ΣΟΦΙΑ–SOPHIA

The learning models of Kolb, Honey and Mumford: implications for science education

Rodrigo Rodríguez Cepeda*

**PhD in Education. Professor Department of Chemistry. Universidad Pedagógica Nacional, calle 72 # 11- 86 Bogotá D.C. Colombia. rrodriguez@pedagogica.edu.co

UNIVERSIDAD
La Gran Colombia
Fundada en 1951

Abstract

This document shows a reflexive analysis around two learning models, which are based on the premise that each person learns differently; this topic has been widely debated and still has great potential for research in education; in this sense, reflection is focused on the models proposed by David Kolb, which is centered on the conception that learning is experiential; and Honey and Mumford, who assume learning in four fully articulated steps. In both cases, an ideal sequence is proposed so that learning is successful, as well as defining learning styles as characteristics inherent in people. With these concepts, a critical analysis is proposed in order to identify similarities and differences between the two models; some implications for science education are proposed. It is expected to motivate researchers to propose new work initiatives in this field of knowledge.

Keywords: Learning, science teaching, chemistry teaching.

Introduction

In order to support all children and young people in their learning processes, it is important to recognize them as transforming people in society, a perspective from which a critical understanding of teaching practices in the classroom is necessary, which should be appropriate and focused on the development of excellence for an education at the service of society. For this ideal to be possible, it is necessary to fully identify the talents that these children and young people have, in order to empower them to benefit a common goal for society.

In the previous context, it is important that the educational community recognize the current society as diverse in cultures, socio-economic contexts, intentions and abilities, so the teaching-learning processes must be structured on these premises; this is how Gingsberg, (2009) mentions: "In view of the great diversity of our nation -of races, ethnicities, languages, economic level and family structure-, it is now more important than ever to reduce and eventually eliminate the gaps in the levels of academic achievement;" this reflection invites to perform classroom works that involve inclusion processes, in order to improve the teaching-learning exercise.

In this sense, many researchers have studied the different variables that affect the learning process in students and have proposed various theories; among others, there highlights the idea that students learn differently, so that the teaching exercise should be accordingly performed.

Based on the above assumption, and without ignoring variables such as social context, family structure and culture, learning styles emerge as a proposal to approach the knowledge of students' own characteristics, thus allowing to identify the way people learn, facilitating the possibilities that teachers have to achieve a strategic planning of their activities in the classroom, and enabling the development of research around this topic.

However, despite the efforts, the concept of learning is still difficult to explain and there is no consensus on its definition; Cruz (2001) defines it as a process where skills are acquired and developed to read, write, do mathematical calculations, etc., promoting academic achievements at different levels; this definition is very broad and does not take into account particular variables of the persons who learn, as their habits, interests, culture, among other important variables; Schunk (1997) assumes learning as the ability to acquire and modify knowledge, skills, strategies, beliefs, attitudes and behaviors; however, he does not clearly define how people achieve this modification.

For Ausubel (1968), learning takes place when a novel idea is assimilated into an existing cognitive structure, thanks to the fact that a variable influences learning and retention due to the availability in the cognitive structure of re-anchoring relevant ideas; this definition has as a strength that is the basis of meaningful learning, but as it can be seen, it is a definition focused on the problem of cognitive structures, that is, on a clearly psychological idea, which does not include the external variables to the person who learns.

According to the previous reflections, it is clear that defining the concept of learning requires the inclusion of a complex series of variables, which involve people's internal processes such as: cognitive, psychological, physiological, probably hereditary and external factors such as culture, family, social and economic contexts, among others, these variables make that the teaching-learning process requires teachers aware of this level of complexity, and that it identifies the most influential variables and use them to potentiate the skills of students.

Models of Learning Styles

Research carried out in the area of psychology has shown that there is no single way to learn, due to the way people relate to the world and what they intend to learn; this reality leads each person to tend to develop certain preferences or general dispositions that define learning styles, understood as cognitive, affective and physiological traits (Gómez, Aduna, García, Cisneros, & Padilla, 2004); (Gómez, Oviedo, Gómez, & López, 2012).

Thus, various researchers have proposed models and theories aimed at knowing the individual characteristics of the subjects who learn; among the most outstanding are those proposed by David Kolb (1974) and one by Honey and Mumford (1986), who propose a learning mechanism and a description of characteristics that define people's learning styles.

Kolb model

In the 1970's, David Kolb considered that the experience refers to the whole series of activities that allow learning (Kolb, Rubin, McIntyre, James, & Brignardello, 1974). These authors consider that learning is conditioned by lived experience, and consists of four stages that include: concrete experience, reflexive observation, abstract conceptualization and active experimentation (Freedman & Stumof, 1980); therefore, optimal learning is achieved as long as all four stages are met, and can be summarized in Figure 1

Figure 1: Optimal learning according to Kolb.
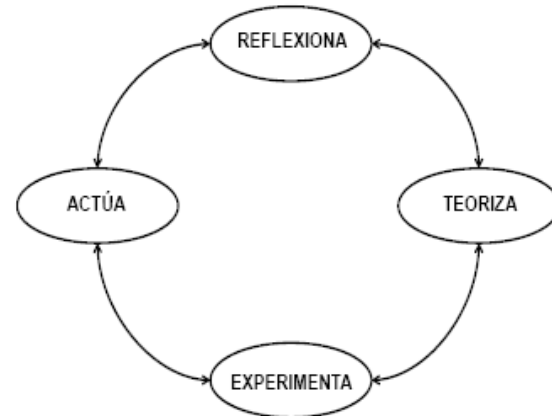
However, in practice, people prefer to carry out activities framed in one or some of the four aspects outlined in Figure 1, leading to the development of personal learning strategies that include the preference for activities in the classroom that fit that specificity, and therefore a rejection by those that are not (like that).

With this perspective, Kolb and his collaborators define the perception and processing of information as dimensions of learning, so that learning will be achieved as things are perceived, and then how they are processed (Kolb, Rubin, & McIntyre, 1977). Under these dimensions, two types of perception and two forms of information processing are described, as follows:

Table 1. Types of perception and forms of information processing according to Kolb.

Learning dimensions	
Perception of information.	Information
By concrete experiences.	By active experiences.
By conceptualization.	By observation
Abstract.	Reflexive.

This approach allowed us to propose a four-quadrant model (Figure 2), which explains the different ways in which people learn, originating the description of learning styles (Kolb, Rubin, & McIntyre, 1977), (Gómez, Oviedo, Gómez, & López, 2012), (Freedman & Stumpf, 1980).

Figure 2. Four-quadrant Matrix of Kolb's Learning Styles (Kolb, Rubin, & McIntyre, Organizational Psychology: Contemporary Problems, 1977)
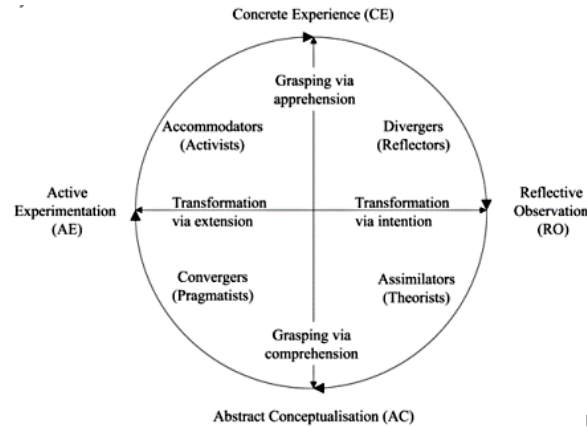
With this proposal, Kolb shows that not all people learn in the same way; some need activities that include concrete experiences, others need abstract sources such as reading or listening on a topic, others like to brainstorm, others require planning actions to develop, and some others learn by trial and error.

This division of learning styles allows proposing some characteristics of each one of them (Monzón, Barría, Bustos, Jaque, & Valenzuela, 2009), (Gómez, Aduna, García, Cisneros, & Padilla, 2004), (Manav & Eceoglu , 2014); for this, Kolb works with a group of adults, mostly professionals or about to finish their university studies, and develops an inventory of strengths and weaknesses for each one; in Table 2, there are presented the characteristics of the four dominant learning styles, which allow to have a general profile of the activities that favor the learning processes in each one of them.

In this way, it is possible to propose teaching strategies based on the learning styles of the students, in which the activities must be included according to the characteristics of each style, in order to improve their academic performance (Tulbure, 2012). Likewise, it is important that students know their learning styles, since it will allow them to plan some strategies according to their characteristics, in order to potentiate their autonomous learning.

Table 2. Characteristics of the learning styles proposed by Kolb (taken and adapted from: Freedman & Stumof, Learning style theory: Less than meets the eye, 1980)

Learning style	General characteristics	Favorable activities	Unfavorable Activities
Convergent	Pragmatic	Challenges	Adopting a passive role
	Rational	Short activities	When he/she has to assimilate, Analyze and interpret data.
	Analytical	Immediate results	Independent work.
	Organized	Emotion, drama and crisis.	
	Task oriented		
	Enjoy technical aspects.		
	He/she is an experimenter		
	Little empathic		
	Hermetic (non-communicative)		
	Little imaginative		
	Leader		
	Insensitive		
	Deductive		
Divergent	Sociable	Acts as an observer.	Act without planning
	Synthesizes well	Analyzing	Pressure of time
	Generates ideas	Thinks before acting	
	Dreamer		
	Values Understanding		
	Oriented to people		
	Spontaneous		
	Empathic		
	Imaginative		
	Emotional		
	Flexible		
	Intuitive		

	Little sociable	Using theories or models.	Ambiguous activities
	Synthesizes well	Ideas with challenges.	Situations involving feelings.
	Generates models	Inquiry	Acts without
			Theoretical foundations.
Assimilator	Reflexive		
	Abstract thinker		
	Oriented to reflection		
	Enjoys theory		
	Little empathic		
	Hermetic (non-communicative)		
	Enjoys designing		
	Planner		
	Little sensitive		
	Researcher		
	Sociable	Theory-practice relationship.	Little relation of what was learned with their needs.
	.		
	Organized	Just watch what others do.	Without an apparent purpose.
	Accepts challenges	Immediate practice of what has been learned.	
	Impulsive		
	Search for objectives		
Accommodator	Action oriented		
	Depends on others		
	Little analytical		
	Empathic		
	Open		
	Non-systematic		
	Spontaneous		
	Flexible		
	Committed		

Finally, and taking into account the aforementioned characteristics, the model concludes that the learning process is an experiential cycle, which includes experimentation, reflection on experimentation, theorization obtained from reflection, and action on the proposed theory; the model highlights the need to cover the four stages in order to allow new reflections to be assimilated (absorbed and transformed) into abstract concepts with implications given by the action (Manav & Eceoglu, 2014).

Model of Honey and Mumford

In the 1980s, and based on Kolb's (1974) theory, Peter Honey and Alan Mumford (1986) proposed a model of learning styles that describes the attitudes and behaviors that determine the preferred ways of learning of an individual (University of Leicester, 2011), (Legorreta, 2000), (Gallego & Nevot, 2008).

According to that proposal, it can be observed how Honey and Mumford give an attitudinal character to learning styles and therefore variable, since in people this characteristic can be changing in time when activities are carried out to transform them; the same can also be said of behavior, since it can be altered very quickly by the influence of external factors to which is subject the individual.

Probably the definition given by Honey and Mumford is influenced by the group object of study used, framed in the business world (Muñoz & Sánchez, 2001); however, the model proposes that the learning process is continuous; it is achieved in four stages, all of them necessary and non-exclusive; they are:

1. Experiential: learning begins when an individual has an experience about the learning object.

2. Review of the experience: The individual performs an analysis of the experience.

3. Concluding from experience: Once the experience is analyzed, the individual draws conclusions.

4. Planning: With the conclusions, the individual plans the next step and retakes an experience, in order to repeat the cycle.

In this learning cycle, the ideal is that people can experiment, reflect, propose hypotheses and apply, but the truth is that individuals develop preferences and act better according to these preferences (Legorreta, 2000).

In this way, Honey and Mumford propose four learning styles, with their own characteristics that define them, and that influence a learning process; these characteristics allow individuals to develop study strategies, and teaching strategies to teachers, facilitating the learning of new concepts and the expansion of concepts already established in the cognitive structure of people (Table 3).

Table 3. Characteristics of learning styles proposed by Honey and Mumford (taken and adapted from: Gómez, Aduna, García, Cisneros, & Padilla, 2004; Muñoz & Silva, Four Dimensions to Induce Learning: The Challenge Profile, 2003)

Learning style	General characteristics	Favorable activities	Unfavorable Activities
Active	Learn by doing Need to have their hands busy Open-minded. Get involved in new experiences. Enthusiastic Act first. Consider consequences after acting Like to surround themselves with other persons.	Brainstorming Solving problems Group discussions Puzzles Competition Role plays	Adopt a passive role Independent work. Very theoretical activities.
Theoretical	Theories before acting Need models. Emotional activities Ordered concepts and facts. Prefer to analyze and synthesize. Systematic and logical Perfectionists Independent Analytical	Elaborate models Statistics Search background Apply theories Being able of investigating and asking	Ambiguous activities Emotional activities Act with no theoretical foundation
Pragmatic	Prefer real application of learned. Don't like abstract concepts. Try new ideas applicable to real life. Their philosophy: if it works, it's good.	Case studies Think how applying what learned Solve problems Discussions	Activities not applicable to reality Non-sense activities Unreal activities
Reflexive	Observers Analyze See different perspectives of one thing. Prefer good support before drawing conclusions. Careful at ensuring something. Enjoy watching and listening to the rest. Analyze implications.	Paired discussions Self-analysis questionnaires Observing activities Accept feedback from others Interviews	Pressure of time Acting as leaders Representing roles Unplanned activities Present ideas spontaneously Quickly moving among activities

This proposal invites reflection in the classroom, both teachers and students must analyze and restructure their roles on the teaching-learning process, especially in areas recognized for their difficulty, as it is the case of science, so, the teacher must plan various activities that encourage students to make the journey through the four stages that ensure learning without ignoring the particularities of each person; and in turn, students must design study strategies for accommodating into the process. According to Alonso (1992): "Cognitive investigations have shown that people think differently, capture information, process it, store it, and recover it in a different way."

Consequently, the teacher is called to develop didactic materials that facilitate the student's learning process, especially for those who have difficulties in meeting objectives; it is common that during a learning process, not all students achieve the conceptualization expected by the teachers, who in general, based on the processes of traditional numerical evaluation, define a classification of students as good, regular and bad, but rarely wonder about the reasons why these students obtained poor academic performance, and which should be the strategies to avoid it; probably the structuring of activities in the classroom, based on learning styles, may help to respond to this problem.

Comparative analysis of the models

Although the models of learning styles were proposed by Kolb and by Honey and Mumford more than three decades ago, they are now becoming important thanks to the rise of information and communication technologies used in educational processes, which have led to promote autonomous learning in individuals.

Under this scenario, it is justified to conduct a thorough analysis of these learning models; in this

sense, the academic community should propose activities that take into account the way of learning, and thus facilitate the academic achievements of students; to deepen this proposal, it is justified a comparative analysis between the Kolb model and the one proposed by Honey and Mumford, in order to provide arguments in their application for the teaching of science.

From the dimensions of learning

A starting point for comparatively analyzing the two models are the dimensions of learning proposed in the two models; in this sense, it is clearly observed that the Kolb model describes the achievement of learning when the individual who learns has a concrete experience with the object of learning; in this experience, information is generated, and the way how it is perceived and processed conditions the way of learning.

On the other hand, Honey and Mumford consider that learning, in addition to (being) experiential, requires some characteristics of the personality, especially the attitudinal and behavioral ones, established as the dimensions in the learning process.

Under this scenario, when studying some postulates of organizational behavior, which consider it possible to predict the behavior of a person based on attitudes, especially if the individual has personal experience (Robbins, 2004), it results clear the link between experience, attitude and behavior; therefore, in a learning process, this link marks a meeting point between the two models of learning styles, where Kolb's experiential character can be explained from its relationship with the attitudes that define behaviors of people, (which are) the basis of the learning styles model proposed by Honey and Mumford.

From the learning process

Another point of comparison is the process proposed about how learning takes place; thus, Honey and Mumford consider that learning is achieved when there is a new experience, which allows a review to conclude something that leads to planning a new experience. In the case of Kolb's model, the learning process occurs when a real experience leads to a reflexive observation, in order to realize an abstract conceptualization, conclusions are generated and later, with an active experimentation, learning is completed.

In this context, it is clear that the two models pose an equivalent learning process, centered on an experiential aspect that requires four stages, all of them important, necessary and not exclusive; therefore, an ideal learning process will be when a student is able to articulate these four stages.

From the characteristics of learning styles

Although both models pose the need to meet the four stages in order to achieve learning, they also recognize that in real life, individuals who learn prefer one of these four stages, thanks to the individual characteristics that mark the way they perceive and they process the information; in this way, four categories of learning styles are presented with their characteristics, Table 4 summarizes the common aspects that define these categories.

Table 4. Similar characteristics among the learning styles proposed by Honey and Mumford and Kolb.

Characteristics	Learning styles according to Kolb	Learning styles according to Honey and Mumford
Learn by doing.		
Enthusiastic.	Accommodator	Active
Like role plays.		
Problem solving.		
Need theoretical models		
Prefer to analyze.		
Logical.	Divergent	Theoretical
Need time to investigate		
Application of what was learned		
Look for the application.		
Solve problems.		
Prefer discussions.	Convergent	Pragmatic
Observers.		
Prefer to analyze		
Listen to arguments		
Like feedback.	Assimilator	Reflexive

Learning styles define characteristics of individuals, on which teachers can develop teaching strategies aimed at promoting learning processes, but probably, the greatest importance lies in focusing these strategies to reduce the number of students who lose a course or that simply fail to meet the academic objectives.

Differences

Despite the similarities between the models, analyzed in the previous sections, there are also differences that emerge, especially from the dimensions of the learning process proposed in the two models; these differences can be used to strategically design the best classroom activities centered on the students.

Accepting that Kolb's model defines two dimensions of the learning process: the perceptual, that is, the way individuals perceive information, thus involving the senses (visual, auditory, verbal) (Kolb, Rubin, & McIntyre, 1977); and secondly, the way in which the information is processed, in which the intrinsic characteristics of the individual and their cognitive structure are involved.

Honey and Mumford's model does not emphasize the senses; it makes explicit the individual characteristics that condition learning by grouping them in attitude and behavior (Rodríguez, 2016), in fact, the questionnaire designed and validated by Alonso (1992) allows the model to be operational and facilitate the identification of these individual characteristics. Table 5 summarizes the differences between the two models of learning styles.

Table 5. Differences between the learning styles proposed by Kolb and Honey and Mumford.

Differences between the models

Kolb		Honey and Mumford	
Learning dimensions	Perception: the way how information is perceived	Learning	Attitudinal: it depends on the individual's attitude
	Processing: the way how information is processed		Behavior: it depends on the individual's behavior

Figure 3 (next page) shows a graphic summary of a comparative analysis between the two models of learning styles proposed by Kolb (1974) and Honey and Mumford (1986).

Implications for science education

Several research works carried out in Latin American countries have been able to account for the high level of dropout in higher education (Quiroga, Biglieri, & Cerruti, 2013), (González, 2006), (Abarca & Sánchez, 2005) , (Guzmán & Durán, 2009), especially in the initial university courses; even though the institutions have designed policies and strategies aimed at reducing this phenomenon, there still persists a high trend to it; for example, the university dropout in Colombia reached values of up to 44.9% in 2008 (Guzmán & Durán, 2009).

In this context, it is known that science courses are those where the learning processes are more complicated, generate confusion, frustration and low academic performance, aspects identified as a cause of student dropout.

In this sense, the use of learning styles emerges as a way to overcome the aforementioned difficulties; in that sense, Rodríguez, Aguirre, Granados and Valdez (2010), based on the model of learning styles and the CHAEA questionnaire of Honey and Alonso, propose a set of strategies for the application of Dialogic Pedagogy in experimental physics; as a result, they perceive a positive influence of learning styles in the activities developed, so the mediation in experimental physics should be oriented to understand it through the connection with reality, fostering situations of teamwork, achieving the best results in learning, when the work teams are integrated with students of different learning styles.

In other research works, it has been found a relationship between educational practice and learning styles conditioned to the personal, academic and professional dimensions, thereby enhancing an integral and individualized education (Adam I., 2004); this confirms the need to deeply know the students, as one of the alternative ways to achieve the objectives set in a teaching-learning process, inviting teachers to be aware of the importance of identifying students' abilities, even before starting an activity in the classroom, since this fact could influence the design of the same. On the other hand, this way of working in class suggests changing the way to organize working groups and, even, the projection of the corresponding evaluations.

Figure 3. Conceptual map of the models of learning styles of Kolb and Honey and Mumford

Another important implication in the teaching of science lies in the possibility that students have to clearly identify their abilities, making it easier for them to establish study strategies when dealing with subjects considered to be complicated, especially in science courses.

Another important indicator that shows the difficulties in the science courses are the results of the PISA tests, project of the Organization for Economic Cooperation and Development (OECD), developed since the late 1990s, whose objective is to evaluate the preparation of 15-year-old students for facing the challenges of adult life. There has been found in these tests, for Latin American countries, a level below the average in the areas of science and mathematics (Table 6).

Table 6. Average scores and standard deviations, in mathematics, reading and science, PISA 2012. (Taken from: ICFES, 2013).

Countries	Mathematics		Reading		Science	
	Mean value	Standard deviation	Mean value	Standard deviation	Mean value	Standard deviation
Chile	423	81	441	78	445	80
México	413	74	424	80	415	71
Uruguay	409	89	411	96	416	95
Costa Rica	407	68	441	74	429	71
Brasil	391	78	410	85	405	79
Argentina	388	77	396	96	406	86
Colombia	**376**	**74**	**403**	**84**	**399**	**76**
Perú	368	84	384	94	373	78
Promedio OCDE	494	92	496	94	501	93
Shanghái	613	101	570	80	580	82

These results show the need to make adjustments in the educational process, and the use of learning styles is one of the proposals that can contribute to the improvement of these indicators, with implications that can be analyzed from the following aspects:

Activities in the classroom

Under the principles of the models of learning styles, classroom activities require to be modified; in them, group work should be encouraged with groups composed of students that conform to the four learning styles, thus promoting cognitive synergies; that way, it is presumed an articulation of the four stages of the learning process.

On the other hand, accepting that learning styles have an attitudinal and behavioral source, it is valid to assume that they can change when performing activities focused for that purpose; in this same sense, it is important that teachers design intervention actions in the classroom focused on developing multi-style characteristics in students, since this will facilitate them any learning process, as it is shown by the work of Rodriguez, (2016); these activities should be encouraged from the first years of basic education, when children are in full development of their cognitive structures.

The curriculum

On the other hand, some researchers have identified some relationships between learning styles and academic performance; it has been concluded that it is necessary to include tutoring as an essential part in the training, in such a way that the students with learning difficulties may have particular sessions with activities designed on the style of learning; this methodology involves the design of curricular plans with individualized tutoring and small groups, encouraging reflection on the part of the students on their own training process, in an autonomous and flexible way (Adam I., 2008).

A curriculum designed on the basis of learning styles requires the availability of tutors, small work groups, activities that involve all the characteristics of learning styles, identification and development of talents, among other aspects.

The teachers

A work designed on the context of learning styles requires that the teachers know students in depth, clearly assuming their role as tutors, in order to work with students according to clearly defined objectives, thus becoming expert integrators of the personal elements of the students, and the didactic

interaction materials; teachers must be aware of the diversity of the students.

In the context of learning styles, teachers must develop methodologies that promote attitudinal and behavioral changes, in order to achieve a balance between observable individual characteristics; as a consequence, a balance of learning styles is expected, emerging as one of the ways to achieve academic goals (Rodríguez Cepeda, 2016)

The students

The educational implications from the role of the students can be associated with the need to identify their strengths and weaknesses; in order to successfully face a learning process, the students must be aware of the importance of working in groups, structured on learning styles, and not as a community formed by personal sympathies, since the conformation of the work teams will obey purely to strategic reasons, where their teammates have learning styles that complement theirs.

In this way, students must use information in order to design their own study strategies, as a particularity of the autonomy that the model requires; in this way, the achievement of the objectives projected in their training will depend on the responsibility assumed for those strategies; they should also be aware of the role of teachers as tutors, and not as characters who have the obligation to provide all knowledge.

Conclusions

The need to improve the academic results of the students has made the researchers to work in order to propose ways that facilitate the learning process in the students; one of them is the study of the individualities circumscribed in the learning styles; this way, the reflections on the Kolb and Honey and Mumford models allow us to raise some conclusions focused on the improvement of the activity in the classroom, among others:

The models of learning styles analyzed have common aspects, especially from the conception of learning, as a process that depends on individual characteristics, the way in which information is perceived, and how it is processed, but also the importance of attitude and behavior.

The two models propose four non-exclusive stages, so that the teaching process may occur; however, in real life, people are inclined to one of the four stages, which defines the learning styles proposed in the models, with their respective characteristics.

The application of learning styles in science education implies the need to modify classroom activities, in which teamwork is encouraged, ensuring that there is at least one student of each learning style, in order to promote possible synergies.

It is proposed to design curricula in which tutorials be highly relevant, and be based on the individual characteristics of the students, circumscribed in the learning styles, promoting reflection, autonomy and work in groups.

In the context of learning styles, teachers are required to know in depth their students, and that their role as tutors be that of an expert who integrates the individual characteristics of students with the educational activities in the classroom, according to them.

On the other hand, students are obliged to identify their learning style, their strengths and weaknesses, in order to design their own study strategies, focused on the achievement of the projected academic objectives, promoting autonomy.

References

Abarca, A., & Sánchez, M. (2005). La Deserción Estudiantil en la Educación Superior: El caso de la Universidad de Costa Rica. Actualidades Investigativas en Educación , 5, 1-22.

Adán, I. (2004). Estilos de Aprendizaje y Rendimiento Académico en las Modalidades de Bachillerato.España: UNED.

Adán, I. (2008). Los Estilos de Aprendizaje en la Orientación y Tutoría de Bachillerato. Revista Complutense de Educación, 19(1), 59-76.

Alonso, C. (1992). Estilos de Aprendizaje: Análisis y Diagnóstico en Estudiantes Universitarios.Madrid: Universidad Complutense.

Ausubel, D. (1968). Educational Psychology: A cognitive View. New York: Rinehart & Winston.

Sophia 14 (1) 201863

Cruz, D. (2001). Enseñanza y Aprendizaje en la Educación superior, un Reto para el Sigo XXI. Universidad de Puerto Rico. Humacao: Universidad de Puerto Rico.

Freedman, R., & Stumof, S. (1980). Learning Style Theory: Less than Meets The Eye . The Academy of Management Review, 5(3), 445-447.

Freedman, R., & Stumpf, S. (Julio de 1980). Learning Style Theory: Less than Meets the Eye. The Academy of Management Review, 5(3), 445-447.

Gallego, D., & Nevot, A. (2008). Los Estilos de Aprendizaje y la Enseñanza de las Matemáticas. Revista Complutense de Educación, 19(1), 95 - 112.

Gingsberg, M. (Marzo de 2009). Observations and Reflections. (N. A. Children, Ed.) YC Young Children, 64(2), 76-77.

Gómez , D., Oviedo, R., Gómez, A., & López, H. (2012). Estilos de Aprendizaje en los Estudiantes Universitarios con base en el Modelo de Hemisferios Cerebrales. Revista Académica de Investigación, 1-23.

Gómez, L., Aduna, A., García, E., Cisneros, A., & Padilla, J. (2004). Manual de Estilos de Aprendizaje. México: Secretaría de Educación Pública.

González, L. (2006). Repitencia y Decersión Universitaria: Informe Sobre la Educación Superior en América Latina y el Caribe 2000-2005. La Metamorfosis de la Educación Superior. Caracas: Metrópolis, C.A.

Guzmán, C., & Durán , D. (2009). principales Resultados del Seguimiento de la Deserción Estudiantil. En: Ministerio de Educación Nacional. Deserción Estudiantil en la Educación Superior Colombiana Metodología de Seguimiento, Diagnóstico y Elementos para su Prevención. Bogotá: Viceministerio de Educación Superior.

ICFES. (2013). Colombia en PISA 2012, Informe Nacional de Resultados, Resúmen ejecutivo.Bogotá: ICFES.

Kolb, D., Rubin, I., & McIntyre, J. (1977). Psicología de las Organizaciones: Problemas Contenporáneos (Primera ed.). (L. Brignardello, Trad.) México: Prentice-Hall Hispanoamericana.

Kolb, D., Rubin, I., McIntyre, J., James, M., & Brignardello, L. (1974). Psicología de las Organizaciones: Experiencias. Mexico: Prentice Hall Hispanoamericana.

Legorreta, B. (2000). Fundamentos teórico - Metodológicos de la Educación a Distancia: Estilos de Aprendizaje. Estado de Hidalgo: Universidad Autónoma del Estado de Hidalgo.

Manav, B., & Eceoglu, A. (2014). An Analysis and Evaluation on Adopting Kolb s Learning Theory To Interior Design Studiowork. 6(5), 153-158.

Monzón , V., Barría, P., Bustos, G., Jaque, O., & Valenzuela, M. (Diciembre de 2009). Estilos de Aprendizaje de Kolb en Alumnos del Liceo Abate Molina: Su Aplicación en el aula. UCMaule-Revista Académica, 92-101.

Muñoz, B., & Sánchez, L. (2001). Los Estilos de Aprender: El Portafolio de Dimensiones Educativas y sus Variables de Acción.Universidad de Navarra. Barcelona: IESE PUBLISING.

Muñoz, B., & Silva, C. (September de 2003). Four Dimensions to Induce Learning: The Challenge Profile. (U. d. Navarra, Ed.) IESE Business School, 2-19.

Quiroga, A., Biglieri, M., & Cerruti, C. (2013). Diseño de una Herramienta Útil para Detectar Tempranamente Alumnos

con Dificultades en el Aprendizaje de onceptos de Química. Avances en Ciencias e Ingeniería, 4(3), 85-94.

Robbins, S. (2004). Comportamiento Organizacional(Décima ed.). México: Pearson Educación.

Rodríguez, I., Aguirre, N., Granados, S., & Valdez, V. (2010). Un Modelo Pedagógico para la Enseñanza y Aprendizaje de la Física Experimental Básica. Revista Cubana de Física, 163-166.

Rodríguez, C. R. (2016). Aprendizaje de conceptos químicos: una visión desde los trabajos prácticos y los estilos de aprendizaje. revista de Investigación desarrollo e Innovación, 7(1), 63-76.

Schunk, D. (1997). Teorías del Aprendizaje. México: Pearson.

Tulbure, C. (2012). Investigating the Relationships Between Teaching Strategies and Learning Styles in Higer Education. Acta Didáctica Napocensia, 5(4), 65-74.

University of Leicester. (2011). Los Estilos de Aprendizaje de Honey y Mumford. Leicester: Community Media Applications and Participation.