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Research note

La educación ambiental en la valoración estética del paisaje de un monumento natural y en campo

Environmental education in the aesthetic appreciation of the landscape of a natural monument

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Resumen:

La percepción de estudiantes de las carreras profesionales del estado de Nuevo León con mayor población estudiantil de las ocho áreas del conocimiento consideradas por la Asociación Nacional de Universidades e Instituciones de Educación Superior (ANUIES) fue evaluada sobre la belleza del paisaje del Monumento Natural Cerro de la Silla (MNCS), símbolo representativo del Área Metropolitana de Monterrey (AMM). Se diseñó un muestreo no probabilístico por cuota máxima de 25 estudiantes por carrera, quienes hubieran cursado materias sobre aspectos ambientales. Se aplicaron en total 386 encuestas, tanto en universidades del sector público (196) como del sector privado (190). Las calificaciones más altas fueron otorgadas por alumnos procedentes de las escuelas privadas; se estableció una asociación entre la valoración otorgada al paisaje del MNCS y la carrera profesional de los encuestados. No obstante que la población considerada había cursado materias sobre aspectos ambientales, solo 17 % de ambos sectores educativos manifestó tener conocimiento acerca del problema ambiental del MNCS. Es necesario fortalecer con ejemplos regionales el contenido de las materias sobre aspectos ambientales que se imparten a los estudiantes de las universidades públicas y privadas de Nuevo León., con especial atención al valor del paisaje natural de áreas protegidas como indicador de su calidad ambiental y su consecuente contribución a mejorar la calidad de vida de la sociedad.

Palabras clave: Área natural protegida, conocimiento ambiental, estudiantes universitarios, monumento natural, paisaje identitario, percepción social.

Abstract:

The perception of students of professional careers in *Nuevo León*, Mexico, with the highest student population of the eight areas considered by the *Asociación Nacional de Universidades e Instituciones de Educación Superior* (ANUIES) on the landscape beauty of the natural monument *Cerro de la Silla* (MNCS), representative symbol of the Metropolitan Area of *Monterrey* was assessed. A non-probabilistic sampling was designed for a maximum quota of 25 students per career, who had studied subjects on environmental aspects. A total of 386 surveys were applied, both in public sector universities (196) and in private sector universities (190). The highest grades were awarded by students from private schools; a relationship was established between the qualification granted to the landscape of the MNCS and the professional career of the students. Notwithstanding that the surveyed population had studied subjects on environmental aspects, only 17 % of both educational sectors said they had knowledge about the environmental problem of the MNCS. And it is necessary to strengthen with regional examples the content of the subjects on environmental aspects that are taught to the students of the public and private universities of *Nuevo León*, with special attention to the value of the natural landscape of protected areas as an indicator of its environmental quality and its consequent contribution to improve the quality of life of society.

Key words: Natural protected area, environmental knowledge, bachelor students, natural monument, identity landscape, social perception.

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The human perception of the environment is interesting because it is the origin of cultural phenomena and the interpretation of the environment (Barrasa, 2013). The landscape represents a key element in issues of environmental and territorial sustainability, considering it for its aesthetic value as a resource and as a combination of physical, biological, ecological and human elements (Muñoz-Pedreros, 2004; Cassatella and Peano, 2011).

The various scientific disciplines that address the scenic value of the landscape have in common the aesthetic aspect (Daniel, 2001; Barrasa, 2013), a criterion frequently applied in the legislation for the protection and conservation of the natural environment (Antrop and Van Eetrvelde, 2000).

Aesthetics is a transcendent process, not only in the traditional context, that goes beyond artistic beauty, but as an emergent property based on the integration of artificial (anthropogenic) and natural (ecosystems) systems (Cairns, 1997). Therefore, it can be understood more broadly as an economy for survival, if concepts such as carrying capacity or self-organization are considered (Barret and Barret, 2008). This definition allows a better management of natural capital so that ecosystems provide their services to society (Daily *et al.,* 1997).

The recognition and importance of the appreciation of protected natural spaces is an achievement attributed to the World Heritage Convention (1972), as the first international legal instrument in favor of the conservation of landscapes, from which other documents derive in Europe (Rubio y Muñoz, 2008; Vázquez and Martínez, 2008; Mitchell *et al.,* 2009), contrary to the legal uncertainty of the concept "landscape" in Mexican environmental legislation and its limited mention within the framework of protected natural areas (Aguilar, 2006; Checa-Artasu*,* 2013; Checa-Artasu, 2014). However, there are known investigations related to the importance of the landscape in Mexico (1970-2010) attenuated by the academic division with the polarization of the hard sciences (of the Earth and biological) and soft sciences (social and humanities) (Urquijo and Bocco, 2011).

Since the formal emergence of environmental education (EE) in the 1970s, the United Nations Educational, Scientific and Cultural Organization (UNESCO) set out to lead the population to identify with the nature of its environment, considering the representation of cultural landscapes as something beautiful and aesthetic, worthy of respect and protection, as well as promoting methodologies for their conservation through the principle of school transversality with a multidisciplinary approach (Heyne, 2005; Novo, 2009). Based on the pedagogical potential of landscape use as a thread for EA programs, different experiences in the world that have based their educational project on a model of landscape perception and interpretation, in which the United Kingdom and France (Benayas, 1992; Otero, 2000).

Meanwhile, the EE in Latin America conceives, in addition to its naturalistic character, its social transcendence, according to the characteristics of diversity, heterogeneity, inequality and poverty of each region (González, 2001; Macedo and Salgado, 2007). However, almost four decades from its implementation, the accumulation of experience in each Latin American State has contributed to different visions, methods and variants to strengthen the processes of EE, in which Mexico has shown reflected progress in the generation of policies and education strategies (Tréllez, 2006).

Thus, in the institutional plans of higher education in the country, the sustainability vision is currently contextualized based on the premise that none of the areas of knowledge is outside the socio-environmental scope; with this, the commitments of the decade of education for sustainable development 2005-2014 and the strategy of environmental education for sustainability in Mexico are fulfilled, based on their relevance in the development of future societies (Bravo, 2012).

It should be noted that as part of the EE in the country, the participation of the *Universidad Nacional Autónoma de México* (National Autonomous University of Mexico, UNAM; the *Universidad Autónoma de San Luis Potosí*, UASLP (Autonomous University of San Luis Potosi); *la Universidad de Guadalajara*, UdeG (University of Guadalajara) and the *Instituto Politécnico Nacional*, IPN (National Polytechnic

Institute) (Ávila, 1999) is acknowledged. Under this premise, in 2005 the *Universidad Autónoma de Nuevo León* (UANL) (Autonomous University of Nuevo Leon) (UANL) approved the *Unidad de Aprendizaje Ambiente y Sustentabilidad* (Environment and Sustainability Learning Unit), a fundamental mandatory subject of the *Área Curricular Formación Universitaria* (University Curricular Area), with the aim of promoting knowledge among its students of every school on the main environmental problems and their implications for human wellbeing under local, regional, national and global perspective (UANL, 2015). However, the effectiveness that this course has had on students regarding their attitudes and vision of nature has not been evaluated in a particular way. Cantú *et al.* (2010) and Cantú *et al.* (2013) consigned a deep ignorance about the Protected Natural Areas of the region.

Although the natural monument *Cerro de la Silla* (MNCS) is the most representative natural symbol of the state of *Nuevo León*, since 2014 its management is carried out by the personnel assigned to the *Cumbres de Monterrey* National Park. Only from 2008 to 2013 the MNCS had a Director, two assistants, office, vehicle, equipment and budget to perform the conservation tasks foreseen in its Management Program published that same year (Conanp, 2014); therefore, it is urgent to assign the resources to carry out an adequate management according to the environmental threats that affect it, such as environmental pollution; the invasion of its limits by urbanization; the poaching; the looting of edible, medicinal and ornamental plant species; the extraction of soil, firewood and wood; agricultural, livestock and fishing activities; the introduction of exotic species; forest fires, and the negative impact that visitors cause.

Based on the conservation problem faced by peri-urban landscapes subjected to pressures caused by population growth (Antrop and Van Eetrvelde, 2000), and the ecological relevance of the MNCS as one of the main sources of environmental services (Cantú *et al.,* 2010), the central interest for this work consisted in knowing the differences in the appreciation of the protected area among students of different professional careers and their relationship with environmental education.

Study area

The MNCS is part of a mountain range that extends southeast from the metropolitan area of *Monterrey* along 42 km in an altitudinal range of 500 to 1 782 m. Together with the *Sierra Cerro de la Silla* state protected area, it constitutes a continuous corridor of natural vegetation that amounts to 16 639 ha (Cantú *et al*., 2010); both areas represent an important source of environmental services that supply water to the Metropolitan *Area of Monterrey* (AMM), mainly (DOF, 2014) (Figure 1).

Figure 1. Panoramic view of *Cerro de la Silla* Natural Monument in *Monterrey* city, Mexico.

Also, in its conservation category, the MNCS is the most extensive natural monument (6 039 ha) in the country (Conanp, 2015); the proximity to the MMA allows contemplating the landscape to more than 4 million of its inhabitants (Inegi, 2010), which has led to real estate pressures on these lands (Cantú *et al*., 2010). In compliance with the objectives of its declaration in 1991, it has a sub-area for public

use (436.32 ha) for recreational purposes (DOF, 2014); however, the recreational value for users is limited, due to the precariousness in the capacity to manage their facilities (Cantú *et al.,* 2010).

Location

The MNCS is located within the municipalities of *Monterrey, Guadalupe* and *Juárez, Nuevo León* State between 100°16'25 "and 100°13'25" W and 25°39'50" and 25°37'40" N; physiographically, it is found mostly within the province of the *Sierra Madre Oriental*, subprovince of the *Gran Sierra Plegada* (Great Folded Sierra). The hydrogeological situation of the area is distinguished by the groundwater recharge zone, represented by the front of *Cerro de La Silla* and the groundwater discharge area located in the valley of the *La Silla* and *Santa Catarina* rivers (Chapa *et al*., 2010).

The climatic gradient is semi-dry in the city of *Monterrey*, sub-humid in *Allende*, south of the *Sierra de la Silla* mountain range and in the upper part, semi-sub-humid. The climate is of type BS_1 (h') hw (e) w" with summer rainfall and winter precipitation between 5 and 10 % total annual, is extreme, heatwave canicular, with an annual average temperature of 22.1 °C and rainfall of 620.7 mm. Soils are of the Eutric regosol type associated with Luvic phaeozem and Lithosol in the area of the gullies (INECC, 2007).

The types of vegetation present in the MNCS are divided into submontane scrub and subhumid oak forest (*Quercus* spp.). With regard to species cataloged under legal protection by the Official Mexican Standard NOM-059-SEMARNAT-2001, *Brahea berlandieri* Bartl. is registered. (Chinese palm) and *Agave bracteosa* S. Watson ex Engelm. (*amole dulce*) (Alanís *et al*., 2010). Likewise, 183 species of terrestrial vertebrates have been consigned, of which 80 correspond to birds, 56 to mammals, 37 to reptiles and 8 to amphibians; of this total, 19 are considered in the referred norm (González *et al*., 2010).

Process

Statistical information was obtained on the population of upper level students of *Nuevo León* corresponding to the 2013-2014 school year, whose enrollment registered a total of 157 242 students (SEPNL, 2015) belonging to both educational sectors, public (62.76 %) and private (37.24 %) enrolled in the 474 existing professional careers, classified into eight areas of knowledge: a) Education, b) Arts and Humanities, c) Social Sciences Administration and Law, d) Natural, Exact and Computing Sciences, and e) Engineering, Manufacturing and Construction, f) Agronomy and Veterinary, g) Services and h) Health.

From each of the areas of knowledge, the professional career with the highest enrollment of students from each educational sector was selected (Table 1).

Table 1. Number of surveyed students by professional career and educational sector by areas of knowledge (ANUIES, 2016).

Area of knowledge	Education sector	Institution	Professional career	Number of students	Number of surveys
Social sciences, Administration and Law	Public	UANL	Lawyer	6 634	25
	Private	UMM	Psicologist	1 586	25
Health	Public	UANL	Midwife, surgeon Medic	6 518	25
	Private	UDEM	Midwife, surgeon Medic	1 209	25
Engineering, Manufacturing and Construction	Public	UANL	Architect	3402	25
	Private	ITESM	Industrial and Systems Engineer	1 041	24
Natural, Exact and Computing Sciences	Public	UANL	Systems Administrator Engineer	2 786	25
	Private	UERRE	Information Technology Engineer	216	21
Arts and Humanities	Public	UANL	Language Science Engineer	1 135	25
	Private	UMM	Graphic designer	985	25
Services	Public	UANL	Exercise Scientific	1 043	25
	Private	CEU	Physical culture and sports manager	149	24
Education	Public	UANL	Educator	974	25
	Private	EELA	Preschool educator	316	25
Agronomy and Veterinary	Public	UANL	Veterinarian	729	21
	Private	CEU	Veterinarian	374	21
Total				29 207	386
Total (public sector)				23 221	196
Total (private sector)				5 876	190

UANL = *Universidad Autónoma de Nuevo León*; UMM = *Universidad Metropolitana de Monterrey*; ITESM = *Instituto Tecnológico y de Estudios Superiores de Monterrey*; UDEM = *Universidad de Monterrey*; UERRE = *Universidad Regiomontana*; CEU = *Centro de Estudios Universitarios de Monterrey*; EELA = *Escuela de Educadoras Laura Arce*.

Surveys

According to the contingent valuation method (Azqueta, 1994), a questionnaire was applied that included the following questions: 1) On an ascending scale from zero to 100, what rating do you give to the beauty of the landscape of the MNCS?; and 2) In your educational formation, did you get knowledge about the environmental problems of the MNCS?

Sampling

A non-probabilistic sampling was carried out, with a maximum quota of 25 students per selected career, under the criterion of preference for those who have completed a learning unit related to environmental aspects whose curricula were in the face-to-face mode; the data collection lasted five months (October 2014 to February 2015).

Statistical analysis

The statistical package IBM SPSS Statistic® 22 version (SPSS, 2013) was used to process information. Kolmogorov-Smirnov normality tests and the Levene test were performed to verify equality of variances. In compliance with the assumptions and based on the sample size for each analysis, bivariate parametric of Student´s t tests and one-way ANOVA were applied; when the data did not show normal distribution and had less than 40 elements in the sample, the nonparametric Mann Whitney test was used (Díaz, 2007).

The total population of surveyed students was 386 individuals aged 17 to 35 years, with an average of 21.25 years and the standard deviation of 2.5 years; the sex ratio is 52 % male and 48 % female. Table 1 shows the distribution of the surveyed population.

Romañá (1994) considers that environmental education is equivalent to education for environmental competence and includes cognitive, affective, axiological and aesthetic aspects. For Benovsky (2015), a landscape is appreciated for its aesthetic characteristics of unity, simplicity and harmony; whose assessment can be of two types: simple and informed; the first is an appreciation based on shapes and colors, less intellective and more visceral, while the informed valuation of the landscape contains a greater number of objective elements.

In this regard, Cantú *et al.* (2013) indicate that the level of school education is correlated with the perception of the landscape of the MNCS, that is, individuals with higher academic degrees granted greater beauty value to the landscape of the monument.

Appreciation of the MNCS landscape according to the areas of knowledge

There were no significant differences in the assessment of the landscape of the MNCS by the total number of students from the different areas of knowledge; however, the grades awarded by the students of Social Sciences, Administration and Law were higher (M = 86.57, SE = 1.67) than those from Agronomy and Veterinary (M = 74.85, SE = 3.34) (Figure 2).

Áreas del conocimiento = Areas of knowledge; C. Soc., *Administración y Derecho* = Social sciences, Administration and Law; *Artes y Humanidades* = Arts and Humanities; *Servicios* = Services; *Ing. en manufactura* = Manufacturing engineering; *C. Nat., Exactas y Computación* = Natural, Exact and Computing Sciences; *Educación* = Education; *Salud* = Health; *Agronomía y Veterinaria* = Agronomy and Veterinary; *Valoración de la belleza del paisaje del MNCS* = Appreciation of the MNCS landscape.

Figure 2. Appreciation of the MNCS landscape by undergraduate students belonging to different areas of knowledge.

Unparalleled for the comparison of values, contributions from various researchers were sought in an attempt to explain the investigation.

Alea and Bolet (2006) highlight the correspondence of the Social Sciences in the study of the origin (causes) of the environmental crisis as part of the society-nature conflict, in which the landscapes are the testimony of the environmental damages caused by human behavior ; they found deficiencies in knowledge of environmental education among students of Sociocultural Sciences in Cuba, because they had difficulties to perceive the quality of rural and forested landscapes, which might come from their condition of city residents.

Fernández *et al.* (2005) also refer, a low environmental knowledge in Mexican students. Particularly in the MMA, Cantú *et al.* (2013), likewise, established that such knowledge is lost as the population is more urban than rural.

On the other hand, higher results were expected from the Agronomy and Veterinary Area, from the close link of the students with natural landscapes due to the focus of the professional career and their direct experiences in the wilderness, according to Almeida-Gomes *et al.* (2014).

Assessment of the landscape of the MNCS by the educational sectors

The qualification granted to the beauty of the MNCS landscape by private school students was higher ($M = 83.17$, $SE = 1.28$) than that of public sector students, finding significant differences ($M = 77.2$, $SE = 1.46$, $t(359) = 3.00$, $p < 0.05$). It should be noted that unlike the UANL, in the private schools selected, subjects related to the compulsory environment were not taught.

In Latin American countries, mainly Mexico, Venezuela and Argentina, the highest concentration of students in the public sector prevails, since the private sector only has a presence in urban areas and serves students belonging to high socioeconomic levels and parents with a higher educational level (Pereyra, 2008; Murillo and Martínez, 2017); these two factors for Yilmaz and Hans (2004) influence positive attitudes towards the environment, however Uyeki and Holland (2000) acknowledge the opposite.

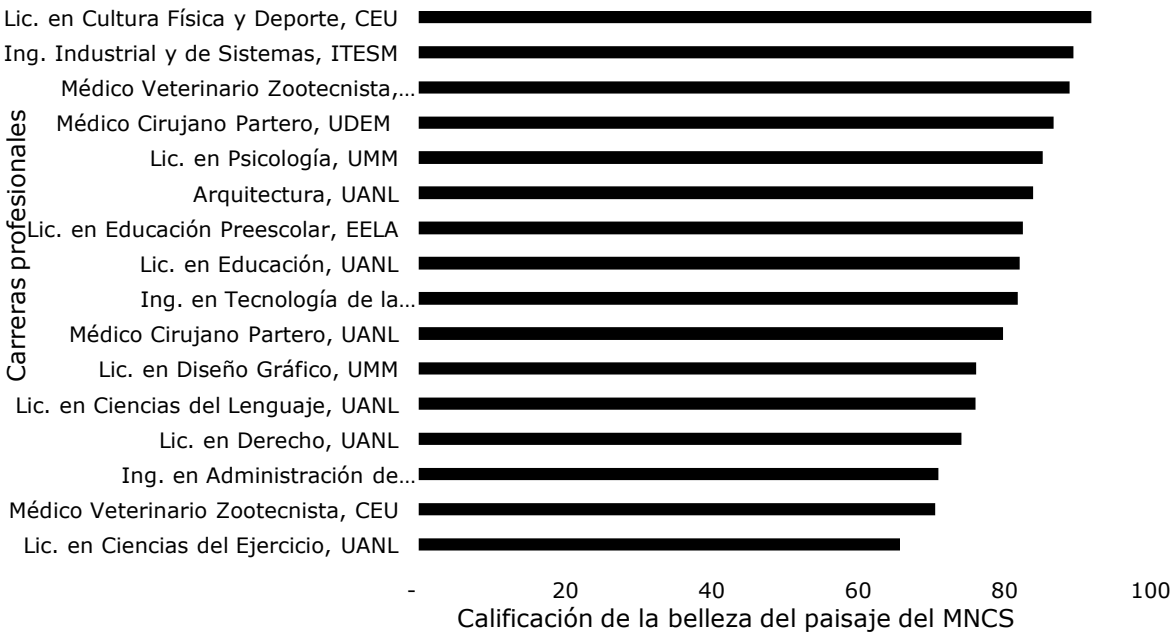
In Mexico, enrollment in private schools has increased by more than 30 % since the 1990s (Gil, 2005; Silas, 2005).

According to González *et al.* (2003), González and Arias (2009) and González *et al.* (2015), the precariousness of public sector universities challenged by society, the State and the global market, are not in a position to face the challenge of sustainability in its structure, operation and substantive functions; however, they gather a public whose discourse influences both the formation of opinion and decision-making, which blurs the frontier that separates civil society from the State or the private sphere (Miñana *et al.,* 2012).

However, Miñana (2002) indicates that in Colombia both educational sectors are not configured to make feasible cross-cutting projects such as environmental education, similar to what was found in the present research.

Appreciation of the MNCS landscape faced by professional careers

The professional career of students in both educational sectors influences the aesthetic assessment of the landscape of the MNCS, according to the results of the ANOVA $t(361) = 4.11$, $p < 0.05$). High marks given by students of Bachelor of Physical Culture and Sport, CEU ($M = 91.82$, $SE = 2.97$), Industrial and Systems Engineer, ITESM ($M = 89.35$, $SE = 1.67$) and Veterinary Zootechnician, UANL ($M = 88.89$, $SE = 1.52$); in contrast, the following careers awarded the lowest values: Bachelor of Science in Exercise, UANL ($M = 65.52$, $SE = 4.8$), and Systems Administration Engineer, UANL ($M = 70.46$, $SE = 4.86$), and Veterinarian Zootechnician, CEU ($M = 70.48$, $SE = 5.10$) (Figure 3).



Carreras profesionales =Professional careers; *Licenciatura en Cultura Física y Deporte, CEU* = Physical Culture and Sport, CEU; *Ing. Industrial y de Sistemas*, ITESM = Industrial and Systems Engineer, ITESM; *Médico Veterinario Zootecnista, UANL* = Veterinary Zootechnician, UANL; *Médico Cirujano Partero, UDEM* = Midwife, surgeon Medic, UDEM; *Licenciado en Psicología, UMM* = Psychologist, UMM; *Arquitectura, UANL* = Architecture, UANL; *Licenciado en educación preescolar, EELA* = Preschool educator, EELA; *Licenciado en Educación, UANL* = Educator, UANL; *Ing. en Tecnología de la Información* = Information Technology Engineer; *Médico Cirujano Partero,UANL* = Midwife, surgeon Medic, UANL*; Licenciado en Diseño Gráfico, UMM* = Graphic designer, UMM; *Licenciado en Ciencias del Lenguaje, UANL* = Language Science, UANL; *Licenciado en derecho, UANL* = Lawyer, UANL; *Ing. en Administración de Sistemas, UANL* = Systems Administrator Engineer, UANL; *Médico Veterinario Zootecnista, CEU*= Veterinary Zootechnician, CEU; *Lic. en Ciencias del Ejercicio*, UANL = Bachelor's Degree in Exercise Science; *Calificación de la belleza del paisaje del MNCS* = Rating of the aesthetic appreciation of the MNCS landscape.

Figure 3. Aesthetic appreciation of the MNCS landscape by bachelor students of the different professional careers.

In the evaluation of the landscape as an environmental management tool, the importance of the variability of the perception of the landscape of the evaluator is recognized, since the cultural and idiosyncratic aspects determine the appreciation of the landscape, which refutes the idea of universality of aesthetic preferences, and it is related to formal education and professional activities (González and Gallardo*,* 1989; Muñoz-Pedreros, *et al.,* 1993; Muñoz-Pedreros *et al.*, 2000; Matthews, 2002; Muñoz-Pedreros, 2004; Tveit, 2009).

It is interesting to note that both careers in the Services area (Bachelor's Degree in Physical Culture and Sport versus Bachelor's Degree in Exercise Science), as well as Agronomy and Veterinary Medicine (Veterinary Zootechnician) show totally polarized results; therefore, in this case, there is a variant regarding the relationship between professional activity and environmental perception.

MNCS landscape appreciation according to the professional careers of the public sector

Statistical differences were registered in the qualification granted to the landscape by the students of the different public sector careers $t(187) = 3.39$, ($p < 0.05$). They stand out for the high assigned values, those of Zoo-technician Veterinary Doctor ($M = 88.89$, $SE = 1.52$) and Architecture ($M = 83.92$, $SE = 2.78$), while the students of Bachelor of Science in Exercise ($M = 65.52$, $SE = 4.81$) and Systems Management Engineering ($M = 70.96$, $SE = 4.86$), gave it the lowest scores.

The high appreciation of the beauty of the landscape of the MNCS by students of Veterinary Medicine and Zootechnics of the UANL, coincides with Sosa *et al.* (2008), Almeida-Gomes (2014) and Muñoz-Pedreros *et al.* (2000) who recognized greater ecological sensitivity towards the environment by students of the agricultural area.

In contrast, the same career in the private sector revealed the lowest valuation; it is assumed that it derives from the professional approach, since it is more oriented to the care of domestic fauna. Even the facilities of this school are located within the city, unlike the Faculty of the UANL that are in an open field.

MNCS landscape appreciation in regard to professional careers of the private sector

Among the qualifications awarded to the landscape by the students of private sector careers, significant differences were identified $t(172) = 4.21$, ($p < 0.05$). The most outstanding are the Bachelor's Degree in Physical Culture and Sports, CEU ($M = 91.82$, $SE = 2.97$) and the Industrial and Systems Engineering, ITESM ($M = 89.35$, $SE = 1.67$); on the other hand, that of Zootechnician Veterinarian, CEU ($M = 70.48$, $SE = 5.10$) and the Graphic Design Degree, UMM ($M = 76.14$, $SE = 4.55$), assigned the lowest scores.

Although the students of the two private schools that contributed the most to the landscape did not study subjects related to the environment, both share greater contact with the Monument, that is to say they have in common what Azqueta (1994) calls the use value of the environmental good, since the Bachelor students in Physical Culture and Sports make constant visits to the Hill for fitness purposes as part of their practices, and students of Industrial Engineering and Systems have the advantage of contemplating the Hill daily because the school (Technological Institute of Superior Studies of *Monterrey*) is located in the skirts of the Monument.

MNCS landscape appreciation by students with knowledge about its environmental problem

MNCS landscape appreciation by students with knowledge about its environmental problem of the students with knowledge about the environmental crisis of the MNCS, the Mann-Whitney test indicates that there are no significant differences between the grade given by students who did not know about this issue, both in the public ($z = 1.94$, $p < 0.05$) and in the private sector ($z = 1.94$, $p < 0.05$).

In this regard, it is worth mentioning that deficiencies were identified in the pedagogical instrument of the learning unit related to the environment. Since its first edition, Alfaro's book (2009), used at the UANL Bachelor's level, as well as at the Laura Arce School of Educators, briefly mentions the beauty of the landscape as one of the main environmental services; however, attention is not focused on the landscape as a particular topic and excludes information regarding protected natural areas.

Although this kind of problems are multidisciplinary (Mercado, 2005), the deficiencies in knowledge as well. It would be worthwhile to redouble efforts since according to Sánchez *et al.* (2014), studies in Latin America highlight that the level of knowledge about the environmental aspects and the information that people possess, determine the actions in favor of the environment.

Landscape is a powerful resource for education about nature, since it is an open book in which it is possible to read and interpret the relationships that a community establishes with it (Martínez, 2004). In Spain, Otero (2000) stated interest in it as an educational tool. Gómez (1993), in his reflections on the landscape in compulsory education curricula, points out that the tendency towards a multidisciplinary nature of the subject (Nature Sciences and Social Sciences), given the complexity of the contents that define it, poses difficulties when it is approached. To this should be added the importance of the pedagogical preparation of the teacher, an aspect also observed by Delgado (2015). In this context, Arenaza

(1997) made a teaching proposal on the concept and method of landscape applied to territorial management, which is referred to as support material.

Undoubtedly, curricular environmental education currently represents efforts aimed at developing the analytical capacity of students in the face of problems of this nature.

A population with environmental knowledge and identified with its environment is visualized, that is, individuals responsible for the natural heritage of Mexico. In reference to the MNCS, it seeks to abate serious threats by human activities, mainly by the change of land use for urban purposes.

The results obtained in the surveys carried out indicate the need to adapt the contents of the subjects related to environmental aspects in the higher education programs, and incorporate information on the natural assets of the region and the services they provide. In addition, the interest to maintain its conservation through transversal knowledge in both educational sectors, is relevant to preserve this identity monument in the *Monterrey* population.

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Conflict of interest

The authors declare no conflict of interest.

Contribution by author

Cynthia Geraldinne Salazar de la Cerda: field work, writing of the manuscript; César Martín Cantú Ayala: writing, general review and correction of the manuscript; Andrés Eduardo Estrada Castillón: support in results and review of the manuscript.

References

Aguilar B., A. 2006. Algunas consideraciones teóricas en torno al paisaje cómo ámbito de intervención institucional. Gaceta Ecológica 79: 5-20.

Alanís, G., C. Velazco, J. Marmolejo, J. Uvalle, C. Cantú A., F. González y S. Morales. 2010. Flora y tipos de vegetación. *In*: Cantú A., C., F. González, J. Uvalle y J. Marmolejo (eds.). Biodiversidad y Conservación del Monumento Natural Cerro de la Silla, México. Universidad Autónoma de Nuevo León. Monterrey, N.L., México. pp. 106-133.

Alea G., A. y J. A. Bolet. 2006. La percepción ambiental en estudiantes de la Universidad de Pinar del Río Innovación Educativa 6 (34):39-45.

Alfaro B., J. 2009. Ambiente y sustentabilidad: por una educación ambiental. Universidad Autónoma de Nuevo León. Monterrey, N.L., México. 237 p.

Almeida-Gomes, M., J. A. Prevedello, D. Lopes S. and J. P. Metzger. 2014. Teaching landscape ecology: the importance of field oriented, inquiry-based approaches. Landscape Ecology 31(5):929–937.

Antrop, M. and V. Van Eetrvelde. 2000. Holistic aspects of suburban landscapes: visual image interpretation and landscape metrics. Landscape and Urban Planning 50(1-3):43-58.

Arenaza, O. 1997. Concepto y método en paisaje. Una propuesta docente. Lurralde (20):333-344.

Arteaga R., R. 2014. Valoración del paisaje cultural de la bahía de Cartagena de Indias: una mirada desde los niños y niñas. Itinerario Educativo 28 (63):119-137.

Asociación Nacional de Universidades e Instituciones de Educación Superior (ANIUES). 2016. Anuario Estadístico de Nivel Superior 2013-2014 http://www.anuies.mx/informacion-y-servicios/informacion-estadistica-de-educacion-superior/anuario-estadistico-de-educacion-superior (2 de marzo de 2016).

Ávila, A. 1999. La Enseñanza de la Educación Ambiental. El caso de la Ingeniería Ambiental en la Facultad de Ingeniería de la UASLP. *In:* Memorias del XXIII Congreso Nacional de la Academia Nacional de Ingeniería. La Educación en Ingeniería. Perspectivas al Inicio del Tercer Milenio. Universidad Autónoma de San Luis Potosí. Mayo. San Luis Potosí, S.L.P., México. pp. 157-165.

Azqueta, O. 1994. Valoración económica de la calidad ambiental. McGraw-Hill. Madrid, España. 306 p.

Barrasa, S. 2013. Valoración de la calidad estética de los paisajes de La Habana (Cuba) con métodos de participación social. Estudios Geográficos 74 (274):45-66.

Benayas, J. 1992. Paisaje y educación ambiental: evaluación de cambios de actitudes hacia el entorno. Monografías de la Secretaría de Estado para las Políticas del Agua y el Medio Ambiente. MOPT. Madrid, España. 243 p.

Benovsky, J. 2015. Aesthetic appreciation of Landscapes. The Journal of Value Inquiry. 2(50):325-340.

Barrett, T. L. and G. W. Barrett. 2008. Aesthetic landscapes of the Golden Mouse. *In:* Barrett, G. W. and G. A. Feldhamer (eds.). The Golden Mouse: Ecology and Conservation. Springer. New York, NY, USA: pp. 193-222.

Bravo, T. 2012. Los planes ambientales institucionales en la educación superior de México: Construyendo sentidos de la sustentabilidad (2002 – 2007). Secretaría de Medio Ambiente y Recursos Naturales e Instituto Nacional de Ecología. Asociación Nacional de Universidades e Instituciones de Educación Superior. México, D. F., México. 588 p.

Cairns, J. Jr. 1997. Global coevolution of natural systems and human societies. Revista de la Sociedad Mexicana de Historia Natural 47:217–228.

Cantú A., C., F. González, J. Uvalle y J. Marmolejo. 2010. Paisaje y aspectos turísticos. *In:* Cantú A., C., F. González, J. Uvalle y J. Marmolejo (eds.). Biodiversidad y conservación del Monumento Natural Cerro de la Silla, México. Universidad Autónoma de Nuevo León, Conabio, Conanp. Monterrey, N.L., México. pp. 106-134.

Cantú A., C., J. García, M. Murguía, L. Leal, L. Chapa, D. González, M. Aragón, R. Nájera, F. González, J. Uvalle y P. Hinojosa. 2013. Percepción Social sobre los Servicios Ambientales. *In:* Cantú A., C., M. Rovalo, J. Marmolejo, S. Ortiz y F. Seriñá (eds.). Historia natural del Parque Nacional Cumbres de Monterrey. Universidad Autónoma de Nuevo León, Conanp, Pronatura. Monterrey, N.L., México. pp. 260-272.

Cassatella, C. and A. Peano. 2011. Landscape indicators: Assessing and monitoring landscape quality. Springer. The Netherlands, Holand. 222 p.

Comisión Nacional de Áreas Naturales Protegidas (Conanp.) 2014. Programa de Manejo el Monumento Natural Cerro de La Silla. Semarnat, Conanp. México, D. F., México. 129 p.

Comisión Nacional de Áreas Naturales Protegidas (Conanp.) 2015. Monumentos Naturales http://www.conanp.gob.mx/que_hacemos/monumentos_naturales.php (4 de febrero de 2016).

Chapa, R., H. de León, E. Alba y S. Ibarra. 2010. Geología e hidrología. *In:* Cantú A., C., F. N. González, J. I. Uvalle y J. G. Marmolejo (eds.). Biodiversidad y Conservación del Monumento Natural Cerro de la Silla, México. Universidad Autónoma de Nuevo León, Conabio, Conanp. Monterrey, N.L., México. pp. 19-42.

Checa-Artasu, M. M. 2013. La cultura del paisaje en México: algunas reflexiones. Revista Bitácora Arquitectura 26:8-16.

Checa-Artasu, M. M. 2014. Oportunidades y carencias para la cultura el paisaje en México, algunas notas. *In:* Checa-Artasu, M. M., A. García C., P. Soto V. y P. Sunyer M. (coords.). Paisaje y territorio, articulaciones teóricas y empíricas. Tirant Humanidades. México D. F., México. pp. 388-423.

Daily, G. C., S. Alexander, P. R. Ehrlich, L. Goulder, J. Lubchenco, P. A. Matson, H. A. Mooney, S. Postel, S. H. Schneider, D. Tilman and G. W. Woodwell. 1997. Ecosystem services: benefits supplied to human societies by natural Issues in Ecology 2:1-16.

Daniel, T. 2001. Whither scenic beauty? Visual landscape quality assessment in the 21st Century. Landscape and Urban Planning 54:267-271.

Delgado H., E. 2015. El paisaje en la formación de maestros, un recurso educativo de alto interés para la educación primaria. Tabanque Revista Pedagógica 28:117-138.

Díaz, F. 2007. Bioestatística. Cengage, São Paulo, Brazil. 304 p.

Fernández C., A., J. Benayas and C. Barroso. 2005. Social representation of the way to interact with environment of the elementary school teachers of the Puebla's municipality (Mexico). International Journal of Environment and Sustainable Development 4(2):140-156.

Diario Oficial de la Federación (DOF). 2014. Acuerdo por el que se da a conocer el resumen del Programa de Manejo del Área Natural Protegida con la categoría de Monumento Natural El Cerro de la Silla. Semarnat. DOF. 6 de enero de 2014. México, D.F., México. http://www.dof.gob.mx/nota_detalle.php?codigo=5328874&fecha=06/01/2014 (13 de febrero de 2018).

Gil A., M. 2005. El crecimiento de la educación superior privada en México: de lo pretendido a lo paradójico... ¿o inesperado? Revista de la Educación Superior 34(133):9-20.

Gómez O., A. 1993. Reflexiones acerca del contenido "paisaje" en los "currícula" de la enseñanza obligatoria. Revista Interuniversitaria de Formación del Profesorado. (16):231-240.

González B., F. y D. Gallardo. 1989. Determinación de los factores que intervienen en las preferencias paisajísticas. Arbor 132 (518-519):15-44.

González G., E. 2001. Otra lectura a la historia de la Educación Ambiental en América Latina y el Caribe. Desenvolvimento e Meio Ambiente 3:141-158.

González G., E. 2003. Atisbando la construcción conceptual de la educación ambiental en México. *In:* Bertely B., María (ed.) Educación, Derechos Sociales y Equidad. La investigación educativa en México1992. Tomo 1: Educación y diversidad cultural y Educación y medio ambiente. Consejo Mexicano de Educación Investigativa. México, D.F., México. pp. 243-275.

González G., E. y M. Arias O. 2009. La educación ambiental institucionalizada: actos fallidos y horizontes de posibilidad. Perfiles Educativos 31 (124):58-68.

González G., E., P. Meira y C. Martínez. 2015. Sustentabilidad y Universidad: retos, ritos y posibles rutas. Revista de la Educación Superior 44 (175):69-93.

González S., F., C., Cantú A., J. Uvalle y D. Lazcano. 2010. Mamíferos. *In:* Cantú A., C., M. Rovalo, J. Marmolejo, S. Ortiz y F. Seriñá (eds.). Historia natural del Parque Nacional Cumbres de Monterrey. Universidad Autónoma de Nuevo León. Conanp, Pronatura. Monterrey, N.L., México. pp. 237-252.

Heyne, P. 2005. Environmental education: a component of sustainable development. *In:* German MAB National Committee (eds). Full of life: UNESCO biosphere reserves-model regions for sustainable development. Springer Science & Business Media. Berlin, Germany. pp. 98-99.

Instituto Nacional de Estadística, Geografía e Informática (INEGI). 2010. Resultados

Preliminares del Censo Demográfico 2010. INEGI, Aguascalientes, México. http://www3.inegi.org.mx/sistemas/scitel/consultas/index (14 de febrero de 2018).

Instituto Nacional de Ecología y Cambio Climático (INECC). 2007. Monumento Natural Cerro de la Silla http://www2.inecc.gob.mx/publicaciones/libros/2/csilla.html (2 de febrero de 2016).

Macedo, B. y C. Salgado. 2007. Educación ambiental y educación para el desarrollo sostenible en América Latina. Fórum de sostenibilidad. Cátedra UNESCO http://www.ficad.org/lecturas/lectura_tres_unidad_cuatro_eca.pdf (1 de julio de 2016).

Martínez H., J. 2004. Educación ambiental y conservación de paisajes frágiles. Reflexiones sobre Educación Ambiental II. Centro Nacional de Educación Ambiental. Valsain, Segovia, España. pp. 203-212.

Matthews, P. 2002. Scientific knowledge and the aesthetic appreciation of nature. The Journal of Aesthetics and Art Criticism 60 (1):37–48.

Mercado, A. 2005. El papel de la universidad en la conformación de un modelo productivo sustentable en Venezuela. Cuadernos del CENDES 22(58):23-45.

Miñana B., C. (ed.). 2002. Interdisciplinariedad y currículo: construcción de proyectos escuela-universidad. Universidad Nacional de Colombia- Programa RED. Bogotá, Colombia. 288 p.

Miñana B., C., C. Toro P. y A. Mahecha G. 2012. Construcción de lo público en la escuela: Una mirada desde dos experiencias de educación ambiental en Colombia. Revista Mexicana de Investigación Educativa 17 (55):1147-1171.

Mitchell, N., M. Rössler and T. Pierre. 2009. World Heritage Cultural Landscapes A Handbook for Conservation and Management. World Heritage Centre UNESCO. Paris, France. 137 p.

Muñoz-Pedreros, A., A. Badilla y H. Rivas. 1993. Evaluación del paisaje en un humedal del sur de Chile: el caso del río Valdivia (X Región). Revista Chilena de Historia Natural 66 (4):403-417.

Muñoz-Pedreros, A., J. Moncada-Herrera y A. Larrain. 2000. Variación de la percepción del recurso paisaje en el sur de Chile. Revista Chilena de Historia Natural 73(4):729-738.

Muñoz-Pedreros, A. 2004. La evaluación del paisaje: una herramienta de gestión ambiental. Revista Chilena de Historia Natural 77(1):139-156.

Murillo, J., E. y C. Martínez. 2017. Segregación social en escuelas públicas y privadas de América Latina. Campinas 38 (140):727-750.

Novo, M. 2009. La educación ambiental, una genuina educación para el desarrollo sostenible. Revista de Educación número extraordinario: 195-217.

Otero, I. 2000. Paisaje y educación ambiental. Observatorio Medioambiental 3:35-50.

Pereyra, A. 2008. La fragmentación de la oferta educativa en América Latina: la educación pública vs. educación privada. Perfiles Educativos 30 (120):132-146.

Romañá, T. 1994. Entorno físico y educación. Reflexiones pedagógicas. Promociones y Publicaciones Universitarias, S.A. Barcelona, España. 28 p.

Rubio M., P. y J. Muñoz N. 2008. Gestión del paisaje en áreas de interés natural. Cuadernos Geográficos 43(2):271-288.

Sánchez, M. P., A. de la Garza G. y M. C. Rodríguez. 2014. Análisis de la percepción y conducta ambiental mediante una red bayesiana. Revista de Psicología 23 (2):56-70.

Secretaría de Educación Pública Nuevo León (SEPNL). 2015. Carreras Técnico Superior y Superior de Nuevo León. Departamento de estadística, Dirección de Educación Superior, Secretaría de Educación Nuevo León, Monterrey, Nuevo León. Base de datos. s/p.

Silas C., J. 2005. Realidades y tendencias en la educación superior privada mexicana. Perfiles educativos 27:109-110.

Sosa, M., J. Alcalá, R. Soto, T. Lebgue y C. Quintana. 2008. Percepción ambiental de estudiantes universitarios a través de variables medioambientales Revista Latinoamericana de Recursos Naturales 4 (2):178 -184.

Statistical Package for Social Sciences (SPSS). 2013. Ibm. SPSS Statistics Ver. 22 for Windows. SPSS Inc. Chicago, IL USA. n/p.

Tréllez S., E. 2006. Algunos elementos del proceso de construcción de la educación ambiental en América Latina. Revista Iberoamericana de Educación 41:69-81.

Tveit, S. M. 2009. Indicators of visual scale as predictors of landscape preference; a comparison between groups. Journal of Environmental Management 90(9):2882-2888.

Universidad Autónoma de Nuevo León (UANL). 2015. Unidad de Aprendizaje Ambiente y Sustentabilidad. http://www.uanl.mx/sites/default/files2/del/unidades_aprendizaje_fundamentales/ambiente _sustentabilidad.pdf (4 de febrero de 2014).

Urquijo, P. y G. Bocco. 2011. Estudios de paisaje y su importancia en México, 1970-2010. Journal of Latin American Geography 10 (2):37-63.

Uyeki, E. and L. Holland. 2000. Diffusion of pro-environment attitudes? American Behavioral Scientist 43 (4):646-662.

Vázquez, C. y J. M. Martínez N. 2008. Del inventario patrimonial a la identificación de unidades de paisaje: estrategias en el marco de un desarrollo territorial sostenible. Scipta Nova: revista electrónica de geografía y ciencias sociales 12 (270):135. http://www.ub.edu/geocrit/sn/sn-270/sn-270-135.htm (3 de julio de 2016).

Yilmaz, O. and O. A. Hans. 2004 Views of elementary and middle school Turkish students toward environmental issues. International Journal of Science Education 26 (12):1527-1546.