









Diagnosis of learning styles as a tool for improvement in teaching processes

Diagnóstico de los estilos de aprendizaje como herramienta de mejora en los procesos de enseñanza

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This research demonstrates the need to include in the study plans activities that allow students to improve their learning styles. The diagnosis of learning styles is a tool for the teacher since it allows them to identify the way in which each of the students learns, so once determined, the teacher can help the student improve their academic performance, for example. Therefore, identifying students' learning styles should be accompanied by teachers' teaching strategies, to the extent that these preferences will impact their usual teaching methods, consequently affecting the ways of learning and student performance. Currently, new techniques can be integrated using ICTs given that the ways of learning change over time and there are electronic means that allow diagnosis through surveys that can be completed online using a cell phone, a similar situation in teaching techniques. teaching in which social networks through programs such as YouTube and TikTok allow teaching with the use of computing. Research on learning styles initially involves knowing students' preferences on how to acquire knowledge and thereby combining it with the teaching styles of teachers, so that they allow better academic performance, which is why various actions are proposed in This document is intended to take advantage of students' abilities and, according to their learning style, to access knowledge that they can apply for their professional development. Of the learning styles evaluated, it was found that the reflective was the one that presented a higher value in relation to the others, however, this did not make any difference between men and women, which indicates that teachers should take advantage of it in their academic activities to develop work where reflection is within the objectives of their classes and thus achieve greater participation as well as better results in it. However, students who learn with other learning styles other than reflective ones should not be left aside since one of the seven transversal axes of the new Mexican school addresses the inclusion of students, so attending and Teaching from particularity is one of the priorities of education at the present time.

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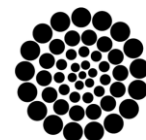
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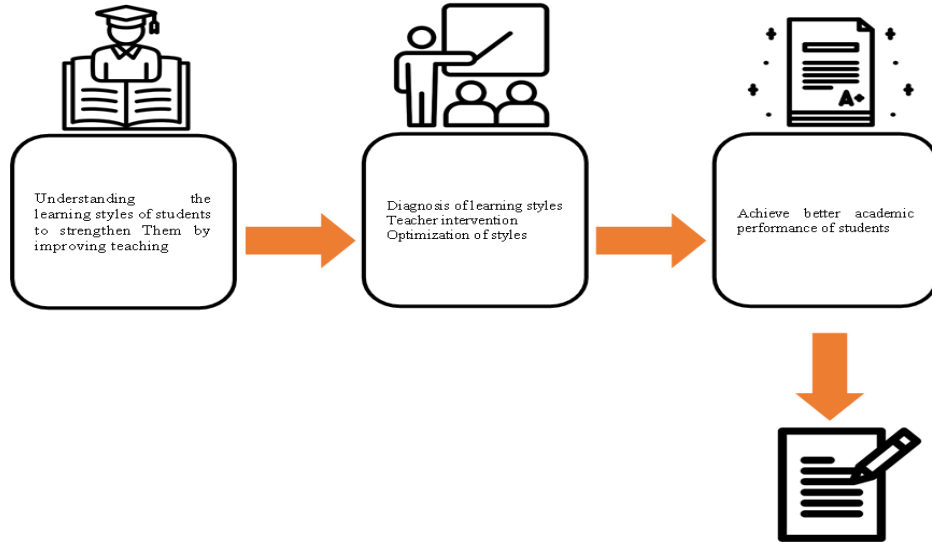
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Abstract

Educational processes include teaching and learning, which represent the interaction between students and teachers. Learning styles (LS) are a set of psychological characteristics, cognitive, affective, and physiological traits that are expressed together when a person faces a learning situation. There are several models that are applied in different areas of knowledge such as: the model of multiple intelligences of Howard Gardner, the Felder-Silverman, Kolb, Myers-Briggs, Kagan Cooperative Learning, Felder, and Soloman Learning Styles Inventory, the VARK Neurolinguistic programming, Margaret Martínez, Grasha and Hruska-Riechmann and Honey-Alonso Learning Styles. The study was carried out with agricultural high school students from the Autonomous University of Chapingo. The Honey-Alonso learning styles questionnaire was applied in print and in person. The analysis of the LS according to the scales was performed. Work must be done in the classrooms with a diversity of methodologies to promote the different LS of each student.

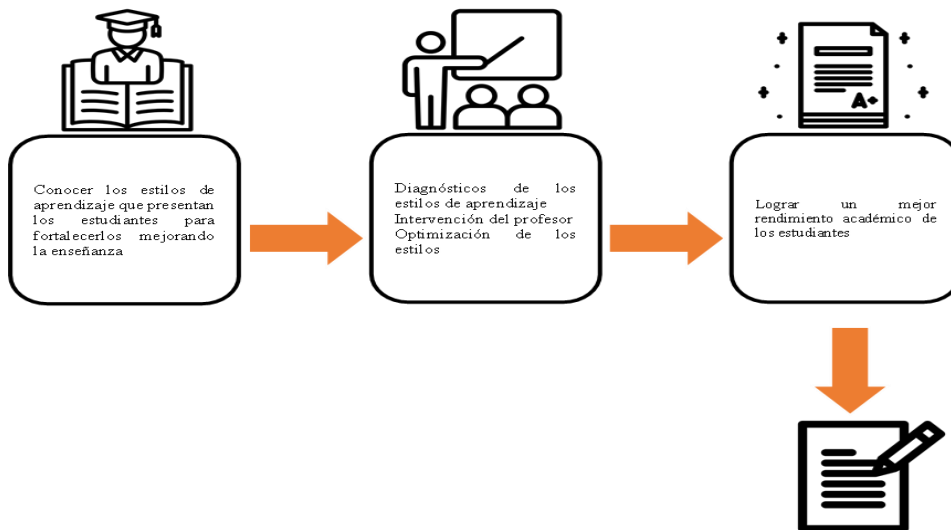


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Teaching, teaching strategies, educational processes

Resumen

Los procesos educativos incluyen la enseñanza y el aprendizaje que representan la interacción entre estudiantes y profesores. Los estilos de aprendizaje (LS) son un conjunto de características psicológicas, cognitivas, afectivas y fisiológicas que se expresan en conjunto cuando una persona enfrenta una situación de aprendizaje. Existen varios modelos que se aplican en diferentes áreas del conocimiento como son: el modelo de inteligencias múltiples de Howard Gardner, el Inventario de Estilos de Aprendizaje de Felder-Silverman, Kolb, Myers-Briggs, Kagan Cooperative Learning, Felder y Soloman, el de programación neurolingüística VARK, Margaret Martínez, Grasha y Hruska-Riechmann y Honey-Alonso estilos de aprendizaje. El estudio se realizó con estudiantes de la preparatoria agrícola de la Universidad Autónoma Chapingo. Se aplicó el cuestionario de estilos de aprendizaje Honey-Alonso de forma impresa y presencial. Se realizó el análisis de la LS según las escalas. Se debe trabajar en las aulas con diversidad de metodologías para potenciar las diferentes LS de cada estudiante.



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Enseñanza, estrategias didácticas, procesos educativos

Introduction

Educational processes include teaching and learning, which represent the interaction between students and teachers. Teaching is supported by curricula to program activities that allow students to learn. For their part, learning styles are very important since they are based on personal characteristics during the acquisition of knowledge. Learning styles are support for the teacher, they allow them to identify the way in which each of their students learns or allows them to acquire knowledge more easily (Roque Herrera et al., 2023). Diagnosing the way the student learns helps create the most appropriate method for each one. However, it has been indicated that on many occasions this interaction does not occur, since teachers teach according to their way of learning and according to strategies that were effective for them in teaching (Vargas-Murillo, 2020). Therefore, identifying students' learning styles should be accompanied by certain teaching strategies of teachers, to the extent that these preferences will impact their usual teaching methods, consequently affecting the ways of learning and student performance (Ventura et al., 2012).

In this study, the diagnosis of learning styles was carried out considering several factors, including the differences between men and women in the different learning styles. The effect of the study location on the learning styles of the students is also determined, since there are different sociocultural conditions in each of them (Montero et al., 2007). In addition, the grades that the students presented during their secondary education studies (secondary or preparatory) were considered in relation to their learning style and the correlations between the different learning styles were also identified with the purpose of knowing the relationship between them. However, an important aspect has been the students' response to the questionnaire during the COVID-19 pandemic, which shows that it is necessary to adapt the instrument to the new conditions to adapt to ICTs (Barbosa Granados & Amariles Jaramillo, 2019) .

The proposed hypothesis considers that learning styles can be improved in students who have received better conditions, as would occur in students who live at the Texcoco campus where the conditions of infrastructure and healthcare services allow for greater comfort and the problem is that school performance It is not similar in all the locations where the university has a campus, which is a reflection of the differences between the learning styles that students have. Furthermore, it is assumed that during the pandemic period, students' learning styles decline due to being in conditions that are not optimal for online study.

In recent times, the world has gone through various changes in the economy, medicine, and education after having overcome a global pandemic (Covid-2019) (Hoofman & Secord, 2021). In the education significant adaptations were developed to cope with confinement, such as the change from face-to-face education to distance education (Aristeidou & Cross, 2021), which implied substantial changes in learning styles (LS). In Mexico, in addition to the development of online classes, in recent years a change has also been implemented in education, with the new Mexican school (Frade Rubio, 2019), which considers four training fields and seven articulating axes, within which is inclusion, a term that implies that all students feel safe, respected, and accepted as they are. Therefore, it is necessary to make adaptations in teaching and in the evaluation of different learning styles and skill levels, so that it is possible to detect the effect of some belonging or inclusion factors on students.

Students must be able to identify their strengths and weaknesses, define their personal goals for the future, practice more complex skills that help them achieve their short, medium, and long-term goals, as well as assume their responsibility to be adults with values. Furthermore, students have an almost unlimited learning potential, which, together with the different learning styles they have, favors them to some extent and contributes to improving or enhancing meaningful learning, and it is the teacher's task to help the student discover how to learn (García Luna et al., 2015; Hurtado Bello et al., 2017).

Due to this situation, both students and teachers are closely related in the teaching-learning process, because students must learn and teachers must use various strategies that adapt to the needs of each of them, to that everyone acquires the expected knowledge, and the expected objectives are achieved. The teacher must be clear about the individual characterization of each student since everyone learns in different ways, but to facilitate their work they must form groups based on common interests and learning preferences.

Learning styles (LS)

Learning styles are defined in psychology as the way in which everyone carries out an activity, which is reflected in a communication style, lifestyle or speaking style (Aguilera Pupo & Ortiz Torres, 2009). Therefore, LS are a set of psychological characteristics, cognitive, affective, and physiological traits that are expressed together when a person faces a learning situation. A broad study on the conceptualization of learning style models was carried out in Venezuela (Silva Sprok, 2018) and studies have also been developed in Mexico that describe the measurement instruments of LS (García-Cué et al., 2009). Other authors have defined LS in different ways, one of them is the form that a student adopts as a special learning strategy, independent of the environment.

Kolb proposed a model of learning through experience in the same learning process (Romero Agudelo et al., 2010), while another definition identified students' LS with a model based on “the onion analogy”, with three layers or three levels: the first level, the outer part that focuses on instructional preference and learning environments; the second stratum is based on preferences about how information is processed; and the third, the center is related to learning preferences due to personality (Ortiz Ojeda & Canto Herrera, 2013). To determine these forms of learning, the learning style and its dimensions must be diagnosed, for which there are several models that are applied in different areas of knowledge such as:

Cognitive models of learning styles

The model of multiple intelligences (MI) of Howard Gardner has constituted an innovative, risky, and provocative proposal for the conception of intelligence (Carpintero Molina et al., 2009). This author originally established seven styles: a) verbal / linguistic intelligence, b) logical / mathematical intelligence, c) visual / spatial intelligence, d) bodily / kinesthetic intelligence, e) musical / rhythmic intelligence, f) interpersonal intelligence, and g) intrapersonal intelligence. The epistemological bases of Howard Gardner's MI model are found in the humanistic psychology of education, neuropsychology, and the holistic model of education (Chura Luna, 2019).

Felder-Silverman model: addresses ten different learning styles: sensory vs. intuitive; visual vs. verbal; inductive vs. deductive; active vs. reflective; sequential versus global (Silva Sprok, 2018). Offer a list of teaching-learning strategies that are not exclusive and that will help the teacher treat the different contents based on the learning styles proposed by Felder and Silverman and the key competencies they enhance.

In this way, will be able to create more complete and effective instructional designs, selecting learning strategies based on the diversity of classroom styles and ensuring key competencies are achieved (Marcos Salas et al., 2020).

Kolb Model is based on learning that takes the student's direct experience as its central axis. The four types are: divergent (concrete and reflective); assimilator (abstract and reflective); convergent (abstract and active); and accommodator (concrete and active), the evaluation uses two dimensions for learning to occur. The first is the perception of the environment and the second is processing (Romero Agudelo et al., 2010; Roque Herrera et al., 2023). Kolb's model has been one of the most worked on and the one that has contributed the most to the creation of other models (Silva Sprok, 2018).

Myers-Briggs Model: Both authors developed an instrument to evaluate personality characteristics. The Myers Briggs Type Indicator (MBTI) is based on the way in which the functions of consciousness interact, that is, the psychodynamic aspect of the typological model (Couto et al., 2016). A set of learning styles are proposed that are combined into 16 different types; The basic styles are: extroverted/introverted; sensory/intuitive; thoughtful/emotional; and judges/receivers.

Kagan Model: The structural approach to cooperative learning (Kagan Cooperative Learning) is based on the use of step-by-step instructional structures or strategies, free of content, that structure the interaction of students with each other, the plan of studies and the teacher. Empowering theoretical concepts are addressed, the keys to success, and the teacher. Kagan structures produce positive results that can be the basis of an educational revolution (Chophel & Norbu, 2021).

The Felder and Soloman Learning Styles Inventory (ILS) to determine learning styles. The ILS measures four cognitive scales: 1) perception, 2) processing, 3) representation, and 4) comprehension. The evaluation is through 44 dichotomous items and 11 reagents for each dimension. Choosing one of the two possible answers in each question indicates opposite learning styles: sensory or intuitive (perception), active or reflective (processing), visual or verbal (representation), sequential or global (comprehension). In each dimension, negative scores refer to the sensory, active, visual, and sequential style. For its part, positive scores refer to the intuitive, reflective, verbal, and global style (Diago Egaña et al., 2022; Ventura et al., 2012).

The VARK Neurolinguistic programming model. It summarizes the words: visual, aural, read/write, kinesthetic, is based on people's sensory preferences, it focuses on measuring the way in which the four dimensions included are related to each other used during learning processes: vision, hearing, reading/writing, and kinesthesia (Medina-Velandia & Plazas-Gómez, 2018).

Models of psychologically oriented learning styles

Margaret Martínez (1999): It has a full psychological orientation on emotions and intentions and points out the existence of several learning styles: student in transformation; student performer; conformist student; and student who resists (Martínez, 1999).

Grasha and Hruska-Riechmann Model: They developed the Learning Style Scale (GRLSS), and Teaching Style Inventory (TSI) defines learning styles as the preferences of each student, referring to two elements: their way of thinking and interaction with the rest of the students in different educational environments and experiences. They propose the existence of the independent student; the dependent student; the competitive student; the collaborative student; the reticent student and the participative student (Rojas-Jara et al., 2016).

Honey-Alonso Questionnaire: Honey-Alonso Learning Styles Questionnaire (HALSQ) has been used in much research. This instrument consists of 80 brief and dichotomous items, from which four learning styles are determined: active, reflective, theoretical, and pragmatic. It consists of 80 items that are structured in four groups of 20, which correspond to the four learning styles. The scoring of the 20 items is additive (Esguerra Pérez & Guerrero Ospina, 2010; Quintanal Pérez & Gallego Gil, 2011).

The styles that are generated from HALSQ are:

- **Active learning style:** They seek new experiences, they are open-minded, not at all skeptical and they enthusiastically undertake new tasks: entertainer, improviser, discoverer, risk-taker, spontaneous.
- **Reflective learning style:** They give preference to reflection over action, carefully observe different experiences: thoughtful, conscientious, receptive, analytical, exhaustive.
- **Theoretical learning style:** They seek rationality and objectivity, fleeing from the subjective and ambiguous: methodical, logical, objective, critical, structured.
- **Pragmatic learning style:** They like to act quickly and confidently with those ideas and projects that attract them: experimental, practical, direct, effective, realistic (Alonso et al., 2007).

The HASLQ has been a widely used instrument in different grades of study such as secondary school (Quintanal Pérez & Gallego Gil, 2011), it has also been applied at the secondary level in a longitudinal study with high school students from the State of Mexico (Ramírez Gallegos et al., 2017) and a bachelor's degree in different areas of knowledge such as: Psychology (Esguerra Pérez & Guerrero Ospina, 2010; Juárez Lugo et al., 2011). In different engineering careers such as Computer Systems, Industrial Engineering, Electromechanical Engineering (Ortiz Ojeda & Canto Herrera, 2013) to determine the relationship that exists with academic performance. Also, in the Forest Engineering (Piorno Ruíz, 2014) and in pedagogy students (Moreno Morales & León Ávila, 2015), as well as in university social work students from Mexico and Chile (Caballero Pino et al., 2015). Also, in the specialty in Rural Sociology at the Autonomous University of Chapingo (UACH), teaching styles and their influence on students' learning styles have been identified (Aguilar-Antonio et al., 2017).

Box 1**Table 1**

Studies that address learning styles and their relationship with academic performance in different educational institutions

Author	Country	Level of study	Category	Conclusions
(Esguerra Pérez & Guerrero Ospina, 2010)	Colombia	Universidad Santo Tomás (Psychology)	80 items in 4 groups of 20. Styles: active, reflective, theoretical and pragmatic. Honey - Alonso	The reflective style is more prevalent.
(Romero Agudelo et al., 2010) <i>et al.</i>	Colombia	Corporación Universitaria Minuto de Dios (Virtual education)	a) Concrete-experience; b) Abstract-conceptualization c) Active-experimentation d) Observation-reflection. Honey -Alonso	The divergent learning style is the predominant one
(Quintanal Pérez & Gallego Gil, 2011)	Spain	High school	Honey -Alonso	Teachers are reflective and theoretical. Reflective and pragmatic students
(Juárez Lugo et al., 2011) <i>et al.</i>	Mexico	UAEM (Psychology).	Honey -Alonso	The predominant style is reflective.
(Ventura et al., 2012)	Argentina	Universidad Pública Argentina (Engineering and Psychology)	1) perception, 2) processing, 3) representation 4) understanding Honey -Alonso	Engineering students: sensory and visual-practical style Psychology students, style: intuitive and verbal-innovative
(Ortiz Ojeda & Canto Herrera, 2013)	Mexico	Instituto Tecnol. de Motul, (Engineering)	Honey -Alonso	The reflective learning style predominated.
(Pioro Ruíz, 2014)	Cuba	Universidad de Guantánamo, Cuba (Forest engineering).	1: (Active and Reflective) 2: (Active and Theoretical) 3:(Active and Pragmatic) 4: (Reflective and Theoretical) 5: (Reflective and Pragmatic) 6: (Theoretical and Pragmatic).	Reflective, theoretical and pragmatic learning styles have greater predominance in students.
(Moreno Morales & León Ávila, 2015)	Cuba	Universidad de Ciencias Pedagógicas (Pedagogy)	Characterization of learning styles. Role of planning and strategic organization of the potential development of student training. Honey -Alonso	Students are dependent on the family and guardianship of the teacher (little motivation to study)
(Caballero Pino et al., 2015)	Mexico y Chile	UNAM y la Universidad de la Frontera de Chile.	Honey -Alonso	The pragmatic and theoretical style predominates in Mexicans and the reflective style in Chilean students.
(Ramírez Gallegos et al., 2017)	Mexico	Preparatory of Estado de México.	Honey-Alonso	Multiple learning styles (multimodal styles).
(Aguilar-Antonio et al., 2017)	Mexico	Universidad Autónoma Chapingo (Rural Sociology)	Honey-Alonso	Formal teaching styles and reflective learning styles are related.

Source own

A current topic is Artificial Intelligence (AI), which has recently revolutionized education, specifically learning. AI is increasingly being used to personalize instruction and streamline administrative tasks. In education, AI is used to develop intelligent tutoring systems, adaptive learning platforms, and automated grading systems, among other applications. As AI continues to evolve, its impact on education will also increase. AI has the potential to personalize learning experiences, improve student academic outcomes, and make education more inclusive. By leveraging AI, teachers can create adaptive learning environments that meet the individual needs of students, improving attention and retention (Onesi-Ozigagun et al., 2024). The integration of AI globally has enabled people to acquire essential skills in their roles, especially in the field of education, where students and educators make use of AI technologies (Ayanwale et al., 2024). A recent study offers practical advice and practical ideas for incorporating artificial intelligence (AI) in medical education, covering practical, ethical, pedagogical, and professional implications for both medical educators and students with the knowledge and tools necessary to learn about medical education in the age of AI (Garcia et al., 2024).

Methodology

The study was carried out with agricultural high school students from the Autonomous University of Chapingo. The Honey-Alonso learning styles questionnaire (HALSQ) (Alonso et al., 2007) was applied in print and in person.

The sample was taken for convenience from students in the fifth semester of agricultural high school and those in the second semester of propaedeutic studies. In both cases, the students were detached from the family nucleus since many of them were of different origin (state of the Republic) than the center or regional unit in which they developed their studies.

In the analysis of the information, a total of 339 records were used, coming from the headquarters located in Tabasco, Yucatán, Veracruz and Texcoco. Two propaedeutic groups from the Unidad Regional Universitaria Sursureste (URUSSE) ($n = 19$ and $n = 41$), in Tabasco, and a propaedeutic group at the Centro Regional Universitario Península de Yucatán (CRUPY) ($n = 44$), located in Mérida, and two groups from the Centro Regional Universitario de Oriente (CRUO) ($n = 41$ and $n = 43$), in Huatusco, Veracruz and four groups in Texcoco ($n = 39$, $n = 39$, $n = 37$, $n = 36$). With a sample of 140 men and 199 women, with an average age of 19.2 ± 2.8 years.

The origin of the students was very varied, predominating the states of Yucatán, Campeche, Oaxaca, Quintana Roo, Veracruz, and Chiapas. It is worth mentioning that all the sampled students have all the services and supports of the UACH.

The database was prepared in an Excel sheet and consisted of recording the general data of the students (sex, age, name, surname, group, grade, average grade in the immediately previous grade, state of origin, regional affiliation, etc.) and the score for each item, as well as the total points accumulated for each of the learning styles.

The maximum score that can be obtained for each style was 20. For the interpretation of the LS, the scheme used called scales allows us to know who is above or below the average, for which the complete list of each rating is ordered. a certain style and the population are divided into five categories (Alonso et al., 2007).

- a) Very high preference: 10% of people who have had the highest score
- b) High preference: 20% of the people who follow the highest score are grouped and counted.
- c) Moderate preference: Here 40% of the people who are still in the score are counted.
- d) Low preference: 20% of people with low scores are counted.
- e) Very low preference: 10% of people with the lowest score are counted.

With the constructed scales and with the information on the origin and sex of the students, the distributions were obtained with the JASP program (JASP Team, 2023) in addition to the figures of boxes, as well as the analysis of variance to separate the averages from the qualifications for each of the LS according to the scales.

Results

The interpretation scales of UACH students obtained with a total sample of 343 students indicated that the average of each of the LS was in the moderate preference. Because all scales had a normal distribution, the highest percentage of students are around the mean, which corresponds to a moderate preference. With these scales, a comparative interpretation can be made of any result obtained in HALSQ applications. The maximum score that can be obtained is 20 points in each style.

The interpretation of the scores is based on the results of all participating subjects with whom the individual data are compared. With the scales it is easy to know who is average, who is above and who is below.

The results indicate that the active learning style (11.8 ± 3.1) was the one with the lowest score compared to reflective (14.7 ± 2.9), theoretical (13.6 ± 2.9) and pragmatic (13.6 ± 3.0).

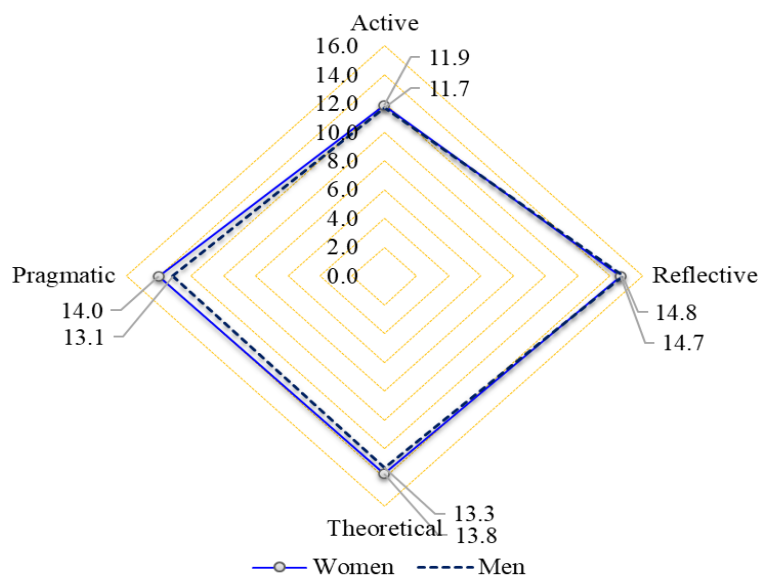
Box 2**Table 2**

Scales of the learning styles of high school students at the Autonomous University of Chapingo.

N = 343	10% Preference Very low	20% Preference Low	40% Preference moderate	20% Preference high	10% Preference Very high
Active	0-7	8-10	11-13 Mean (11.8)	14-15	16-20
Reflective	0-10	11-13	14-16 Mean (14.7)	17-18	19-20
Theoretical	0-9	10-12	13-15 Mean (13.6)	16-17	18-20
Pragmatic	0-9	10-12	13-15 Mean (13.6)	16-17	18-20

Source own

In general, the agricultural high school students showed the reflective learning style as their main learning style, which obtained the highest score (14.73), while the pragmatic and theoretical styles had similar values (13.56 and 13.53, respectively), while active learning was the one that had the lowest score (11.79). These values had similar behavior in both women and men (Figure 1).

Box 3**Figure 1**

Learning styles of high school students at the Autonomous University of Chapingo, categorized by gender on the 1-20 scale.

Source own

The learning styles in all the groups studied were similar in women and men ($P > 0.05$) and between the different locations of the agricultural high school ($P > 0.05$). The observed values of the LS were not significant ($P > 0.05$), but some trends observed were that the average in the active LS was slightly higher in men and women at the Veracruz and Texcoco sites. In the case of pragmatic LS, the lowest value was observed only in men from the state of Tabasco. In the reflective style, only women from the state of Veracruz had slightly higher values. In the theoretical LS, men and women at the Veracruz headquarters had the lowest value and all other comparisons were similar between them (Figure 2). The shapes of the distributions of all LS (active, reflective, theoretical, pragmatic) show a trend towards normality in both men and women, although high variability is observed in the distributions.

Box 4

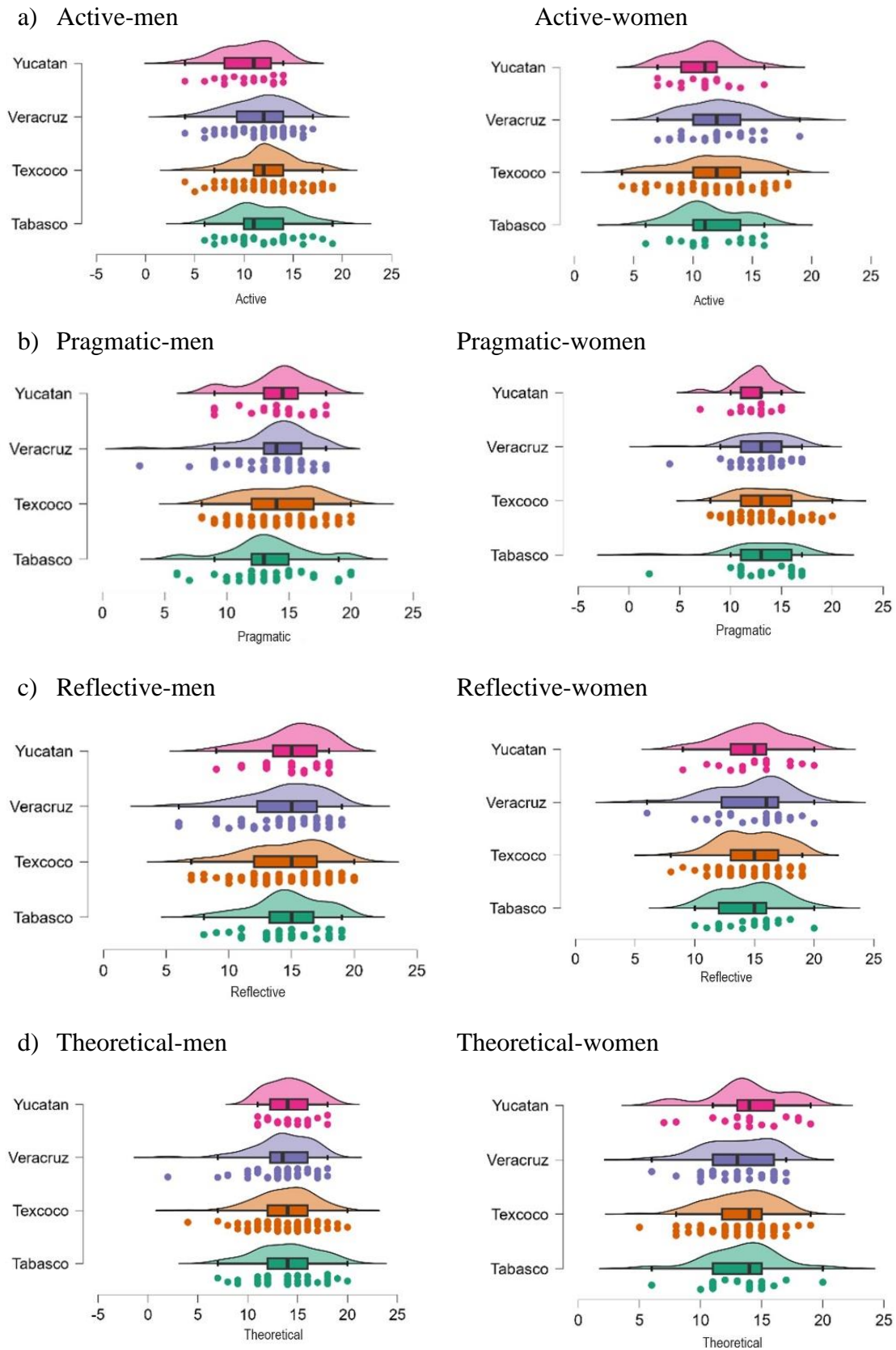


Figure 2

Learning styles of agricultural and preparatory high school students according to location of origin and gender.

Source own

The level of learning style in the average score did not show trends in the cases of reflective, theoretical, and pragmatic LS. It was observed that the very low and very high levels had similar scores, while in the case of active LS it was observed that a very high level in the LS obtained the lowest score in both men and women (Table 3).

Box 5**Table 3**

Average grades from the previous degree and their relationship with the level of learning style in high school students at the Autonomous University of Chapingo.

Level	Active			Reflective			Theoretical			Pragmatic		
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
Men												
Very low	18	8.6	0.5	17	8.5	0.5	12	8.7	0.5	17	8.8	0.6
Low	41	8.8	0.8	41	8.6	0.7	46	8.6	0.7	35	8.5	0.6
Moderate	70	8.7	0.6	70	8.7	0.7	73	8.5	0.7	74	8.7	0.7
High	38	8.4	0.7	48	8.6	0.6	41	8.7	0.7	40	8.5	0.7
Very high	21	8.5	0.6	12	8.8	0.7	16	8.9	0.5	22	8.5	0.7
Women												
Very low	12	9.0	0.6	6	8.5	0.6	8	8.5	1.2	8	8.8	0.8
Low	30	8.7	0.6	37	8.7	0.7	34	8.6	0.6	42	8.8	0.7
Moderate	42	8.7	0.7	45	8.7	0.7	49	8.8	0.6	42	8.6	0.7
High	19	8.7	0.6	21	8.8	0.7	23	8.6	0.6	23	8.7	0.5
Very high	17	8.6	0.7	11	8.7	0.5	6	9.3	0.5	5	8.9	0.4

SD. Standard deviation

Source own

In each of the subjects, the highest averages were found in one of the scales without any trend (Table 4).

Box 6**Table 4**

Active learning styles and their relationship with the grades of different subjects taught in preparatory studies at the Autonomous University of Chapingo.

Scale	N	First semester									
		Bot	SS1	ADiv	Phy	Chem	Math1	APSy	Stt1	Ave 1	SD
Very low	11	74.2	84.1	82.2	75.9	80.0	79.4	86.1	88.5	81.4	6.3
Low	40	75.7	83.1	77.6	82.0	82.6	79.6	88.8	91.3	82.6	10.5
Moderate	44	76.9	86.0	81.0	79.8	78.8	78.7	87.5	88.3	82.2	9.0
High	32	71.8	81.4	75.6	75.8	74.2	74.0	86.4	86.4	78.2	9.5
Very high	15	75.1	79.1	75.7	77.5	76.3	72.7	87.0	85.6	78.5	11.8
Scale		Second semester									
		Fore	SS2			Math2	AnPS	Stt2	Ave 2	SD	
Very low		86.7	88.1			84.8	87.1	90.0	87.3	9.4	
Low		85.0	85.3			82.8	83.0	84.5	84.0	11.5	
Moderate		86.6	90.1			83.4	83.2	86.8	85.4	10.3	
High		85.3	84.8			78.7	79.3	83.0	80.0	12.3	
Very high		82.6	83.1			77.6	78.1	79.7	80.2	13.3	

Bot: Botany of seed plants, SS1: Social Sciences 1, Adiv: Animal diversity, Phy: Basic experimental physics, Chem: introduction to chemistry, Math1: mathematics, APSy: Agricultural production systems, Stt1: Integrative study tour 1, Ave1: Average 1, Fore: Forestry production systems, SS2: Social sciences 2, Math2: Mathematics 2, AnPS: Animal production systems, Stt2: Integrative study tour 2, Ave2: Average 2, SD: Standard deviation.

Source own

In Active style, learning styles did not show any trend with the grades of the preparatory students at the Autonomous University of Chapingo. The high and very high scales did not correspond to the best grades (Table 4) in any of the subjects (Botany of seed plants, social sciences 1, animal diversity, basic experimental physics, introduction to chemistry, mathematics, agricultural production systems, integrative study tour 1, forest production systems, social sciences 2, mathematics 2, animal production systems, integrative study tour 2).

In the case of students with the reflective style, the grade averages obtained by preparatory students did not show any trend in any of the subjects taken either in the first semester or in the second, and on the contrary, in some cases the low and very low reflective style showed high scores as in the case of integrative trip 1 and 2 and forestry production systems, which indicates that it is necessary to know very well how learning style influences academic performance (Table 5).

Box 7

Table 5

Reflective learning styles and their relationship with the grades of different subjects taught in preparatory studies at the Autonomous University of Chapingo.

First semester											
Scale	N	Bot	SS1	ADiv	Phy	Chem	Math1	APSy	Stt1	Ave 1	SD
Very low	13	74.3	85.6	82.1	76.2	73.5	78.2	85.6	90.0	80.6	13.5
Low	31	72.5	81.7	76.1	77.6	76.8	73.9	85.9	87.2	79.1	11.4
Moderate	57	75.9	82.8	77.6	81.1	81.5	78.4	89.2	89.7	82.0	9.0
High	32	76.6	85.8	79.8	78.3	77.6	78.8	86.9	86.5	81.2	7.9
Very high	9	73.8	79.4	80.8	76.7	78.4	75.1	86.6	89.6	80.1	8.5

Second semester											
Scale	N	Fore	SS2	Math2	AnPS	Stt2	Ave 2	SD			
Very low	12	88.3	84.2	79.3	85.8	86.8	84.9	11.5			
Low	25	87.6	86.0	77.7	81.3	84.1	82.8	14.0			
Moderate	50	84.0	86.7	84.7	82.7	84.2	84.0	11.0			
High	30	85.9	88.7	81.2	79.3	85.9	82.5	10.5			
Very high	7	81.6	85.9	82.4	87.0	84.1	84.2	10.5			

Bot: Botany of seed plants, SS1: Social Sciences 1, Adiv: Animal diversity, Phy: Basic experimental physics, Chem: introduction to chemistry, Math1: mathematics, APSy: Agricultural production systems, Stt1: Integrative study tour 1, Ave1: Average 1, Fore: Forestry production systems, SS2: Social sciences 2, Math2: Mathematics 2, AnPS: Animal production systems, Stt2: Integrative study tour 2, Ave2: Average 2, SD: Standard deviation.

Source own

The relationship between school performance measured through the grade before entering university and learning styles showed that the correlation between active EA and grade was negative ($r = -0.133$), so students with very high active style will have the lowest rating. Positive correlations were also observed between the pragmatic style with the active, reflective, and theoretical style and between the theoretical style with the active and reflective style, but there was no relationship between the active and reflective style (Table 6).

Reflective, theoretical, and pragmatic learning styles have a greater predominance than active ones in forestry engineering students at the University of Guantánamo, Cuba (Piorno Ruíz, 2014). In other studies, a high frequency of the reflective style is observed, and it has been indicated as the most consistent with the area of social sciences in the case of the UACH (Aguilar-Antonio et al., 2017). In secondary school students there is a slight inclination towards reflective and pragmatic styles (Quintanal Pérez & Gallego Gil, 2011). In the same way, in the case of Psychology students, the reflective style predominates (Esguerra Pérez & Guerrero Ospina, 2010; Juárez Lugo et al., 2011).

The same was found in engineering careers, in which the predominant learning style was reflective (Ortiz Ojeda & Canto Herrera, 2013). However, there are differences in learning styles when comparing the country of origin, thus pragmatic and theoretical styles predominated in Mexican students, while the reflective style was the most frequent for Chilean students (Caballero Pino et al., 2015).

Box 8**Table 6**

Spearman correlations between the learning styles of high school students at the Chapingo Autonomous University.

Variable		Active	Reflective	Theoretical	Pragmatic
Reflective	Spearman's rho	0.047	—		
	p-value	0.388	—		
Theoretical	Spearman's rho	0.115	0.427	—	
	p-value	0.035	< .001	—	
Pragmatic	Spearman's rho	0.264	0.320	0.406	—
	p-value	< .001	< .001	< .001	—
Average	Spearman's rho	-0.133	0.057	0.098	-0.056
	p-value	0.018	0.313	0.082	0.320

Source own

The reflective and theoretical styles have been associated with students with higher averages and who pursue scientific careers (Quintanal Pérez & Gallego Gil, 2011). It has been shown that “high achieving” students reflect a greater tendency to behave in creative, adventurous, innovative, and novel ways. And a significant relationship has been observed between learning styles and academic performance in students who show active style (Esguerra Pérez & Guerrero Ospina, 2010). Although other authors indicate that the results of academic performance and learning styles are not necessarily associated with outstanding academic performance, because there are other factors of greater weight that influence student performance, such as: the teaching methodology by teachers, the context of the students and the curricular content taught in the courses (Caballero Pino et al., 2015; Ramírez Gallegos et al., 2017).

Regarding gender, it has been observed that the averages obtained by female students in all learning styles were higher than that of men (Quintanal Pérez & Gallego Gil, 2011). Furthermore, the learning style of men is more pragmatic, and is above the reflective, theoretical, and active style, in contrast to that of women in which there is a preference for the reflective, then pragmatic, theoretical and active styles (Juárez Lugo et al., 2011). It has also been indicated that between men and women there are significant differences in the average academic performance, demonstrating that women have better academic performance (Ortiz Ojeda & Canto Herrera, 2013). In a study with university students in the physiology course, no differences were observed between men and women in the learning style preference when using the VARK Neurolinguistic programming model (Ankad et al., 2015). A similar situation occurred in a study in the Philippines in which both men and women did not have significant differences. The reasons for this behavior were the pandemic and the modular learning approach (Cabual, 2021). However, there are other studies in which differences are indicated, for example a study with Dun's learning styles inventory, found that 9 of 22 styles showed differences between men and women, in this case the children were more kinesthetic and oriented. than girls, while girls revealed higher levels of self-motivation, persistence, responsibility, need for warmer temperatures and sociological variety, parental motivation, and teacher motivation than boys (Honigsfeld & Dunn, 2003). With other instruments such as the Kolb learning styles inventory, it has been observed that men and women have different learning preferences. Women have a greater preference for abstract materials than men. On the other hand, female respondents chose testing implications as the preferred method of learning new material (45.5%) and conducting research (41.3%) as the second preferred method (Kulturel-Konak et al., 2011). Also with the perceptual learning style preferences questionnaire, it has been observed that male and female students have different types of learning styles. Female students outnumbered males and in the types of tactile, auditory, and kinesthetic learning, female students had higher average scores than males (Şener & Çokçalışkan, 2018).

There are other factors that affect the learning style, such as coexistence, in which it has been shown that those who live with their family have a reflective learning style (Esguerra Pérez & Guerrero Ospina, 2010) and in students of Pedagogical Sciences in Cuba a high dependence on the family and the tutorship of the teacher was indicated (Moreno Morales & León Ávila, 2015). Other factors such as socioeconomic status and age have had a low influence on learning styles, which were not associated in a particular way with a style directly (Esguerra Pérez & Guerrero Ospina, 2010).

Regarding the relationship of learning styles with academic performance, there are contradictory results, while some authors do not find a direct relationship with academic performance (Juárez Lugo et al., 2011), others indicate a positive relationship between learning style pragmatic and academic performance, both in students of Computer Systems Engineering and Industrial Engineering (Ortiz Ojeda & Canto Herrera, 2013).

In a study carried out on secondary school teachers, high values were presented in the reflective and theoretical styles (Quintanal Pérez & Gallego Gil, 2011). However, another study shows that the ideal is to identify the relationship between the teaching style and the learning style, with which a direct relationship has been found between the teaching style (formal) in teachers and the learning style (reflective) in students (Aguilar-Antonio et al., 2017).

Improving Learning Styles through learning opportunity

According to Alonso et al. (2007), the five conditions that help learning are: Lifelong learning. In a colloquial way, one never stops learning through family, colleagues, at work, through the media and currently through social networks and all the technology that has been generated in recent years. However, formal ways of learning have evolved and with the pandemic there have been important changes in the way we learn. Furthermore, scientific, and technological development in all areas of knowledge requires that students learn at an accelerated pace since knowledge quickly becomes obsolete. This situation requires Universities to train professionals with updated knowledge and who can also do so on their own. have habits and styles to learn throughout life, in which the direction of the teacher is important since it is their responsibility to promote self-learning that allows them to provide solutions to professional problems that require self-management of knowledge (Tinoco-Izquierdo & Tinoco-Cuenca, 2018).

Learning is a personal and natural process. This concept is taken up even in transversal competencies that include independent learning. Furthermore, the important role played by values such as discipline, perseverance, and concentration during a period of professional training is recognized, along with values that support individual training such as: adaptability and creativity, knowledge processing, critical thinking and learning strategies, and managing harmonious learning relationships (Caena & Stringher, 2020).

Learning implies changing. Learning theories, institutional changes or teaching and learning modes are not enough for change to occur. The aim is to reorient students' disposition to foster a positive self-concept that allows them to feel capable of learning, overcoming the conditioning that may have been generated during the course of their studies. The changes empower the student for the learning process. However, work on conceptual change shows that they occur in the very long term, therefore it is important that teachers change their conceptions and adapt better to current conditions and especially university professors must be trained to be teachers, or they must be immersed in continuous training processes (Pérez-Echeverría, 2014).

Learning is linked to human development and gives meaning to evolutionary development with its alternating periods of stability and transition. Human development is the different levels of well-being in all aspects of life. Learning is always an interactive process, mediated by the existence of a culture that becomes its own, the existence of others and oneself. There exists here a dialectical unity between learning and development. Each new level of development is the result and starting point for the continuous learning that the subject carries out in his or her life (Molerio Pérez et al., 2007).

Learning combined with experience. It is a process of reaffirming, reorganizing and reintegrating previous experiences. In education and even more so in higher education, a lot of weight has been given to reason and logical thinking and the first form of learning has been left aside: sensitive, intuitive, experiential. This process of giving weight to the rational allowed an advance in science and technology, however, you cannot take only one aspect of the human being, it is important to integrate both forms in learning. Integration is desired, as part of a holistic view of the human being. The main challenge for the teacher, the group's facilitator, is to generate the necessary climate so that the students allow themselves to enter the realm of art, play and imagination. Delimiting agreements such as respect for others and care for confidentiality, in itself is already a learning experience (Osés Ruiz, 2014).

To improve learning styles according to [Granados López and García Zuluaga \(2016\)](#), four phases of carrying out the project are proposed. In the first phase, the Honey-Alonso Learning Strategies Questionnaire is applied to identify and characterize the preferred learning styles of the students who are the reason for the project. Subsequently, in the second phase, the design of workshops is carried out, according to the dominant and non-dominant preferences after analyzing the results derived from the administration of the HALSQ questionnaire. Afterwards, the third phase will be carried out in which the workshops will be developed and once the improvement workshops are finished, it will be verified whether or not there was mobility in learning preferences, so in the fourth phase the statistical analyzes are carried out with based on the data obtained (descriptive statistics), according to the application before the improvement program and after ([Granados López y García Zuluaga, 2016](#)).

Strategies to improve learning styles

Strategies are a set of actions that are carried out to reach a proposed goal. This term has been used in the educational field within the framework of the proposals of “teaching to think” and “learning to learn.” Also, strategies are considered to be the system of activities, actions and operations that allow the completion of a task with the required quality ([Gutiérrez Tapias & García Cué, 2016](#)).

Teaching strategies have been approached from different points of view, one of them considers that they are procedures that a teacher uses in a conscious, controlled, and intentional way as flexible instruments to teach meaningfully and solve problems ([Vargas-Murillo, 2020](#)).

Furthermore, teaching strategies can be classified into ([Vargas-Murillo, 2020](#)):

- 1) pre-instructional (at the beginning),
- 2) co-instructional (during)
- 3) post-instructional (at the end).

Although the teaching strategies have been classified into four different groups ([Gutiérrez Tapias & García Cué, 2016](#)):

- 1) Cognitive
- 2) Teaching
- 3) Didactics
- 4) Learning

The purpose of pre-instructional strategies is for the student to be able to set objectives and goals, which allow the teacher to know if the student has an idea of what the subject includes and the purpose of its instruction. Some proposed activities are the objectives themselves, introductions, signage, prior knowledge, brainstorming and others ([Vargas-Murillo, 2020](#)).

Co-instructional teaching strategies support the curricular contents during the teaching process, they perform functions such as detection of the main information, conceptualization of the contents, delimitation of the organization, structuring, and interrelationships between said contents, some activities proposed are illustrations, graphic organizers, interspersed questions, maps, and conceptual networks ([Vargas-Murillo, 2020](#)).

Post-instructional teaching strategies are presented after the content to be learned. Its usefulness lies in generating in the student the formation of an integrative and even critical vision of the material, allowing a critical stance on the contents developed, the types. Post-instructional strategies are link promotion, summaries, analogies, among others ([Vargas-Murillo, 2020](#)).

Cognitive. They are internally organized capacities that the student uses to guide his or her own attention, learning, memory, and thinking. The student uses a cognitive strategy when she pays attention to various features of what she is reading, to select and employ a cue about what she learns, and another strategy.

To get it back. Most importantly, she employs cognitive strategies to think about what she has learned and to solve problems.

Teaching. They take the form of a series of learning activities aimed at students and adapted to their characteristics, the available resources, and the contents under study. They determine the use of certain media and methodologies in specific organizational frameworks and provide students with the appropriate information, motivation, and guidance systems. The activities must promote the understanding of concepts, their classification and relationship, reflection, the exercise of forms of reasoning, and the transfer of knowledge.

Didactics. They are the system of actions and operations, both physical and mental, that facilitate the confrontation (interactivity) of the learning subject with the object of knowledge and the relationship of help and cooperation with other colleagues during the learning process (interaction) to carry out a task with the required quality.

Learning. They are a set of steps or skills that a student intentionally acquires and uses as a flexible instrument to learn meaningfully and solve academic problems and demands. The responsibility falls on the student (comprehension of academic texts, composition of texts, problem solving, etc.). Students go through processes such as recognizing new knowledge, reviewing their previous concepts about it, organizing, and restoring that previous knowledge, assembling it with the new and assimilating it and interpreting everything that has happened with their knowledge on the topic ([Gutiérrez Tapias & García Cué, 2016](#)).

To improve study habits, it is necessary to know the questions asked in the Honey-Alonso questionnaire. Therefore, the analysis will be carried out on each of the learning styles.

The designed activities consider the characteristics of each learning style and must be adapted to the way of learning of each student. The activities have been designed to be inserted into the teaching work plan and can be adapted to the different specialties of knowledge.

Active Style ([Alonso et al., 2007](#))

3. Many times I act without looking at the consequences
5. I believe that formalisms restrict and limit the free action of people
7. I think that acting intuitively can always be as valid as acting reflectively
9. I try to be aware of what is happening here and now
13. I prefer original and novel ideas, even if they are not practical
20. I feel like I grow with the challenge of doing something new and different
26. I feel comfortable with spontaneous and fun people
27. Most of the time I openly express how I feel.
35. I like to face life spontaneously and not have to plan everything in advance.
37. I feel uncomfortable with quiet and overly analytical people.
41. It is better to enjoy the present moment than to delight in thinking about the past or the future
43. I contribute new and spontaneous ideas in discussion groups
46. I think it is necessary to break the rules many more times than to comply with them
48. Overall, I talk more than I listen
51. I like to seek new experiences
61. When something goes wrong, I downplay it and try to do it better
67. I find it uncomfortable having to plan and foresee things.
74. I am often one of the people who cheers up the parties the most.
75. I get bored quickly with methodical and meticulous work.
77. I usually let myself be carried away by my intuitions

Students with an active style integrate fully, without prejudice and with enthusiasm in the tasks; They have an open mind; its activity is very high; They intend to make new attempts, even if it is only once, and as soon as the pace of the activity they have started slows down, they begin the next one; They face new experiences as a challenge and grow from them; They don't like long deadlines; They become the center of group work activities ([De Moya Martínez et al., 2009](#)).

Activities proposed for the active learning style ([De Moya Martínez et al., 2009](#))

- Coordination of work in small groups, avoiding activities in large groups.
- Preparation of summaries, based on articles and conferences.

- Participation in classes in which practical activities prevail.
- Sharing of ideas.
- Bibliography consultation.
- Attendance at classes with a playful approach.
- Use of ICT (video, audio, photography, internet, computer applications, etc.) to carry out tasks.
- Exchange of notes.
- For multiple choice exams, group study; for development testing, individual study.
- Preparation of concept maps with keywords.
- Putting into practice what was learned in class.
- Using Powerpoint to summarize the most important things.
- Teacher-student interaction in dynamic classes.

Pragmatic style (Alonso et al., 2007)

1. I have a reputation for saying what I think clearly and bluntly.
8. I think the most important thing is that things work.
12. When I hear a good idea, I immediately start thinking about how to put it into practice.
14. I admit and adjust to the rules only if they help me achieve my goals.
22. When there is an argument I don't like to beat around the bush.
24. I like realistic and concrete people more than theoretical ones.
30. I am attracted to experimenting and practicing the latest techniques and innovations.
38. I frequently judge other people's ideas by their practical value.
40. In meetings I support practical and realistic ideas.
47. I often realize other better and more practical ways of doing things.
52. I like to experiment and apply things.
53. I think we should get to the point quickly, to the heart of the issues
56. I get impatient when they give me irrelevant and incoherent explanations.
57. I check first if things really work.
59. I am aware that in discussions I help keep others focused on the topic, avoiding digressions.
62. I reject original and spontaneous ideas if I do not see them as practical.
68. I believe that, in many cases, the end justifies the means.
72. In order to achieve the goal I aim for, I am capable of hurting other people's feelings.
73. I don't mind doing whatever is necessary for my work to be effective.
76. People often think that I am insensitive to their feelings.

Students with a pragmatic style seek the rapid application of their ideas, attributing the positive side and taking advantage of the first opportunity to experiment with them. Students are restless, they like to act and quickly manipulate those projects or activities that attract them. They are concerned about theoretical speeches and masterful presentations that are not accompanied by demonstrations or applications. They become impatient in long-term theoretical debates and discussions where they do not appreciate anything tangible.

Activities proposed for the pragmatic learning style (De Moya Martínez et al., 2009)

- Preparation of schematic tables.
- Using repetitions to memorize.
- Attendance at classes that present a useful approach to help you learn.
- Participation in midterm exams before finals.
- Study with summaries and diagrams prepared by themselves.
- Motivating and varied activities that encourage them to study.
- Taking notes in class.
- Reading and highlighting notes.
- Voluntary reading of books.
- Individual and voluntary work.
- Participation in classes that have surprising content and creative and dynamic activities.
- Carrying out activities that relate theory to practice.
- Daily study to avoid accumulating material.

Reflective style (Alonso et al., 2007)

10. I enjoy when I have time to prepare my work and do it conscientiously.
16. I listen more often than I speak.
18. When I have any information, I try to interpret it well before expressing any conclusions.
19. Before doing something, I carefully study its advantages and disadvantages.
28. I like to analyze and turn things around.
31. I am cautious when drawing conclusions.
32. I prefer to have as many sources of information as possible. The more data you gather to reflect, the better.
34. I prefer to hear other people's opinions before expressing my own.
36. In discussions I like to observe how the other participants act.
39. I get overwhelmed if I am forced to speed up work too much to meet a deadline.
42. I get annoyed by people who always want to rush things.
44. I think that decisions based on thorough analysis are more consistent than those based on intuition.
49. I prefer to distance myself from the facts and observe them from other perspectives.
55. I prefer to discuss specific issues and not waste time with empty talk.
58. I make several drafts before final writing a work.
63. I like to weigh various alternatives before making a decision.
65. In debates and discussions I prefer to play a secondary role rather than being the leader, or the one who participates the most.
69. I usually reflect on issues and problems.
70. Working conscientiously fills me with satisfaction and pride.
79. I am often interested in finding out what people think.

Students with a reflective style consider aspects from different perspectives; They collect data and analyze it carefully; they are prudent; They listen to others before intervening, creating a sense of tolerance around them. In the reflective style, students collect all possible data, and, after careful analysis, make a decision, and even do not hesitate to go back to rethink it. They like to study all facets of an issue and consider all possible implications before managing it. They are not in favor of actively participating in meetings, they prefer to remain on the lookout by observing and analyzing the behaviors and expressions of others.

Activities proposed for the reflective learning style (De Moya Martínez et al., 2009)

- Attendance at a master class with slides that serve as a script.
- Preparation of summaries and outlines of the topics.
- Attendance in class where the teacher gives various examples that allow reflection.
- Preparation of very brief outlines that allow later development.
- Work with ICT and bibliographic search.
- Keep work up to date.
- Transfer class notes to clean.
- Carry out individual work based on proposed topics.
- Internet search for useful and relevant information.
- Collect opinions from the teacher or other classmates and compare them with your own.
- Study individually to review with other classmates.
- Preparation of summary tables with important ideas.
- Critical reflection on articles or short texts.
- Use of ICT as a complement to books.
- -Group work, where each member contributes their ideas to finish the task sooner.
- Memorization through mnemonic techniques: rewrite what has been read and analyze it several times; read aloud repeatedly what needs to be studied; make sentences with difficult words and acrostics.
- Carrying out work on paper, taking care of structuring, order, and cleanliness.
- Reflection on everything learned.

Theoretical style (Alonso et al., 2007)

2. I am sure of what is good and what is bad, what is right and what is wrong.

- 4. I usually try to solve problems methodically and step by step.
- 6. I am interested in knowing what the value systems of others are and with what criteria they act.
- 11. I am comfortable following an order, at meals, in study, exercising regularly.
- 15. I normally fit in well with thoughtful people and it is difficult for me to tune in with people who are too spontaneous, unpredictable.
- 17. I prefer structured things to organized ones.
- 21. I almost always try to be consistent with my criteria and value system. I have principles and I follow them.
- 23. I dislike being effectively involved in my work environment. I prefer to maintain distant relationships.
- 25. It is difficult for me to be creative, break structures.
- 29. It bothers me that people don't take things seriously.
- 33. I tend to be a perfectionist.
- 45. I frequently detect inconsistencies and weaknesses in the arguments of others.
- 50. I am convinced that logic and reasoning must prevail.
- 54. I always try to get clear conclusions and ideas.
- 60. I notice that I am often one of the most objective and dispassionate in discussions.
- 64. I often look ahead to foresee the future.
- 66. People who do not act logically bother me.
- 71. Faced with events, I try to discover the principles and theories on which they are based.
- 78. If I work in a group I try to follow a method and order.
- 80. I avoid subjective, ambiguous and unclear topics.

Students with a theoretical style adapt the observations they make within logical and complex theories; they use logic to solve problems; They are perfectionists; they frequently use analysis and synthesis; They possess objectivity and deep thinking. In the theoretical style, students approach problems vertically and in logical phases and are not satisfied until they consider that they have reached perfection or are the best.

They resist working in a group, unless they consider that the members are of the same intellectual level. They tend to be perfectionists and are not satisfied when there is no organization, or the elements are not articulated according to rational logic. They are interested in everything related to systems of thought, theoretical models, general principles, and conceptual maps.

Activities proposed for the reflective learning style (De Moya Martínez et al., 2009)

- Attendance at classes and asking questions.
- Individual study to concentrate better.
- Resolution of problems and conflictive exercises.
- Formulation of questions among colleagues to strengthen their self-esteem.
- Carrying out concrete and clear activities, avoiding excess redundant information.
- Promotion of a participatory environment in class.
- Participation in activities that allow the search for information on the Internet, rather than in the library.
- Essential attendance to class.
- Use of online educational platforms, such as Moodle.
- Use of study techniques, such as underlining and summaries of books and notes.
- Raising doubts to the teacher-tutor so that they can be resolved by him.

Conclusions

Although the learning styles in the average grades did not show trends in the reflective, theoretical and pragmatic learning styles, work must be done in the classrooms with a diversity of methodologies to promote the different learning styles of each student, taking into account that observed positive correlations between the pragmatic style with the active, reflective and theoretical style and between the theoretical style with the active and reflective style, even when there was no relationship between the active and reflective style.

Of the learning styles evaluated, it was found that the reflective was the one that presented a higher value in relation to the others, however, this did not make any difference between men and women, which indicates that teachers should take advantage of it in their activities. academics to develop work where reflection is within the objectives of their classes and thus achieve greater participation as well as better results in it. However, students who learn with other learning styles other than reflective ones should not be left aside since one of the seven transversal axes of the new Mexican school addresses the inclusion of students, so attending and Teaching from particularity is one of the priorities of education at the present time.

Annexes

Honey-Alonso Learning Styles Questionnaire

1 I am known for speaking my mind clearly and bluntly.
2 I am sure of what is right and wrong, what is good and what is bad.
3 I often act without looking at the consequences.
4 I usually try to solve problems methodically and step by step.
5 I believe that formalisms restrict and limit people's freedom of action.
6 I am interested in knowing what the value systems of others are and what criteria they act with
7 I think that acting intuitively can always be just as valid as acting reflexively.
8 I believe that the most important thing is that things work out.
9 I try to be aware of what is happening here and now.
10 I enjoy it when I have the time to prepare my work and do it thoroughly.
11 I am at ease following an order, at meals, in my studies, exercising regularly.
12 When I hear a good idea, I immediately start thinking about how to put it into practice.
13 I prefer original and novel ideas, even if they are not practical.
14 I accept and conform to rules only if they help me to achieve my goals.
15 I usually fit well with thoughtful people and find it difficult to get along with people who are too spontaneous and unpredictable.
16 I listen more often than I speak.
17 I prefer structured things to orderly things.
18 When in possession of any information, I try to interpret it well before expressing any conclusion.
19 Before I do something, I carefully study its advantages and disadvantages.
20 I feel that I grow with the challenge of doing something new and different.
21 I almost always try to be consistent with my criteria and value system. I have principles and I follow them.
22 When there is a discussion I don't like to beat around the bush.
23 I dislike getting effectively involved in my work environment. I prefer to maintain distant relationships.
24 I like people who are realistic and concrete rather than theoretical.
25 I find it difficult to be creative, to break structures.
26 I feel at ease with people who are spontaneous and fun.
27 Most of the time, I openly express how I feel.
28 I like to analyze and turn things around
29 It bothers me when people don't take things seriously.
30 I enjoy experimenting and practicing the latest techniques and novelties.
31 I am cautious about drawing conclusions.
32 I prefer to have as many sources of information as possible. The more data I can gather for reflection, the better.
33 I tend to be a perfectionist
34 I prefer to listen to the opinions of others before expressing my own.
35 I like to face life spontaneously and not have to plan everything in advance.
36 In discussions, I like to observe how the other participants act.
37 I feel uncomfortable with people who are quiet and overly analytical.
38 I often judge other people's ideas by their practical value.
39 I get overwhelmed if I am forced to speed up work to meet a deadline
40 In meetings I support practical and realistic ideas.

41 It is better to enjoy the present moment than to delight in thinking about the past or the future.
42 I am annoyed by people who always want to rush things.
43 I contribute new and spontaneous ideas in group discussions.
44 I think that decisions based on careful analysis are more consistent than those based on intuition.
45 I frequently detect inconsistency and weaknesses in the arguments of others.
46 I believe that it is necessary to break the rules many more times than to follow them.
47 I often notice better and more practical ways of doing things.
48 On the whole, I talk more than I listen.
49 I prefer to distance myself from the facts and look at them from other perspectives.
50 I am convinced that logic and reasoning must prevail.
51 I like to seek new experiences
52 I like to experiment and apply things
53 I think that we should get to the point, to the heart of the matter, early on
54 I always try to reach clear conclusions and ideas
55 I prefer to discuss concrete issues and not to waste time with empty talk
56 I get impatient when I am given irrelevant and incoherent explanations.
57 I check beforehand if things really work out
58 I make several drafts before the final writing of a paper
59 I am aware that in discussions I help to keep others focused on the topic, avoiding digressions
60 I find that I am often one of the most objective and dispassionate in discussions.
61 When something goes wrong, I play it down and try to make it better.
62 I reject original and spontaneous ideas if I don't see them as practical.
63 I like to weigh various alternatives before making a decision
64 I often look ahead to foresee the future.
65 In debates and discussions, I prefer to play a secondary role rather than being the leader or the one who participates the most.
66 I am annoyed by people who do not act logically.
67 I find it uncomfortable to have to plan and foresee things.
68 I believe that, in many cases, the end justifies the means.
69 I tend to reflect on issues and problems.
70 Working conscientiously fills me with satisfaction and pride.
71 Faced with events, I try to discover the principles and theories on which they are based.
72 I am capable of hurting other people's feelings in order to achieve the objective I am aiming at.
73 I do not mind doing whatever is necessary for my work to be effective.
74 I am often one of the most lively people at parties.
75 I get bored very quickly with methodical and meticulous work.
76 People often think that I am insensitive to their feelings.
77 I tend to let myself be carried away by my intuitions.
78 If I work in a group, I try to follow a method and an order.
79 I am often interested in finding out what people are thinking.
80 I avoid subjective, ambiguous and unclear topics.

Declarations

Conflict of interest

The authors declare no interest conflict. They have no known competing financial interests or personal relationships that could have appeared to influence in this chapter.

Author contribution

Peña-Escalona, Fleider Leiser: Writing the original draft, review, data curation.

González-Garduño, Roberto: Statistical analysis, review, and correction.

Cruz-Tamayo, Alvar Alonzo: Review and correction.

Availability of data and materials

The information contained in this document is available upon express request from the main author.

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Abbreviations

AI	Artificial Intelligence
CRUO	Centro Regional Universitario de Oriente
CRUPY	Centro Regional Universitario Península de Yucatán
HALSQ	Honey-Alonso Learning Styles Questionnaire
ICTs	Informatic
ILS	Felder and Soloman Learning Styles Inventory
LS	Learning Styles
MBTI	Myers Briggs Type Indicator
MI	Multiple intelligence
TSI	Teaching Style Inventory
UACH	Autonomous University of Chapingo
URUSSE	Unidad Regional Universitaria Sursureste

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