It can be observed that 35% of these schools only offer



an itinerary in a single area of knowledge. CEE-ES Ordinance No. 5,666/2020 is being followed: two or more different itineraries are offered per municipality; however, it still does not guarantee the free choice of students, especially those who depend on school transport.

The resolution fails to make it mandatory to guarantee the provision of more than one AIF, even in different areas, as this measure is not sufficient to guarantee choice for all students, limiting the development of skills and abilities for those who do not fall within the AIF offered.

Furthermore, even if a school within the municipality offers the student's intended AIF, it is not a guarantee that the student will be able to reach that school, as this directly conflicts with Ordinance 225-R, of September 15, 2021. Such document establishes standards, execution procedures, monitoring and accountability of financial resources of the State School Transport Program - PETE/ES, which makes it clear, in its Article 2, that the Program will provide resources to "guarantee the provision of school transport to students basic education from the state public network to the school unit closest to your residence". (ESPÍRITO SANTO, 2021 p.18 – emphasis added by the author).

One of the justifications for preparing the NEM was the lack of attractiveness of the high school curriculum, characterized as extensive, superficial and fragmented, far from the needs of the world of work, in addition to not engaging in dialogue with youth (BRASIL, 2016), making it necessary to offer a more attractive CV. From this perspective, what is the solution for those students who, due to school transportation, are attending schools that offer AIF that do not meet their expectations for the future?

Let's take the municipality of Brejetuba as an example of this scenario: a small city, with

around 12 thousand inhabitants (IBGE, 2021), where the AIF of MOD, (referring to the area of Human and Applied Social Sciences), EFF (area of mathematics), technician in Administration and technician in Agriculture. In this context, the question remains: where is the choice option for those students who have an affinity with the area of Natural Sciences? How are these AIFs "attractive" to these students?

In this context, it can be inferred that the teaching of subjects in this area tends to be compromised, as, in addition to the AIF offered not covering the aforementioned area, the subjects of Chemistry, Physics and Biology are covered in only two of the three years of the cycle, in other words, there is a reduction of around 240 classes in the area during the entire NEM stage. This is just one point to take into consideration, as the same panorama is observed in several municipalities in the State.

Similar scenarios were reported by studies by Cássio and Goulart (2022), where it was observed that small schools in the State of São Paulo offer only one training itinerary, since "the decision on offering training itineraries is influenced by variables related to the school itself. school management" (CÁSSIO; GOULART, 2022 p. 525) and not by the students' expectations.

In this context, Santos and Silva (2018) also question whether this flexibilization of the curriculum will not contribute to the increase in inequalities in the provision of public education, since "the process of constructing school curricula will be directly influenced by the budget available for their construction" (p.66).

The curricula of those schools that offer only one AIF, which is related to just one area of knowledge, are harmed, as already predicted by Bodião, (2018) because the "relevance to the local context" allows managers to "exclude training itineraries composed of due to school



content that they lack professionals” (p. 114). The same author corroborates the studies mentioned above regarding the provision of AIFs being directly dependent on the budget of each school.

The same is discussed by Silva and Boutin, (2018), that, as much as the propaganda presented by the media focuses on the student’s opportunity to choose, “the text of the law leaves these itineraries to be at the discretion of the education systems, and not the student” (p. 529).

As for the Chemistry subject, which is currently only offered in the 1st and 2nd series of the NEM, the New Capixaba Curriculum does not indicate the “contents” to be taught, but rather “Objects of Knowledge” to be developed throughout the cycle. For the Chemistry subject, the objects of knowledge covered during the first two series can be seen in table 04, drawn from the Espírito Santo Curriculum - Natural Sciences and Their Technologies Notebook. (Espírito Santo, 2020).

It can be seen that the contents of Radioactivity and Organic Chemistry, which were previously offered in the 3rd year of high school, were “condensed” in the 1st year of the NEM. In short, all the content that was covered in 240 hours throughout high school (and it can be said that the time was already insufficient) must now be reduced to 160 hours.

In the In-Depths, the Chemistry subject appears “contextualized” so to speak, and can be observed in four AIF, of the nine offered for Regular Education, that is, more than half of the AIF do not address chemical knowledge in their curricula. Table 05 was prepared based on the Curricular Organization Matrices, which came into force in the 2022 academic year (ESPÍRITO SANTO, 2022). It is worth noting that, according to this matrix, teachers with a degree in Chemistry can teach the

subjects listed here.

Observing the context of the SRE in question, the subject of Chemistry is only present in the subjects of Chemistry and Sport, present in the AIF of “Sport, Science and its Languages”, offered by 18% of schools, and in the subject of Matter and Energy, present in the AIF “Renewable Energy and Energy Efficiency”, offered by 29% of schools.

Such data corroborates the ideas of Togores (2021): the scope of competencies and skills brought by BNCC are hampered by the fragmentation of areas of knowledge into disciplines, and even themes within the same discipline.

Chemistry is a young science, however, since prehistoric times man “knew how to use the properties of chemical substances and was in contact with chemical transformations, trying to control them for his own benefit. (SCHEFFER, 1997, p. 01). According to Chassot, Science can be seen as a language constructed by human beings to explain the natural world, and he also states that Chemistry, “together with music and mathematics form the three universal languages” (CHASSOT, 1990, p.37). Chemistry teaching has a specific language and a varied range of codes involving the learning of its concepts, requiring abstraction skills from students.

In order for students to be able to exercise their rights and duties in modern society, skills and abilities related to mastering this language must be developed, leading to the formation of critical subjects, capable of making conscious and responsible decisions about technology and science in the social environment, as well as act on such issues (SILVA; LORENZETTI, 2023).

Learning to read scientific writings means knowing how to use strategies to extract information; know how to make inferences, based on different ideas; understand the role of scientific argument in the construction

of theories; recognize the possibilities for the text to be interpreted and reinterpreted; and understand the theoretical limitations imposed, in which their interpretation implies the non-acceptance of certain arguments. (POLANCZKY, 2019).

This change that occurred in high school contributes to possible insecurities regarding the construction of the student's scientific knowledge, which may increase these existing difficulties, also causing students' lack of interest in this science (HACK; BIASSIO, 2022).

Another fact to consider is that reducing the workload of the Chemistry subject could lead to gaps in the student's scientific knowledge, especially in schools that offer AIF not related to the area of Natural Sciences.

## CONCLUSION

Secondary education is an important stage in school life, as the skills and abilities acquired in this cycle influence the choices for the future professional or academic life that will follow.

From what has been stated in this work, the AIF offered by institutions are not, effectively, options that reflect the real choice of students, as they are destined to study what schools can offer, and these, in turn, are limited by the structure of the network, local context and demands of the school context.

Even if municipalities are offering more than one training itinerary, in different areas, as provided for by law, there are still obstacles such as transportation, in addition to the "sum" of the itineraries offered not, at times, covering all areas of knowledge, limiting the choice of students in that city.

In a world increasingly dependent on scientific and technological knowledge, which produces intense social, political, economic and cultural changes, it is necessary to understand scientific language, which

contributes to the formation of committed citizens who are responsible for their individual attitudes. or collective. In this context, teaching subjects belonging to the Natural Sciences Area is essential.

However, it is observed that, in addition to the reduction in course loads for Chemistry, Physics and Biology subjects, many schools do not offer AIF that cover this area of knowledge.

Given the changes made to the NEM and how challenging such a proposal is, in order for the competencies and skills indicated in the guiding documents to be covered, methodologies are necessary that effectively enable its actions, in order to contribute to bringing students and scientific training closer together.

To fill the possible gap left both by the reduction in the workload of subjects in the Natural Sciences Area during Basic General Training, and by the absence of these in schools where the AIF does not include this area, it is essential that institutions and teachers develop strategies that encourage the interest and engagement of students in the scientific area. It is also necessary to develop means that meet the needs of those students whose training desires are not covered by the AIF offered.

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