International Journal of Science Academic Research
Vol. 03, Issue 03, pp.3628-3634, March, 2022
Available online at http://www.scienceijsar.com

ISSN: 2582-6425

Research Article

UPDATING OF THE PROPOSED NEW DESIGN OF THE PERIODIC TABLE AND ITS DIDACTICS AN EDUCATIONAL SCIENTIFIC INTERPRETATION

[1,*]Rodríguez-López, Rosa Maria and [2]Medina-Rodríguez, Nataly

[1]Professor, Cetys Universidad, Tijuana, México
[2]Engineering Director, Cetys Universidad, Tijuana, Mexico

Received 20th January 2022; **Accepted** 24th February 2022; **Published online** 30th March 2022

Abstract

A new observable pattern is found that reaffirms the design proposed on the Periodic Table presented by authors in a report prior to this one; the update is based on the previously presented model, now with the found pattern it is reconfigured by folding the proposed Periodic Table in the form of a ladder, by folding it the double position that Hydrogen has is identified; so we will also find that the Periodic Table is a projection of the Moeller diagram. In this update with the identified pattern, we find the diagonals that fold the design proposed by the authors in 2020. The key to carry out thisresearch work with all certainty has been Didactics, being an extension of articles prior to this one. The teaching method is precisely to *teach to think* and the learning method consists of favoring basic and superior cognitive processes. Five proposals are related by different authors, from different backgrounds, from different places, at different times, by different methods, which converge in different aspects to this update and one of them is approached.The objectives of this documentary and explanatory research as a result of teaching praxis are to facilitate learning, contribute to science and education, as well as professional improvement.

Keywords: Design, Periodic Table, Pattern, Didactics.

INTRODUCTION

There have been many changes in the Periodic Table since Russian chemist Mendeleev, 1871, chemists still in the XXI century, still do not agree on which is the definitive Table; The closest research to the proposal presented in this research is thegeologist Charles Janet's, 1928proposal, known as the Periodic Table extends from the left in the form of a ladder, (Goya, Román, and Elguero, 2019; Chamizo, 2018) where also the location of the block (s) is changed keeping the order (s, p, d, f), reflecting the Madellung rule; Gary Katz, 2001, American chemical educator, "revives Janet's proposal as it offers the periodic system more orderly than the conventional representation", in fact he uses Janet's table in his university classes(Scerri, 2008); There is a certain similarity of this update with the proposal of engineer Valery Tsimmerman, 2006with its vertical tower model (Arellano Palma, 2021) where it coincides with the diagonals and centered blocks; and almost totally coincides with the chemist Scerri, 2008 who proposed to place Hydrogen in Halogens, Helium's inseparable neighbor, keeping it in noble gases (Zambón, 2013).Some didactic and chemical aspects that need to be considered are identified as follows:

a) Proposal from Dr. Scerri, 2008, which places Hydrogen in Halogensgroup still does not completely satisfy the location that Hydrogen has (Zambón, 2013), "since it coincides in physical properties but not in chemical properties with the Halogens and that it must remain without a group" (William Atkins and Jones, 2006). The problem of the position of Hydrogen is still open, it is placed with Halogens because it lacks an electron to complete the valence level, or with the Carbon family due to its chemical similarity, it is placed with the alkalines because it has an electron of valence";

Corresponding Author:** ***Rodríguez-López, Rosa Maria
Professor, Cetys Universidad, Tijuana, México.

"Laing 2001, proposes two positions, other proposals sustain that it does not have a group" (Agudelo Carvajal, C., 2015); This supports the authors' proposal.

b) It is seen that the Moeller diagram has been underestimated as a simple mnemonic rule (Agudelo Carvajal, 2015) that only applies to find the electronic configuration of the elements and it is not like that; the diagram being an arrangement of orbitals that can be interpreted in a vertical horizontal and staggered order (Rodríguez-López& Medina-Rodríguez, 2020).

c) The view of Chemistry, in particular the Periodic Table, that it is very complicated: "In it, the rare earth elements were placed after Lanthanum, so the table was too cumbersome", "It was the Austrian chemist Friedrich Adolph Paneth who solved the problem, simply taking the elements out of the table and placing them outside" (Fernández& Fernández, 2012). This view that the Periodic Table is cumbersome should be changed to something more formal, such as finding a pattern for all elements, even when they are all different, according to authors.

d) From the didactics point of view, chemistry teachers do not always teach the same thing or with the same depth, the way in which teachers usually approach the subject of the Periodic Table in various ways" (Agudelo Carvajal, 2015); it should be taught to think since"In the world of work, so much labor is not required, but rather thinking brains" (Tejada, Acevedo, and Mendoza, 2015; Muria Vila, Damián Díaz, 2008). According to the pedagogue Pablo Romero Ibáñez (Ibañez, 2021), widely recognized internationally, the model of the 21st century teacher must include the dimensions not only of knowing how to be, knowing how to do, knowing how to know, but also knowing how to think, knowing how to innovate; a teacher committed to didactics is constantly renewing the planning of their classes. Understanding Didactics as "the set of rules and principles that support the teaching-learning process, without considering a specific field or content" (Abreu,

Gallegos, G., and Martinez, 2017). "The act of thinking implies reasoning, representing, understanding, perceiving, identifying the source of origin; knowing how to think implies methods, strategies, instruments, tools", according to Dr. Pablo Romero Ibáñez (Ibañez, 2021), in contrast to memorizing a topic such as the Periodic Table, just to mention an example.

e) It should consider teaching the subject of the Periodic Table understanding that there is a pattern that organizes the elements instead of memorizing it.

METHODOLOGY

Investigation Methodology

1. A numerical pattern is observed in each block of the Periodic Table, which is related to the number of orbitals present in the Moeller diagram and its diagonals.
2. Finding these diagonals visualizes that it is possible to fold the Periodic Table and the following questions arise: why fold it? How to fold it?
3. It is deduced that the location of Helium, because it is in the bending corner, has a double face, giving Hydrogen the opportunity for a possible second location. In order for it to be feasible to fold the Periodic Table in a new design and we can see Hydrogen in a second location, it is necessary to consider that this element located in the Halogen group by Dr. Scerri, 2008, has an apparent location in Halogens.
4. It is generalized that the Periodic Table is rigorously theoretical, placing the elements in the basal state based on the pattern previously reported by the authors. The proposal is updated to a new design of the Periodic Table, which suggests using the flat form and the folded form of the Periodic Table with two different locations for Hydrogen.

Teaching-Learning Methodology

To teach, you can pose questions like the ones that will be presented below; to learn,learners should be encouraged to develop basic skills in the following order:observe, relate, compare, classify and describe; as well as superior skills such as: analysis, synthesis, induction, deduction, transfer, representation, among others (Muria Vila and Damián Díaz, 2008). Thinking in an organized way implies methods, strategies, techniques, tools, resources, according to the pedagogue Romero Ibañez (Ibañez, 2021), this has been the key for the elaboration of this and previous reports by authors.

1. Why should the conventional Periodic Table be changed?

Block (d) as well as block (f) must move up of level since their main quantum number is three and four respectively, therefore, they belong to the third and fourth level, from the proposal of Valery Tsimmerman, 2006(Arellano Palma, 2021); furthermore, the block(s) must be changed to the beginning to follow the order (s, p, d, f) because the Periodic Table is arranged to left from Janet's proposal, 1928(Goya, Román, and Elguero, 2019; Chamizo, 2018). Proposal by Dr. Scerri, 2008, which locates Hydrogen in Halogens, a foundation was found that ensures that Hydrogen must remain without a group (William Atkins and Jones, 2006), based on this finding, this proposal to a new design of the Periodic Table by authors, assigns to Hydrogen a second location. In 2020, a new proposal was presented that places the elements in the basal state in the Periodic Table and is therefore rigorously theoretical, elements cannot be placed with an activated state configuration because they present different patterns previously reported by authors (Rodríguez-López and Medina-Rodríguez, 2020); now an update is being made to reinforce the proposal and complement it by relocating Hydrogen. "We must not forget that the electronic configurations of the fundamental state of the elements, on which the Periodic Table is based, are built with an orbital approximation model (Cassabó i Gispert,1996); "The conventional Periodic Table reflects the outermost electronic configuration, or the valence layer in the basal state of an atom of each of the elements as a function of its maximum main quantum number n and of the values (n – l) and/or (n-2)"; however, it "suffers from its inability to logically classify the Lanthanide and Actinide elements" (Moeller, 1994) . "Hydrogen is a non-metal that resembles the Halogens, only one electron is needed to complete its valence electronic configuration, it can form ions (-1) and its diatomic formula is the most stable. However, the chemical properties of Hydrogen are very different from Halogens,because it does not fit into any group of elements, it is not assigned to any group" (William Atkins and Jones, 2006). These fundamentals are the basis for the new proposal of authors.

2. Why is the topic relevant for someone learning Chemistry at a professional introductory level?

In the first place, because in the Periodic Table there are elements of Nature organized physically, chemically and mathematically, because it is the basis of all knowledge. Secondly, it opens up new ideas, new contributions, to find answers to questions that are being asked in the 21st century. Thirdly, it is taught to think favoring cognitive development in those who learn by developing basic and superior skills (Muria Vila *et al.,* 2008); therefore, the negative view of Chemistry as a subject must be changed.

3. What would be the previous knowledge of the topic?

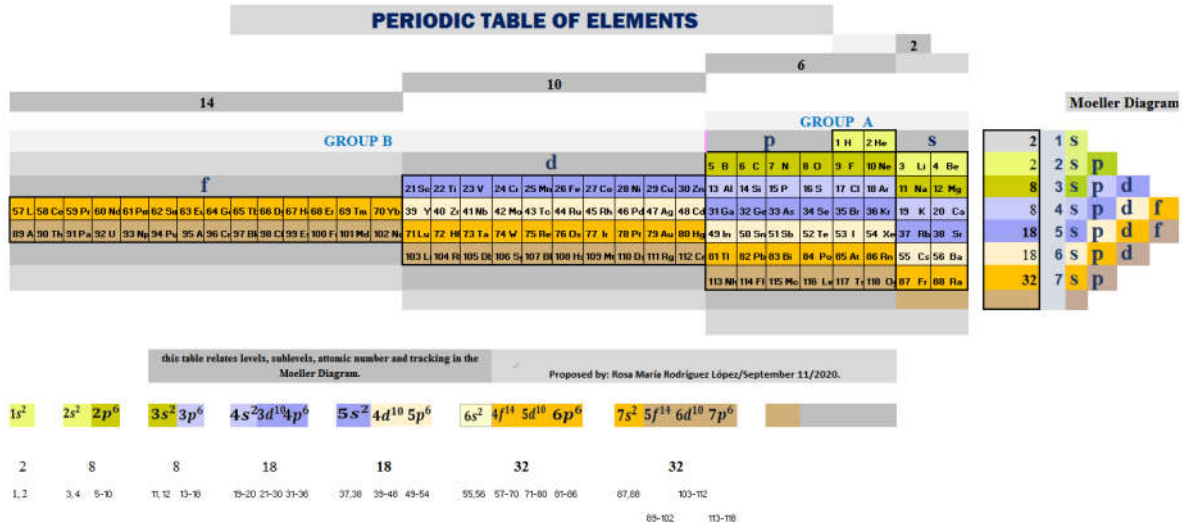
Identify concepts such as atoms and their models, elements, molecules, types of bonds, structural formula, space, electronic configuration, theories, among others (Tejada *et al.,* 2013).

4. What was the proposal for the Periodic Table previously presented by the authors and what did it consist of?

In the first report, the last orbital that locates each element of the Periodic Table in its respective box under the basal state was found as a pattern. In the second report, another pattern was identified that justifies the anomalies that certain elements present in an activated state; In this second report, the first design proposal is updated with respect to the Periodic Table. "The blocks of the Periodic Table are designated considering to the last occupied orbital according to the construction principle. The periods are numbered according to the principal quantum number of the valence level" (William Atkins and Jones, 2006). The pattern that classified the elements by blocks, contributed by Alfred Werner and Paneth, 1905 (Fernández and Fernández, 2012); It is the same pattern that now relocates the elements by box and that modifies the conventional Periodic Table, to a new design in the form of a ladder, proposed by the authors (Figure 1).

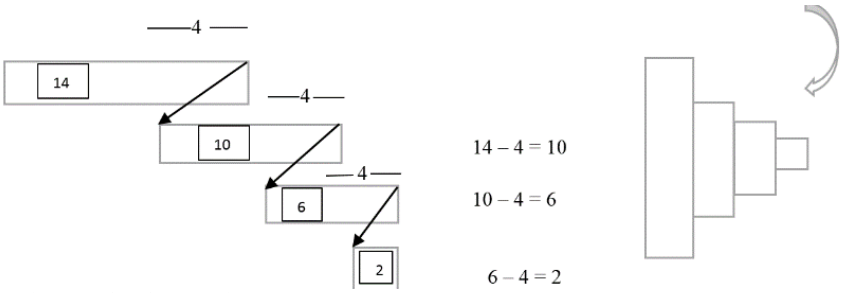
Table 1. Numeric Pattern on the Periodic Table.

Four orbitals	s	p	d	f
Observable pattern	2	2, 4	2, 4, 4	4, 4, 4, 2
Observations	The pattern found indicates the number for cells that comprise each fold of the periodic table to minimize it and compare it with the Moeller diagram.			



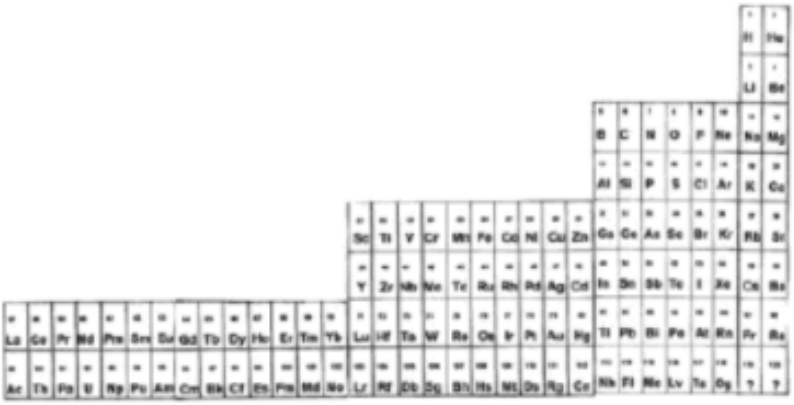
Source:*(Rodríguez-López & Medina-Rodríguez, 2020).*

Figure 1. Periodic Table, prior modelproposal



Source:*(Own Authorship, 2022).*

Figure 2. Periodic Table representation, first attempt



Source:(*Goya, Román and Elguero, 2019; Chamizo, 2018).*

Figure 3. Periodic Table Proposal by Janet, 1928

5. What is an update to this previous proposal?

A numerical pattern is found (Table 1) that indicates the sum of the capacity that the orbitals present in it have, this leads to folding the Periodic Table in the form of a ladder. Several attempts have been made to logically fold the Periodic Table, the first (Figure 2) and the final (Figure 6) are presented;

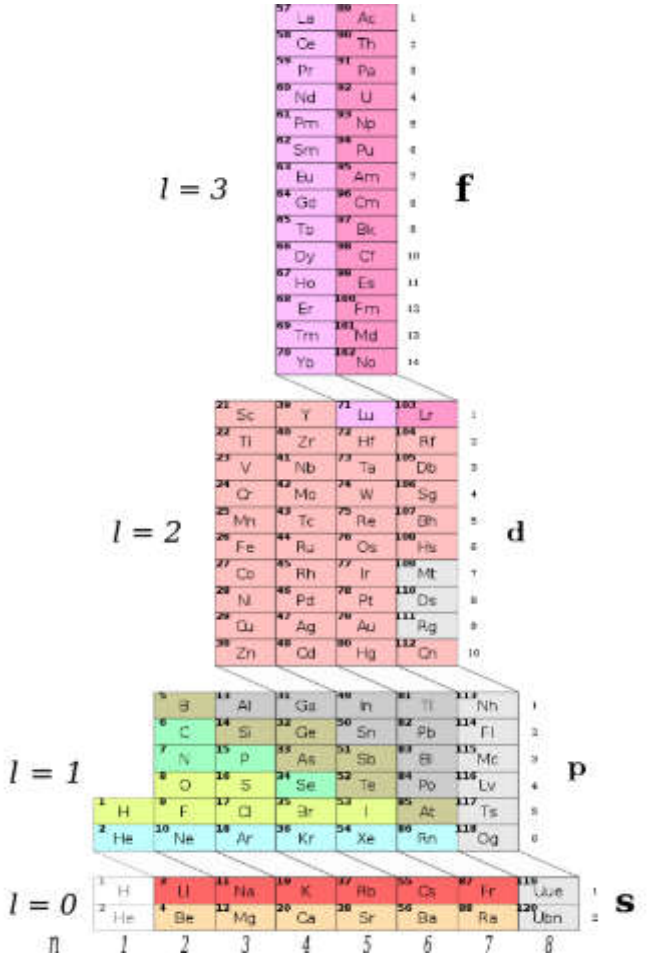
Until then, it was still necessary to find out why and how the Periodic Table had to be folded, forward or backward, with respect to the beginning.

Activity. If we draw the contour with pencil of the Periodic Table (Figure 1) attached to the Moeller diagram, on graph paper and make folds according to the pattern found in the

order presented in Table 1 and Figure2, we will find the diagonals that will fold the design proposed above.

6. Does the updated proposal by authors coincide with any other author?

There is similarity with Janet's proposal, 1928, (Figure 3) as they coincide in a table arranged to the left, staggered and preserving the order (s, p, d, f) (Goya, Román, and Elguero, 2019; Chamizo, 2018).The proposal presented by Valery Tsimmerman, 2006(Arellano Palma, 2021), is a vertical model to which if we turn it ninety degrees clockwise (Figure4), the table would be the same to proposal by authors but arranged to the right, , however it coincides in the diagonals and centered blocks,authors find that it is arranged to the left based in Janet, 1928; it coincide with Dr. Scerri, 2008(Zambón, 2013), by placing Hydrogen in Halogens (Figure 5), the only difference is that this element is not attached to group 7 so that when folding the Periodic Table Hydrogen presents a second location.

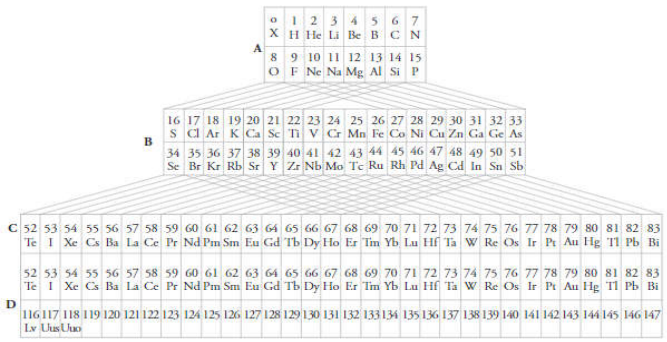


Source:*(Arellano Palma, 2021).*

Figure 4. Periodic Table Proposal by Valery Tsimmerman, 2006

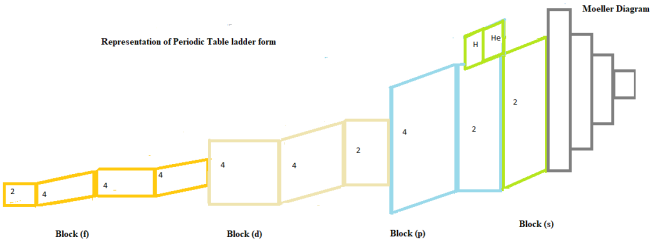
7. What is the relevance of folding the Periodic Table in the form of a ladder?

After various ways of folding the Periodic Table, the objective had to be found to fold it in the form of a ladder, finding a new location for Hydrogen, which is presented in results section. There were several attempts in the design, in the following figure the final version is presented when observing the pattern in the Periodic Table (Figure 6).



Source:*(Zambón, 2013).*

Figure 5. Periodic Table Proposal by Dr. Scerri, 2008



Source: *(Own Authorship, 2022)*

Figure 6. Folded Periodic Table representation, final version

8. Why can not an element in active stage be placed in the periodic table?

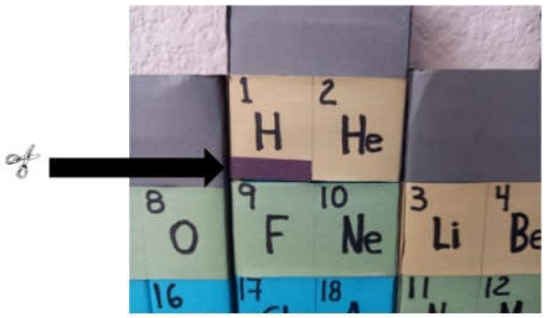
Patterns in active and basal stage are different. The pattern of the Periodic Table is in the basal state of the elements:"Configurations with s^2d^4 or s^2d^9 are less stable than s^1d^5 or s^1d^{10}" (Teixidó, 2019); this is justified (Gladys, et al., 2017) from the third level there are orbitals (d)(William Atkins and Jones, 2006), since there is enough empty space, the electrons seek to accommodate themselves to achieve stability, this being a pattern that characterizes the active state of the anomalies (Rodríguez-López and Medina-Rodríguez, 2020).

9. How is the location of Hydrogen and Helium justified in a new update to the Periodic Table design proposal?

The pattern found folds the Periodic Table, for this it is required that Hydrogen that it was located by Dr. Eric Scerri, 2008 in the group of Halogens (Arellano Palma, 2021; Teixidó, 2019; Goya, Román, and Elguero, 2019; Zambón, 2013), be its location in an apparent way because being an inseparable neighbor of Helium, we will see it as if it belonged to the Halogen group; this position of Hydrogen still does not fully satisfy the location that Hydrogen has (Zambón, 2013), "since it coincides in physical properties but not in chemical properties with the Halogens and that it must remain without a group". (William Atkins and Jones, 2006).

RESULTS AND DISCUSSION

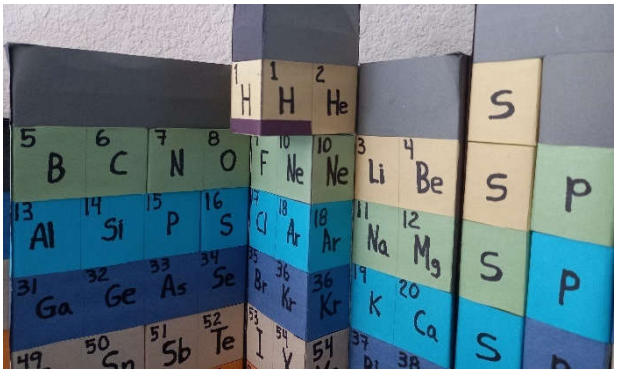
As seen above (Figure 5), the authors' proposal coincides almost completely with the proposal of Dr. Eric Scerri (Goya, Román, and Elguero, 2019) regarding the location of Hydrogen as an inseparable neighbor of Helium; it only differs in that Hydrogen must remain free or not attached to the block (p), (Figure 7) so that, when folding the table (Figure 8) proposed by the authors, Hydrogen can rotate ninety degrees, remaining as Helium's neighbor, which has two faces because it is in the corner of the fold, leaving Hydrogen outside the Periodic Table.



Source:*(Own Authorship, 2020).*

Figure 7. Hydrogen should not be attached to group 7 represented on Proposed New Design of the Periodic Table – Flat view

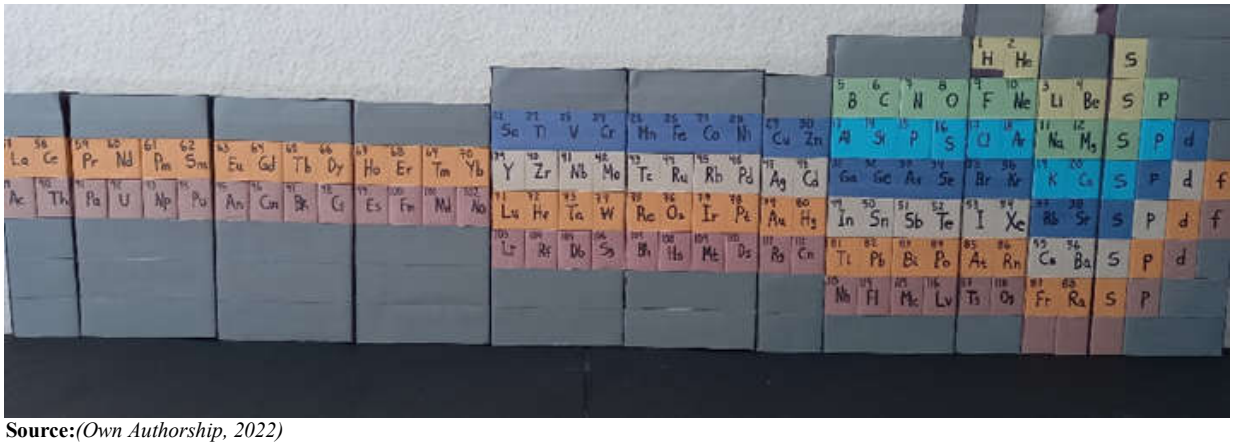
With the authors' proposal, Hydrogen would be towards the front and without a group (Figure 8) with the basis presented above, for this the location of Hydrogen must be apparent in Halogens and inseparable neighbor of Helium.



Source:*(Own Authorship, 2022)*

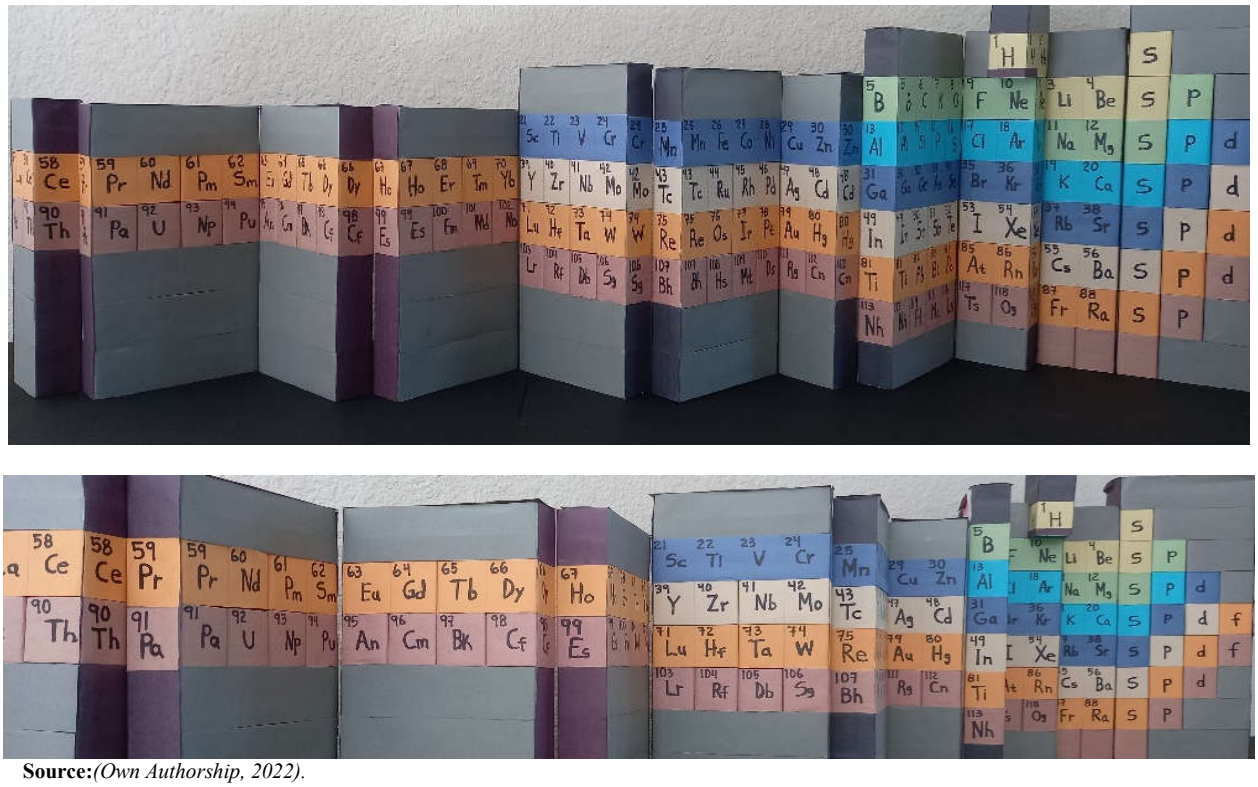
Figure 8. Detailed view of Hydrogen out of Halogen group. Folded Periodic Table

If we use the flat table (Figure 9), we will see Hydrogen in the group of Halogens, located by Dr. Scerri, 2008 in an apparent location in Halogens, according to authors (Figures 9 and 10).



Source:*(Own Authorship, 2022)*

Figure 9. Complete view of the proposed new design of the periodic table. Flat Periodic Table



Source:*(Own Authorship, 2022).*

Figure 10. Complete views of the proposed new design of the periodic table. Folded Periodic Table.

The pattern that classified the elements by blocks, contributed by Alfred Werner and Paneth, 1905(Fernández and Fernández, 2012), is the same pattern that now relocates the elements by box, proposed by the authors; and that modifies the conventional Periodic Table in a ladder model (Figure 10); the flat shape or the folded shape with two different locations for Hydrogen could be used, proposed by the authors.

Conclusion

The consequence of this research should impact the teaching-learning process as well as in science, by accepting that the patterns for the basal state and the activated state are different. In 2020, a new proposal was presented that places the elements in the basal state in the Periodic Table and therefore is rigorously theoretical, elements with an activated state configuration cannot be placed in the Periodic Table because they present different patterns previously reported by authors. The Periodic Table should be taught without the view that it is complicated. It is reaffirmed that the Periodic Table proposed by the authors is a projection of the Moeller diagramand modifies the conventional Periodic Table in a form of a ladder model with the flat shape or the folded shape options to be used, with two different locations for Hydrogen, apparent location in Halogens group and Hydrogen out of the table without a group assigned.In it,elements are ordered by atomic number, quantum number "n", in order (s, p, d, f), it follows the pattern of the Madellung rule represented by the Moeller diagram, and the properties of the groups are preserved.The Moeller diagram has been underestimated as a simple mnemonic rule that only serves to find the sequence of the electronic configuration of the elements, when it is the key in everything because it provides us with more information and is the basis of the Periodic Table. Didactics has been a key piece to achieve the development of the topic presented. If five proposals including authors converge or tend to a similar result, with different curriculum, at different times, from different places, by different methods, this can only mean that you are on the right track. The bases were established by Mendeleev, the theories, principles, postulates, rules and diagrams of Pauling, Hund, Werner, Moeller, Lewis, among others, are and will continue to be the basis of the Periodic Table. This has been a contribution resulting from teaching praxis, hoping to be accepted by the scientific and educational community.

REFERENCES

Abreu, O., Gallegos, M. C., G., J. J., and Martinez, R. J. 2017. *La Didáctica: Epistemología y definición.*Facultad de Ciencias Administrativas y Económicas de la Universidad técrnica del norte del Ecuador. Universidad de Concepción. Chile: Formación Universitaria. doi:10.4067/S0718-50062017000300009

Agudelo Carvajal, Carlos Guillermo 2015. *La función de la Tabla Periódica en la enseñanza de la Química. Clasificar o aprender*. Bellaterra; Universidad Autónoma de Barcelona; Depto. Didáctica de la Matemática; tesis de doctorado.

Arellano Palma, I. d. 2021. *Una nueva Tabla Periódica?DEMO, 22(2)*. doi:http://doi.org/10.22201/cuaieed.16076079e.2021.22.2.4

Cassabó i Gispert, J. 1996. *Estructura atómica y enlace químico*. (Reverté, Ed.) Obtenido de https://books.google.com.mx/books?id=V4fyDwAAQBAJ&pg=PA74&dq=valencia+del+bloque+s&hl=es-419&sa=X&ved=2ahUKEwiRw9uAydP1AhUTKEQIHWWCCRIQ6AF6BAgDEAI#v=onepage&q=valencia%20del%20bloque%20s&f=false

Chamizo, J. A. 2018. *A Tale of Seven Scientists and a new Philosphy*. *Educación Química, 29(1)*. Obtenido de http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S0187-893X2018000100012&lng=es&nrm=iso

Fernández, E. J., and Fernández, J. 2012. *El ícono de los químicos: La Tabla Periódica de los Elementos*. Universidad de la Rioja, Química. Real Sociedad Española de Química. Obtenido de file:///C:/Users/rmari/Downloads/Dialnet-ElIconoDeLosQuimicosLaTablaPeriodicaDeLosElementos-4104949.pdf

Gladys, L., Tonidandel, C., Cáccomo, H., Ruiz Alcantú, M. N., Márquez, M. E., and Morán, M. A. 2017. *Química Inorgánica.* Programa Educativo. Obtenido de http://fcai.uncuyo.edu.ar/catedras/teoria-2017.pdf

Goya, P., Román, P., and Elguero, J. 2019. *La Tabla Preriódica de los elementos químicos.* Madrid, España: CSIC. Obtenido de https://books.google.com.mx/ books?id=ZiyODwAAQBAJ&pg=PT51&lpg=PT51&dq=tabla+periodica+de+Janet&source=bl&ots=TsInwgj_YT&sig=ACfU3U0C5IGp2xXiRNyOa150YwBbA7Rb2Q&hl=en&sa=X&ved=2ahUKEwiCrKGFs8PpAhXYFzQIHZkNDFk4ChDoATADegQIChAB#v=onepage&q=tabla%20periodica%2

Ibañez, P. R. 2021. *El saber pensar: un derecho fundamental en la Educación*. (M. TV, and D. Ayarza, Entrevistadores) Colombia. Recuperado el 2021, de https://www.youtube.com/ watch?v=4F5L14CawMk

Moeller, T. 1994. *Química Inorgánica*. España: Reverté. Obtenido de https://books.google.com.mx/books?id=e6sjNMgUjt0C&pg=PA390&lpg=PA390&dq=teoria+de+alfred+werner&source=bl&ots=H3_FCAFCxd&sig=ACfU3U0y8XoiJDvfs_X24Ye3gvvCQiSYPw&hl=en&sa=X&ved=2ahUKEwjcyNn2lrXrAhVS7J4KHWJzCX44HhDoATAHegQIBxAB#v=onepage&q=teoria%20de%20alfr

Muria Vila, I.D., Damián Díaz, M. 2008. *Desarrollo de las habilidades de pensamiento en diferentes niveles educativos.* Revista de Psicología Iztacala vol 11(1). Universidad Nacional Autónoma de México.

Rodríguez López, R.M.& Medina Rodríguez, N. (2020). Interpretation and representation of the theories the Werner, Pauling, Hunds rules and diagram of Moeller, in the analysis of the Anomalies for a profesional introductory educacional level.Cetys, Universidad, Tijuana, B.C. Obtenido de http://www.scienceijsar.com/article/interpretation-and-representation-theories-werner-pauling-hunds-rules-and-moellers-diagram

Scerri, E. 2. 2008. *El pasado y el futuro de la Tabla Periódica.* UCLA Facukty. Loas Angeles, USA: Educación Química. Obtenido de http://revistas.unam.mx/index.php/req/article/viewFile/25837/24332

Teixidó, C. M. 2019. *La Tabla Periódica, que no es tan periódica.* Investigación y Ciencia. Obtenido de https://www.investigacionyciencia.es/blogs/fisica-y-quimica/24/posts/la-tabla-peridica-tan-peridica-no-es-18091

Tejada, C., Acevedo, D., and Mendoza, A. 2015. *Didáctica para la enseñanza del concepto de valencia química.* (Vol. 8(5)). Formación Universitaria. doi:http://dx.doi.org/10.4067/S0718-50062015000500005

Tejada, C., Chicangana, C., Villabona, A. 2013. Enseñanza de la Química basada en la formación por etapas de acciones mentales (Caso: enseñanza del concepto de valencia). *Revista virtual católica del Norte,* Num 38--; pg. 13

William Atkins, P., and Jones, L. 2006. *Principios de Química* (Vol. 3a edición). Panamericana. Obtenido de https://books.google.com.mx/books?id=0JuUu1yWTisC&pg=PA572&lpg=PA572&dq=hibridacion+de+elementos+bloque+d&source=bl&ots=kPov6WR6pF&sig=ACfU3U3wwZHcX0BgkHtbAE8qHZGqsXtkGA&hl=en&sa=X&ved=2ahUKEwi_54GRhfHqAhU8GDQIHdUyBYE4UBDoATAJegQICxAB#v=onepage&q=hibridac

Zambón, A. 2013. Representación del Sistema Periódico: una tabla basada en triadas. Universidad El Bosque. Bogotá, Colombia: Revista colombiana de filosofía de la ciencia. Obtenido de el químico Scerri propuso ubicar a Hidrógeno en Halógenos y Helio mantenerlo en gases nobles.

****