Revista Iberoamericana para la Investigación y el Desarrollo Educativo
ISSN 2007 - 7467

https://doi.org/10.23913/ride.v11i21.701

Artículos científicos

Identificación de un nuevo patrón en la configuración electrónica de los elementos que modifica el diseño tradicional de la tabla periódica

Identification of a New Pattern in the Electronic Configuration of the Elements that Modifies the Traditional Design of the Periodic Table

Identificação de um novo padrão na configuração eletrônica dos elementos que modificam o design tradicional da tabela periódica

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Resumen

Este trabajo propone un nuevo diseño de la tabla periódica de los elementos que consiste en una doble clasificación, una externa y otra interna: la externa incluye bloques, grupos y periodos reorganizados en forma de escalera, y la interna sigue un patrón que ubica a todos los elementos en su respectiva casilla, e incluye el patrón establecido por el químico ruso Dimitri I. Mendeléyev, principios cuánticos y patrones matemáticos. Científicamente se concluye que, al identificar el patrón como el último orbital localizado en la configuración electrónica, es este el que rige la organización de los elementos en la tabla periódica, y es el eslabón para comprender el nuevo diseño de esta y de otros temas. Los elementos se organizarán en el nuevo diseño de la tabla periódica siguiendo teóricamente la regla de Madelung o en su estado basal.

Palabras clave: conocimientos previos, didáctica, diseño, habilidades, organización, patrón, tabla periódica.

Abstract

This work proposes a new design of the periodic table of the elements that consists of a double classification, one external and the other internal: the external one includes blocks, groups and periods reorganized in the form of a ladder, and the internal one follows a pattern that places all elements in their respective box, and includes the pattern established by the Russian chemist Dmitri Mendeleev, quantum principles and mathematical patterns. Scientifically, it is concluded that, when identifying the pattern as the last orbital located in the electronic configuration, it is this that governs the organization of the elements in the periodic table, and is the link to understand the new design of this and other topics. The elements will be organized in the new design of the periodic table theoretically following Madelung's rule or in its basal state.

Keywords: previous knowledge, didactics, design, skills, organization, pattern, periodic table.

Resumo

Este trabalho propõe um novo desenho da tabela periódica dos elementos que consiste em uma classificação dupla, uma externa e a outra interna: a externa inclui blocos, grupos e períodos reorganizados na forma de uma escada, e a interna segue um padrão que coloca todas as elementos em sua respectiva caixa e inclui o padrão estabelecido pelo químico russo Dimitri I. Mendeléyev, princípios quânticos e padrões matemáticos. Cientificamente, conclui-se que, ao identificar o padrão como o último orbital localizado na configuração eletrônica, é este que governa a organização dos elementos na tabela periódica e é o link para entender o novo design deste e de outros tópicos. Os elementos serão organizados no novo desenho da tabela periódica, teoricamente seguindo a regra de Madelung ou em seu estado basal.

Palavras-chave: conhecimentos prévios, didática, design, habilidades, organização, padrão, tabela periódica.

Fecha Recepción: Enero 2020 **Fecha Aceptación:** Julio 2020

Revista Iberoamericana para la Investigación y el Desarrollo Educativo
ISSN 2007 - 7467

Dedico esta investigación realizada con tiempo, esfuerzo, esmero y con mucho amor a mi esposo e hijas por su apoyo incondicional en todo momento. Dedicado también a la Naturaleza porque merece nuestro respeto ecológico. Se agradece la guía recibida por revista RIDE.

Introduction

Didactics, with all certainty, is the most valuable tool that a teacher has to teach a subject of any subject, of any level, of any area and in any field. Young scientists no longer worry about learning the memory table. And the teachers don't demand it either; As at the University of Ljubljana, Slovenia (Vazquez, September 1, 2017), they prefer to develop skills in the classroom and consult it whenever it is required. There are data that have to be memorized (telephone number, addresses, rivers, capitals, countries) because they do not have logic or deduction, while there are others that involve reasoning such as multiplication tables and the elements of the periodic table and yet they are They have taught by memorizing (Agudelo, 2015; Arranz, September 14, 2017). In particular, understanding and understanding the organization of the elements that exist in nature is relevant to address issues of the macro behavior of matter and, therefore, the phenomena presented in nature itself.

For a student to understand, they have to develop basic cognitive skills; for him to understand, he has to develop superior cognitive skills (Caamano, 2011): he interprets and represents, he transfers knowledge to new contexts. The development of skills (see Table 1) has been a key part to achieve the scientific part in the new design of the periodic table (see Figure 3) proposed in this research work. It is recommended as a teaching strategy the method of teaching to think (Swartz, 2019; Woolfolk, 2010) and of learning, that of developing skills. It should be clarified that ability refers to "knowing how". In this regard, Portillo (2017) mentions something important: "Skills are individual in nature and competences are social in nature" (p. 4). And later she adds the following: “Skills education has its main interest in the idea of the progress of a skill and, therefore, in the progress of each student in the development of the skill in the educational process (Heritage, 2015) ”(Portillo, 2017). In addition, the global assessment International Program for Student Assessment (PISA) requires the preparation of students with scientific skills in developing cognitive skills (Franco, 2015; Sanz, 2010; Barbán, 2008).

Chemistry has always been seen as a deeply scientific area of knowledge, and is rejected by many students because they say they are not going to be chemists. However, what many are unaware of is that learning chemistry offers the opportunity to develop all the skills that are recognized in education as useful for everyday life.

The relevance of teaching how the periodic table is organized lies, first of all, in accepting that nature is in it and is organized at the micro level and the macro behavior of matter depends on it; at both levels, prior knowledge (Woolfolk, 2010) and basic knowledge of physics and mathematics are involved, since a certain level of abstraction and elementary knowledge is required to understand and understand chemistry. Secondly, it is relevant in daily life to form humans who are respectful of nature, with sound decision-making and susceptible to micro, something that we cannot see, but it exists (Busquets t.e, 2016) (Agudelo, 2015).

For the theoretical part, when teaching chemistry topics, it is recommended to use techniques that apply color codes in activities so that students can develop the “basic skills”: observe, relate, compare, classify and describe (Swartz, 2019; Sanz, 2010; Woolfolk, 2010;) (see Table 1); likewise, orderly use of the blackboard, as well as the use of analogies to teach thinking (Woolfolk, 2010). For the experimental part, there are currently many educational simulators on the Internet (Caamano, 2011) that also contribute to the development of skills and avoid, for example, the risk that the student will get burned with a reagent in the laboratory, Which, in addition, are expensive for many schools.

Here it is suggested not to memorize the periodic table (see Figure 3); what should be done with it is to use it as another form of consultation, understand and understand its organization according to the identified pattern. As already mentioned, at the University of Ljubljana, Slovenia (Vazquez, September 1, 2017), they do not memorize it, they consult it whenever it is required. What is relevant is to understand and understand the organization at the micro level that governs the elements in it under a pattern (see Figure 2) (see Table 2), to later understand and understand chemistry issues at the macro level.

As part of this work, various didactic proposals have been found (see class example in Methods), in the teaching of the periodic table (see Table 1). Arévalo's study (2016) tackles chemistry issues playfully for a basic level; favors the learning of names, atomic numbers, properties and symbols. The problem of understanding and understanding in upper and upper level students in the microscopic part of the subject (Busquets, te 2016) is that they will not apply the senses as we do when learning or teaching the macroscopic part of the subject, instead, the level of abstraction must be applied, you have to imagine something that is not seen (Busquets, et 2016) and accept photos or videos that scientists provide us with the support of tools such as the electron microscope (Agudelo, 2015). Another study at the basic and upper secondary level affirms that the textbook is seen as the only educational resource (Agudelo, 2015). Furthermore, he debates that "the teaching of the periodic table contributes to perpetuate the idea that atoms are the object of study in chemistry, rather than a tool for thinking about chemical changes and intervening them rationally and reasonably" (p. 10). Students can observe phenomena difficult to understand, this is where it is necessary to implement the development of basic and higher cognitive skills (Busquets, te2016), (Canmano, 2011) such as representing and interpreting (Pasek and Matos, 2007; Sanz, 2010 ; Woolfolk, 2010). Following the Johnstone model (Cutrera and Stipcich, 2016), in teaching better learning can be achieved by separating the macro (the senses are applied), the micro (abstract and organized thought) (see Table 1) and the symbolic (formulas and equations) (see Table 3). In order to understand the macro part of matter, you have to understand the micro part, both converge on the symbolic part.

The periodic table (see Figure 3) is classified by blocks following a pattern of the atomic number implemented by the Russian chemist Dimitri I. Mendeléyev in 1869 (Agudelo, 2015). In this research, however, the periodic table is redesigned with a second pattern that includes the first and all the principles already recognized and established by quantum theory. To understand this, students must imagine something they do not see, (Busquets, te2016), which is achieved using concrete material to see how atoms are constituted by orbitals (s, p, d, f), which have been Analytically studied (separately). Thus, they must arm (synthesis) (Sanz, 2010) with concrete material an atom and a molecule, exposing the following example: sodium (Na), its electronic configuration is: 1s2 2s2 2p6 3s1, this means that the same axis of symmetry it contains the orbitals (s, p), as specified by their particular electronic configuration (Burns, 2011); the student must learn to identify the pattern (see Table 2) (see Fig. 2) that assigns this and all the elements its location in the new design of the periodic table (see figure 3), so that it can be understood that, therefore, this element is found in block (s), group 1, period 3, box 1 (see Fig. 3). It is common to teach how to memorize the elements of the periodic table, when it is more interesting and relevant

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to understand and understand the pattern that places each element in its proper place in the proposed design.

Justification

According to Dr. Eric R. Scerri (2019), the periodic table is not finished. In this regard, there are several controversies:

As for Scandium, the additional electron is said not to be located in the 4p orbitals, but in 3d: indeed, a 4s to 3d orbital hybridization process occurs, stated by Dr. Heber Gabriel Pico Jiménez (Pico, 20 October 2014) and theoretically proven in this research work by performing a series of hybridization exercises of various compounds to observe this behavior; the last electron is responsible for seeking balance in the orbital, a detailed topic released in a following article by the author.

Hydrogen and helium are still a matter of discussion: these are elements that must be together for approved and proven foundations. One of them is that the quantum number (l) assigns the pattern that governs the elements of the periodic table (see table 2). The proposed design is based on the Madelung rule, further known by the Moeller diagram, for containing the additional pattern in the last orbital of the last level.

An increasing number of researchers consider that the last two elements of group 3 should be replaced by Lutetium and Lawrencio, instead of Lanthanum and Actinium, and be part of the group of Scandium and Yttrium: that is, the configuration electronics of these elements ends in d, so they must be in block d (see Table 2); indeed, they will be replaced: 71 and 103, that is their place in the proposed new design.

Transition elements like Copper and Chromium are difficult to reconcile with the global patterns of the periodic table: in block d a type of hybridization (spd) with a delta bond occurs (Atkins and Jones, 2006; Pico, October 20 2014); the last electron is responsible for achieving balance in the orbital, a detailed topic will be released in a following article by the author.

Aufbau's principle uses a simple number rule to describe the sequence in which the orbitals are filled. This is known as the Madelung rule, by the physicist Erwin Madelung, who formulated it in the 1930s (Agudelo, 2015). The filling sequence is simple for the first three rows of the periodic table, in which the elements only have electrons in the s and p orbitals. Here, on the contrary, the Aufbau principle will no longer be considered a simple numerical

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rule; Madelung's rule is the filling sequence not only for the first three rows, but for the entire periodic table.

The 3p orbitals are filling in the elements that go from aluminum to argon. But things get complicated when we get to the fourth row of the table. The 4s orbital is then filled into potassium and calcium. Indeed, it follows the order of Madelung's rule.

The elements are thought not to follow Madelung's rule, which is illogical for scandium to lose an electron from the 4s orbital, where it is observed experimentally, since this orbital has lower energy than the 3d orbital: it is not illogical, this element is found in block d, level 3, box 1, according to the proposed pattern; There are three foundations that support the case: a) the electron that reacts first is the one with the highest level (〚4s〛 ^ 2) and lowest energy (〚3d〛 ^ 1) (Atkins and Jones, 2006; Grosvenor and Gálvez, 1976; Orgel, 2003); b) the electrons are distributed looking for equilibrium, one electron in block d (Orgel, 2003); c) this is complemented by the hybridization topic (Pico, October 20, 2014), where the 4s electron is located in the second orientation of d, thus obtaining three empty spaces so that three chlorines unite and the scandium trichloride, for example.

Chromium is one of those anomalous elements. Madelung's rule predicts that it should have four electrons in its 3d orbitals and two in its 4s. However, spectroscopy shows that chromium has five electrons in the 3d orbitals and one in the 4s. Similarly, copper, niobium, ruthenium, rhodium, and a dozen other elements have an additional electron in the d or f orbitals, rather than the outermost orbitals, as might be expected. In the present investigation, this is not considered an anomaly, the aforementioned fundamentals occur; it is a delta bond that occurs between the 3d orbital and the 4s orbital in a fourth period transition metal (Pico, October 20, 2014) and theoretically verified when performing a range of exercises related to the topic of hybridization; where the last electron of the last 4s level and of lower energy acts (Atkins and Jones, 2006) and is located in an orientation of the d orbital, thus achieving a semi-occupied orbital that achieves equilibrium (Orgel, 2003); with six spaces (one in s, five in d) it achieves its maximum oxidation state (+6); to reach its oxidation state (+3) it is reduced. It is recommended to understand and understand this article as knowledge prior to the next topic to present. The pattern has been identified because what is already established includes it (see Table 2) (see Fig. 2) With the proposed design, it is expected to contribute to the didactics and dispel all or most of the scientific doubts that are regarding the periodic table in the XXI century.

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Materials and methods

The suggested didactic methods in chemistry are, in teaching, the method of teaching to think (Swartz, 2019; Woolfolk, 2010); while in learning, the development of cognitive and higher skills (Canmano, 2011) (Woolfolk, 2010). The following is an example of a class: 1) Conduct a survey of previous knowledge and homogenize the group for the necessary time. 2) Define the basic and elementary skills that students must develop, such as observing, relating, comparing, classifying and describing. Show students an educational video related to the subject of the atom, cells starting from nature, where the student elaborates questions about it and with the guidance of his teacher, he can get involved in the subject, with answers found in the aforementioned video without sound. 3) Using a conceptual map, separate what we will study and expose it in class: a) micro, b) macro and c) symbolic (table 1) (Johnstone method) (Cutrera and Stipcich, 2016). 4) Gradually, go on to involve other higher-order skills, namely: interpreting, representing, analysis, synthesis, among others. 5) That the students, by team, investigate and present real cases where chemical products or phenomena are involved; develop their critical thinking, communication and language skills by submitting an individual report by the end of the topic. 6) The teacher's expository classes must include analysis and analogies (Caamano, 2011; Sanz, 2010; Woolfolk, 2010). 7) Students who understand quickly can help those who have not yet understood (scaffolding by J. Brunner) (Woolfolk, 2010) (Barbán, 2008). 8) Students must learn to identify patterns and number series (see table 3) on the periodic table; They will carry out exercises applying the principles of quantum theory (enactive, iconic and symbolic; J. Brunner theory) (Woolfolk, 2010). 9) Provide clues in problem solving (Vygotsky's theory). 10) Make atoms and molecules with concrete material to form molecular networks in order to understand how the elements in the periodic table come together and how they are arranged, according to their orbitals (s, p, d, f). 11) Use the laboratory or simulators to complement the practical part (gamification and experimental) (Caamano, 2011). 12) Carry out dangerous household practices such as observing an oxidized material in a soda with an acidic pH; With balloons as concrete material we can represent the orbitals and see how they fit in a three-dimensional space (synthetic method). 13) Evaluate your ability to identify three-dimensional molecular geometry by networking with the water molecule, essential for life, and create ecological awareness in the care of it.

As for the scientific method used to create the new design of the periodic table, it is documentary and hypothetical-deductive, which aims to understand phenomena and explain the causes that generate it and part of general premises to arrive at a particular premise (magisterial spill, May 11, 2006; Sánchez, 2019). And it consisted of the following: 1) a lag was observed in the elements of block d compared to elements in block p when the same data is shown in the consulted table for both levels and they are at another level (Zn and Ga; Cd e In; Hg and Tl; Ca and Sc; Sr and Y; Ba and Lu); the orbitals were observed to carry a vertical, horizontal and diagonal order in Madelung's rule (Atkins and Jones, 2006), and this order is related to the periodic table and the internal composition of the atom; and that the organization of the elements is governed by mathematical patterns (see Table 3) and an identified pattern (see Figure 2) (see Table 2), in addition to everything established. 2) A hypothesis was proposed: the blocks should be rearranged to avoid the observed lag. 3) Only, when reordering the blocks, in the internal part the order of the atomic number was not sequential; The staggered pattern was identified by applying a color-coding system that makes it stand out clearly, that is, from the seventh to the first period. 4) It is verified that the pattern is the last orbital that locates the elements in a new design of the periodic table (see Figure 3), and they will be organized theoretically according to Madelung's rule or in their basal state. This was how the results obtained and presented in this research work were reached.

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Tabla 1. Habilidades cognitivas a desarrollar en química

Macro	**Micro**					**Simbólico**
Sentidos	**Pensamiento abstracto**					**Razonamiento lógico**
Observar en tabla periódica	**Identificar en tabla periódica**	**Interpretar, relacionar**	**Diferenciar, comparar**	**Clasificar o describir**	**Representar**	**Calcular**
Grupos o columnas, nivel o periodo, bloques.	Bloques s, p, d, f	Conceptos: *elemento*, *sustancia*, *átomo*, *partículas*, *molécula*, *compuesto*, entre otros	Diversos modelos atómicos; niveles de subniveles; orbital de mayor nivel de orbital de menor energía	Describir con sus propias palabras cómo reconocer el átomo central en las moléculas	Fórmulas	Notación científica, radio atómico, ángulo de enlace, longitud de enlace
Periodos o filas	Patrón que rige la tabla periódica	Teorías	Principios de teoría cuántica	Clasificar las fórmulas químicas al aprender ejemplos	Moléculas, estructura de Lewis, tipos de enlaces	Estado de oxidación, carga formal
Propiedades físicas y químicas por grupo	Tipos de fórmula, enlaces; átomo	Fórmulas	Variables n y m: AX_nE_m de n, l, m, s	Clasificar las propiedades	Modelos	Números cuánticos

y periodo.	central (1, 2, 3)			físicas y químicas		
Número de columnas por bloque, número de elementos por periodo y número de elementos por bloque	Fórmulas matemáticas	Hibridación, números cuánticos	Valencia de estado de oxidación		Configuración electrónica	Restar números atómicos de parejas en elementos por grupo

Fuente: Elaboración propia con base en: (Portillo & Torres, 2017) (Cutrera & Stipcich, 2016) (Atkins, 2007)

Results

The proposed design comprises two classifications, one external and one internal. the external preserves the order of group and period reorganizing blocks; the internal organizes the elements according to the pattern that is the last orbital of the last level of the electronic configuration, placing the elements in their correct box (see figure 3 and table 2). The didactics consists of developing skills under the criteria of shape and color. Table 1 shows the skills that students must develop in chemistry topics. Table 2 provides the relationship of the identified pattern with the organization of the elements. And in Table 3 there are some elementary mathematical patterns in the periodic table. In turn, figure 1 shows the pattern experimentally verified by Dr. David Goodstein (Ministry of Public Education [SEP], 2014); Figure 2 proposes the way to identify the pattern, taking the scandium element as an example, and Figure 3 shows the proposed new design of the periodic table.

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Tabla 2. Relación de los elementos con el patrón identificado y su ubicación en un nuevo diseño de la tabla periódica

Elemento	**Orbitales antecesores al patrón en estado basal del átomo**	**Patrón identificado**	**Bloque**	**Nivel ó periodo**	**Grupo**	**Casilla**
He		$1s^2$	s	1	8 ó 18 ó 0	2
C	$2s^2 2p^2$	$2p^2$	p	2	4 ó 14	2
Cl	$3s^2 3p^5$	$3p^5$	p	3	7 ó 17	5
Sc	$4s^2 3d^1$	$3d^1$	d	3	3	1
Lu	$6s^2 4f^{14} 5d^1$	$5d^1$	d	5	3	1
Cr	$4s^2 3d^4$	$3d^5$	d	3	6	4
Cu	$4s^2 3d^9$	$3d^9$	d	3	11 ó 1	9
Si restamos número atómico en parejas de elementos en un mismo grupo, encontraremos como resultado $\mathbf{2n^2}$**;** lo cual confirma su ubicación correcta.			Lr – Lu: 103 – 71 = **32** Cd – Zn: 48 – 30 = **18** Ne – He: 10 – 2 = **8**		Lu – Y: 71 – 39 = **32** Ca – Mg: 20 – 12 = **8** Be – He: 4 – 2 = **2**	

Fuente: Elaboración propia con base en (Cassabo, 1996) (p. 70)

Tabla 3. Algunos patrones matemáticos que rigen la organización en la tabla periódica

Nivel o periodo (n)	**O orbital**	**Número cuántico secundario (ℓ)**	**Número de orbitales (m)**	**Suma acumulada de orbitales**	**Número de electrones en orbitales**	**Número de electrones acumulados**	**Orbitales mayor ó menor energía**	
		(n − 1)	$\mathbf{2\ell+1}$		**2(2n − 1)**	$\mathbf{2n^2}$	**(n + ℓ)**	
1	S	0	1	1	2	2	$4s^2$	$3d^1$
2, 3	P	1	3	4	6	8	4 + 0 = 4	3 + 2 = 5
4, 5	D	2	5	9	10	18	$3s^2$	$3p^5$
7	F	3	7	16	14	32	3 + 0 = 3	3 + 1 = 4

Fuente: Atkins (2007, p. 25), Burns (2011, p. 142) y Grosvenor y Gálvez (1976, p. 6)

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Figura 1. Patrón comprobado experimentalmente por el Dr. David Goodstein (2014) y sustento de este trabajo de investigación

Orbitales				m				# orientaciones
s				**0**				**1**
p			**-1**	**0**	**1**			**3**
d		**-2**	**-1**	**0**	**1**	**2**		**5**
f	**-3**	**-2**	**-1**	**0**	**1**	**2**	**3**	**7**

Fuente: Goodstein (SEP, 2014)

Figura 2. Propuesta de autora: patrón identificado como el último orbital de la configuración electrónica que modifica el diseño tradicional de la tabla periódica, modelando con el elemento escandio

Escandio:

nivel: **3** bloque: **d** casilla: **1**

grupo: **3** estado de oxidación: **3**

↑Nivel, ↓ energía

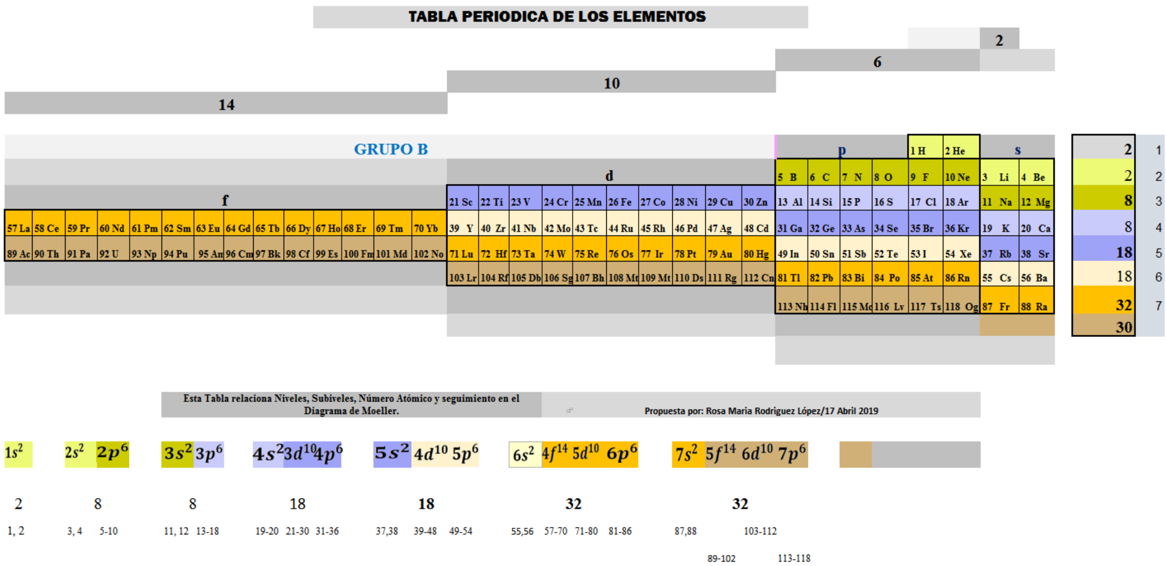
$4s^2 3d^1$

↓Nivel, ↑ energía

Patrón: **s, p, d, f**

Fuente: Orgel (2003, p. 3) y Grosvenor y Gálvez (1976, p.7)

Figura 3. Propuesta de un nuevo diseño de la tabla periódica



Fuente: Casabó (1996, p. 78)

Discussion

The proposed design coincides with the staggered shape of the model presented by Charles Janet in 1928 (Arévalo, 2016); it only differs in the internal part of the periodic table, since the presented model did not consider the electronic configuration. It is based on the experimental part of Dr. David Goodstein (SEP, 2014) of the Institute of Technology in California, who states that the pattern that governs the elements is the quantum number (m), which has been the basis for its identification as pattern rather to the last orbital of the last level of the electronic configuration of each element, since the second quantum number (l) is the one that gives the values to the third quantum number (m); In colloquial words, l gives the shape and m is the orientation of the molecule, and therefore, the pattern will be the last orbital, which places the elements in their respective box on the periodic table.

It was also based on Dr. Gabriel Heber Pico (October 20, 2014 =, Colombian scientist, who has been the basis on the subject of hybridization; however, as in the previous case, there is also an exception here, since he proposes a different design to the one he proposed in 2014 for the periodic table, namely, the scandium retains its place as in the traditional table.In addition, this author joins block d with block f and block s changes it by dividing it into boxes two by two staggered; in this proposal the s block is also moved, but in a different way, following the pattern and the d and f blocks are joined, but they are at different levels, taking into account Madelung's rule. Finally, a questionnaire presented by the Puerto Rico Department of Education was found, without data from the author: "Patterns in the electronic configuration", where the pattern is mentioned and identified as the last orbital without going into this concept; In addition, it should be clarified, no further information was found on the subject and no bibliography on Dr. Goodstein was found, but only video (SEP, 2014).

Conclusions

Regarding didactics, there are two aspects: on the one hand, how is it taught ?, and on the other, how is it learned? In the first, the approach of teaching to think as a methodology for any subject of any subject at any level and in any field is recommended, which consists, as already mentioned above, of asking questions together with the group and regarding the subject. ; and in the second, it is recommended to apply activities and educational material that favors the development of cognitive skills; in addition, develop scientific skills. The student, to understand, must first understand, and this is achieved by developing basic skills. Cognitive skills are complemented by other skills that exist in education, such as inter and intrapersonal skills, communication, self-control, critical thinking, social and decision-making, to name a few. Previous knowledge is a key piece. Thus, to understand and understand this specific topic, the skills required are: in mathematics, basic operations, fractions, powers, series, substituting a variable in an equation, algebraic language, scientific notation, the ellipse, three-dimensional axes; in physics, differentiate what is a physical phenomenon from a chemical one, three-dimensional axes, vector, angular momentum; in chemistry, distinguish concepts such as element, atom, molecule, bond, electronic configuration and principles of quantum theory.

Scientifically, it is concluded that, when identifying the pattern as the last orbital located in the electronic configuration, it is this that governs the organization of the elements in the periodic table, and is the link to understand the new design of this and other topics. The elements are located in the new design of the periodic table theoretically following Madelung's rule or in its basal state.

Academically, at the upper secondary level in Mexico, it is observed that chemistry is taken in the first semester and physics in the third semester, that is, in two different times; should be, in addition to being related in third, in the first semester there should be an introductory subject or scientific skills workshop prior to both subjects, including mathematical skills not translated to solve exercises, but to interpret concepts and reinforce algebraic language, this is only a suggestion .

This research work will be complemented by another article and an activity book that will be focused on the development of cognitive skills. This work was completed precisely at a historic moment, on the 150th anniversary of the periodic table, and released until the present 2020, with the hope that it will be accepted by the scientific, teaching and student community.

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