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

https://doi.org/10.23913/ride.v10i19.524

Artículos Científicos

Transversalización curricular ambiental en educación superior mediante comités de diseño curricular

Environmental Curricular Mainstreaming Strategy in Higher Education Through Curricular Design Committees

Transversalização dos currículos ambientais no ensino superior por meio de comitês de design de currículo

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Resumen

La problemática ambiental es un desafío para las instituciones educativas que debe afrontarse desde todas sus funciones, y con especial énfasis desde la docencia y la investigación. Este trabajo expone la experiencia de la conformación de comités de diseño curricular como una estrategia para desarrollar la transversalización curricular del eje medio ambiente en los planes de estudio de educación superior en la Universidad Autónoma de Guerrero, México. A través del método de investigación-acción, se trabajó de manera colaborativa con comités de 15 programas educativos en dos ciclos (2012-2013 y 2016-2017). Como resultado, se presenta una estrategia dividida en cuatro etapas: *a)* conformación del comité; *b)* diagnóstico de la presencia del medio ambiente en el plan de estudios; *c)* transversalización curricular del eje medio ambiente, y *d)* definición del perfil de egreso y elaboración del programa de unidad de aprendizaje. La estrategia se acompaña

de dos instrumentos para su implementación. Se concluye en la necesidad de darle continuidad a la propuesta, fortalecerla y generalizarla en los demás programas educativos de educación superior de la universidad, así como iniciar un nuevo ciclo de investigación.

Palabras clave: diseño curricular, educación superior, investigación-acción, medio ambiente, transversalización curricular.

Abstract

The environmental problem represents a challenge for educational institutions, which must be addressed from all its functions, especially in teaching and research. In this work it is presented the experience of the conformation of curriculum design committees as a strategy to develop the curricular mainstreaming of the environment axis in higher education study plans at the Autonomous University of Guerrero, Mexico. Through the action research method, collaborative work was carried out with committees of 15 educational programs in two cycles (2012-2013 and 2016-2017). As a result, a strategy divided into four stages is proposed: a) conformation of the committee; b) diagnosis of the presence of the environment in the curriculum; c) curricular mainstreaming of the environment axis; and d) definition of the graduate profile and development of the learning unit program. Two instruments for its implementation accompany the strategy. It concludes in the need to give continuity to the proposal, strengthen it and generalize it in the other higher education educational programs of the university, as well as start a new research cycle.

Keywords: curricular design, higher education, research-action, environment, curricular mainstreaming.

Resumo

O problema ambiental é um desafio para as instituições de ensino, que deve ser abordado a partir de todas as suas funções, basicamente do ensino e da pesquisa. Neste trabalho a experiência na conformação dos comitês de design de currículo foi compartilhada, como uma estratégia para desenvolver a transversalização curricular do eixo ambiental em planos de estudos de ensino superior na Universidade Autônoma de Guerrero, México. Por meio do método de pesquisa-ação, foi realizado trabalho colaborativo com comitês de 15 programas educacionais em dois ciclos (2012-2013 e 2016-2017). Como resultado, é apresentada uma estratégia dividida em quatro etapas: a) conformação do comitê; b) diagnóstico da presença do ambiente no currículo; c) integração

curricular do eixo ambiental; e d) definição do perfil de saída e desenvolvimento do programa de unidade de aprendizagem. A estratégia é acompanhada de dois instrumentos para sua implementação. Conclui-se na necessidade de dar continuidade à proposta, fortalecê-la e generalizá-la nos demais programas de educação superior da universidade, além de iniciar um novo ciclo de pesquisa.

Palavras-chave: desenho curricular, ensino superior, pesquisa-ação, meio ambiente, integração curricular.

Fecha Recepción: Marzo 2019 **Fecha Aceptación:** Septiembre 2019

Introduction

In 2007, the Autonomous University of Guerrero (UAGro) initiated a process of updating its degree study plans: it went from a "traditional" system to one by competencies. The first educational programs to participate were Geography and Geology; It is worth clarifying that for these first experiences there was no area with advisory functions and institutional support for those responsible. Work continued in 2009: the Law, Psychology, Sociology and Economics programs joined.

In 2011, the Teaching Department (now the General Directorate of Higher and Higher Secondary Education) officially established an interdisciplinary team, called the Institutional Commission for Educational Development, based on the evidence that its members, in addition to having the competences required for the tasks entrusted, they participated in the updating of the educational programs in their respective schools. In 2012, this commission considered it important to systematize academic work and involve teachers as the main actors in the educational process; Thus, it was decided to organize them through the figure of curricular design committees (CDC). A first task was the incorporation into the curriculum of the emerging social issues indicated in the Educational and Academic Model of the Autonomous University of Guerrero (UAGro, 2004), among which were: human rights, equity, multiculturalism and the environment; Although they were indicated, there was a lack of methodological guidelines for their implementation. One of the topics that by its nature generated the greatest interest was the environment and sustainable development. The process for the incorporation of these emerging social issues was possible from various academic events that strengthened teacher competencies, such as: First Diploma in Teaching Competences 2012: Education, Citizenship and Human Rights; First Week of Teacher

Update 2013; Second Stage of Teacher Update 2014; Summer 2015 Teacher Update, and Summer 2016 Teacher Update. Because of its importance and significance, the First Meeting of Curriculum Design Committees in the Implementation of Study Plans for Competencies, held in October 2014, where participants were able to exchange experiences and evaluate your performance (UAGro, 2017).

Background

Higher education institutions must experience profound changes in their administrative structures and in their teaching work to meet the challenges and demands of an increasingly demanding society. Within these professional training institutions, the university becomes more relevant, as it is a depository not only of higher expectations, but of political and social pressures to fulfill this function (Aparicio, 2014). Renewal processes are demanded to overcome the tradition of curricula focused on disciplines rather than values (González and Arias, 2015). The educational institutions, in addition to focusing on disciplinary issues, must address issues considered emerging social, such as environmental. We cannot continue with educational processes based on pedagogical models 50, 100 or 200 years ago (Clavijo, 2018).

In the literature reviewed experiences were found that can be classified into two aspects: those that incorporate the environment as an integrated whole, and those that address it from sustainability or sustainable development. In this work, sustainability and sustainable development were considered as they contemplate environmental, social and economic aspects (Lozano, 2008).

Mora (2012) conducted a study to diagnose teachers' conceptions about the incorporation of the environmental dimension in the curriculum of the Faculty of Environment, at the District University in Bogotá, Colombia. The result evidenced an incipient curricular environmentalization, product of a monodisciplinary formation; It was necessary to strengthen pedagogical-didactic aspects, as well as the constitution of a curriculum committee that will work on the environmental inclusion in the contents and the improvement of educational practices in the classroom.

Cárdenas (2013) He outlined a proposal to introduce the environmental dimension in Peruvian universities, with an emphasis on social responsibility. He referred to the need to integrate an agency that proposed and executed the actions that the university itself defined. This figure, called the Environmental Committee, was aimed at promoting, managing, coordinating and supervising the processes of environmental incorporation in substantive functions (teaching,

research, extension and management). In turn, Espejel, Castillo and Martínez (2011) proposed an environmental education model for the upper middle level of the Puebla-Tlaxcala region, Mexico; They also concluded on the importance of integrating an environmental committee, made up of teachers, managers, administrative and environmental institutions, with the objective of achieving the implementation of the programmed tasks.

Another experience was that of the Mexican Commission of Cooperation-Organization of the United Nations for Education, Science and Culture (Conalmex-Unesco), with pedagogical actions aimed at environmental incorporation in the curriculum in the state of Tabasco through a regional committee, whose focus was to take the teacher as the main actor, and provide it with materials, training and monitoring (Arias and Ramírez, 2006).

Stubbs and Cocklin (2008) pointed out that in the development of these processes of change it is important that students know the concepts of environment and sustainability, and integrate them into their professional life; likewise, that they be considered in the training, since the teacher appears as ultimately responsible for the eventual success of the curricular innovations, by bringing the didactic change to the classroom. The Hogeschool-Universiteit Brussel designed a manual and a method for the integration of sustainable development in its curricula; He focused on commercial engineering careers at the bachelor's and master's level; The purpose was to motivate teachers to integrate this topic into their courses and develop it with students (Ceulemans y De Prins, 2009).

The experiences discussed here give an account of the institutional efforts to achieve the incorporation of emerging issues in the curriculum (such as the environmental one); They also agree on the importance of having a group, commission or curriculum committee that, through the strategy of collaborative work of small groups, with the same information and objectives (Moreno, 2011), manages to involve the teacher as the main generator of information, since it is he and his students in the classroom who make up a true ecosystem where previously designed training proposals are applied and developed (Domínguez, Medina y Sánchez, 2011).

Theoretical foundation

Education is a means to mitigate global environmental problems. Therefore, it is necessary to conceptually define what the environment is. The terms environment and environment are redundant, but due to its repeated and constant use the term environment has been coined. Thus, the use of the environment, environment or environment refers to the environment in which human

beings develop (United Nations Environment Program [UNEP], 2006). The environment refers to the "nature transformed by human activity, (…) is not only what' surrounds 'but also a product of' that which is surrounded '" (Bocco and Urquijo, 2013, p. 84). It is a hybrid object that encompasses all relationships between nature and society, between nature and culture (Galochet, 2009). Being an inter and multidisciplinary concept, it has varied meanings: environmental preservation, environmental effects of climate change, or as one of the components of sustainable development: environmental, economic and social (González, 2000; Giannuzzo, 2010). Here the meaning of preservation is adopted, but not reduced to the ecological, but to a problem contained in the relationship of nature and society that must be approached from the educational field.

Being global and of devastating effects, the environmental problem must be studied in a transversal way in all subjects of all educational levels. With this provision, mainstreaming is presented as a relevant curricular strategy, based on establishing axes or themes considered priority for the integral training of students, in all programs, activities and curricula contemplated in the institutional project (Velásquez, 2009). It involves, among other processes, curriculum redesign, from the study of disciplines and their occupational fields, and the redefinition of "environmentalized" professional profiles, as well as curricula and learning units (Santamaría and Bravo, 2015) .

It is pertinent to make a distinction between themes and axes. The transversal themes are non-disciplinary educational contents, also known as social emergencies: health, consumption or environment; while the axes or transversal lines have the potential to structure those social emergencies that are "impregnated" in the curriculum (Yus, 1996). In this case, because they are curricular design, they were referred to as transversal axes.

The mainstreaming of the curricula can occur in two ways: horizontal, interwoven in different courses, and vertical, through a course of sustainable development within the curriculum (Ceulemans and De Prins, 2009). Lozano (2008) proposes four approaches: a) inclusion of the environmental theme and materials in a course or module, b) inclusion of a specific course, c) intertwining the concept of sustainable development in regular disciplinary courses and d) sustainable development as a specialty ; the author specifies that these approaches are used independently; other authors combine them. For Fernández (2003), transversality must establish bridges of union between academic knowledge (learning to learn) and vital or vulgar knowledge (learning to live); it implies the taking of curricular decisions, so it is necessary that it be done through the discussion and collegial reflection; The design committees are presented as the best

option, since they allow the development, change, improvement, adaptation, growth and participation of the teacher himself in a context of free participation.

The curriculum design is "a decision-making process for the preparation or adjustment of the curriculum" (Tovar and Sarmiento, 2011, p. 509); It responds not only to problems of an educational nature, but also to those of an economic, political and social nature. "It includes the same stages of planning (diagnosis, analysis of the nature of the problem, design and evaluation of the possibilities of action, and implementation and evaluation" (Díaz, Lule, Rojas and Saád 1990, p. 22).

In this context of curricular redesign, in 2011 the first CDC for the update of higher education curricula was constituted in the UAGro, complemented with a training process that allowed them to pass from a traditional model for objectives to one for competences (Aparicio, Torres, Sánchez and Gutiérrez, 2015).

This work aimed to share the experience on an educational strategy for environmental mainstreaming in higher education curricula in UAGro, Mexico, through the constitution of CDC.

Methodology

This research is qualitative, based on action research; It is empirical; retrieves the ideas and proposals, based on experience, of the participating teachers.

The work involved the collaboration of 15 CDC of the same number of educational programs; 14 reformed in 2011 and 1 created in 2016 (Information Sciences and Technologies). In accordance with the methodology of action research (Latorre, 2003), two cycles were developed, as shown in table 1.

Tabla 1. CDC participantes

Ciclo	Periodo	Programas Educativos
Primero	2012-2013	*1)* Biólogo, *2)* Ingeniería en Sistemas Ambientales, *3)* Ingeniería en Producción Sustentable, *4)* Ingeniería en Recursos Maderables y no Maderables, *5)* Ingeniero Topógrafo y Geomático, *6)* Licenciado en Enfermería (Taxco), *7)* Licenciado en Enfermería (Chilpancingo), *8)* Licenciado en Artes, *9)* Licenciado en Ciencias de la Educación, *10)* Licenciado en Ciencia Política y Administración Pública, *11)* Licenciado en Sociología de la Comunicación y Educación, *12)* Licenciado en Desarrollo Regional
Segundo	2016-2017	*1)* Ciencias y Tecnologías de la Información, *2)* Licenciado en Contaduría, *3)* Licenciado en Administración de Empresas

Fuente: Elaboración propia

At the beginning of the study, in 2012, the participating committees were already formed, each consisting of a minimum of five and a maximum of nine teachers, including a coordinator responsible for structuring and managing the agreed program of activities. The process for mainstreaming was built alternately to a process of curricular design and updating at UAGro, based on the methodology of the book Design, update and evaluation of curricula at the Bachelor level (UAGro, 2012). Elements of this institutional methodology were taken to achieve mainstreaming, such as: redefinition of the graduation profile, construction of skills and development of the learning unit program.

Based on the proposal of the cycle spiral made by Kemmis in 1989 (Latorre, 2003), for each of the two cycles four phases were contemplated: planning, action, observation and reflection. In the first one, we worked with 12 programs, while with the second, 3 more programs were added (table 1).

The process was designed with a “practical modality” to reflect, dialogue, transform ideas and broaden teachers' understanding of the curricular mainstreaming of the environmental axis (Colmenares y Piñero, 2008).

First cycle

- Planning. It consisted in the elaboration of the research project from 2012. Based on the competency-based education (EBC), the components of the environmental axis (knowledge, skills, attitudes and values) were defined and the instruments were designed; An external advisory committee was formed with experts on environmental and cross-cutting issues to validate its content.
    - Instrument 1. It was designed for the CDC coordinator or one of its members to diagnose the level of linkage of the components of the environmental axis with the discharge profile of their current curriculum. It shows four Likert-type response options: closely linked, partially linked, poorly linked and not linked.
    - Instrument 2. It was built so that the teachers who are members of the CDC analyze the components of the environmental axis and assess the possibility of incorporating some (s) in their learning units; shows an additional column to write, if applicable, a different proposal.
- Performance. To implement the plan, the 50 educational programs that formally operated in 2012 were invited, 12 agreed to participate (table 1). The advisability of implementing the mainstreaming strategy in their curricula was analyzed and discussed, and the procedure for correctly responding to instruments 1 and 2 was explained.
- Observation. The development of the participants was observed; The data obtained during the action phase, on the presence and levels of transversality presented by each educational program curriculum to prepare the diagnosis were analyzed and discussed with the committee of experts and coordinators of each program.
- Reflection. The results obtained in the performance and in the observation were analyzed; adjustments were made to give more clarity and consistency to the instruments and some adjustments were made to the content.

Second cycle

- Planning. In 2016, a second research cycle was planned and a training process was designed for the strengthening of teaching competencies, on the topics: Environmental education for sustainability, Transversality of the environmental axis and Development of teaching sequence.
- Performance. In 2017, the training process was developed separately; first to the CDC of the Science and Information Technology program; subsequently to those of Accounting and Business Administration; The topics were approached by the committee of experts in curricular design and transversality, with a duration of six hours each.
- Observation. The degree of progress in the domain of concepts related to curriculum design (graduation profile, competencies and learning unit program), environmental issues and the strategy of transversality was identified.
- Reflection. The results obtained in the first and second cycle are the basis for the presentation of the "Methodology for mainstreaming the environmental axis" in the following section.

Results

The findings are divided into three parts. First, the initial conditions of the investigation are presented; The changes shown by the CDC for the mainstreaming of the environmental axis continue; The third part derives from the reflection of the teachers and exposes the authors' strategy to start a new cycle.

How did the work with the CDC begin?

At the beginning of both cycles the teachers of the 15 CDC expressed ignorance or a false conceptualization of emerging social problems (within them the environment) and mainstreaming as a curricular strategy.

In addition, they evidenced ignorance of the curriculum and programs of each learning unit, due to a lack of application of the institutional regulations, since the allocation of the academic

load is carried out according to the labor category and not the disciplinary domain; The teacher's profile is not always respected.

What changes were generated for the mainstreaming of the environmental axis?

The training process in the subjects of curriculum design, environmental education and transversality in the second cycle allowed adjustments to be made to the structure of the instruments used, as well as the adaptation and clarification of the components of the environment.

With observations of the three CDC participants in the second cycle, and with the support of the advisory committee, two changes were made in instruments 1 and 2, taken up from the proposal by Aparicio, Rodríguez and Beltrán (2014); originally there was a verb for the four knowledge (build): in the second one a differentiation was made (know, identify, distinguish and relate); Likewise, the interrelation of air, water, soil and ecosystems in biodiversity was included in the knowledge component, more in line with the conceptualization adopted on the environment (see Annexes).

Another aspect was to base on the EBC the program and the didactic sequence for the course-workshop, which allowed teachers to have more conceptual, procedural and attitudinal references for the incorporation of the environment into their curriculum and learning units.

It was established that the collegiate work of teachers, by means of the constitution of the CDC, is compatible and pertinent with the strategy for mainstreaming the environmental axis in the undergraduate curricula.

With the committee of experts and the CDC coordinators, each of the phases and cycles developed was documented. For a better understanding, the information was systematized and presented as a methodology that allows continuity with a new research process, in the search to institutionalize it in the university.

One of the most significant achievements was the reconceptualization of environmental issues and collegiate work, which facilitated the development of work on mainstreaming.

It is hoped that the results obtained so far will be the basis for the planning of a third cycle of intervention, which leads to the impregnation of the environmental axis throughout the curriculum, from the graduation profile, the skills to be developed in each subject program, up to

the didactic sequence or class plan, and ensure that transversality is a reality in the classroom or classroom, contributing to the integral formative processes.

Strategy to mainstream

1. CDC conformation:

a) The process belongs to formal education, so it must be institutionalized through a commitment letter, signed between the General Directorate of Higher and Higher Secondary Education, the director of the school and the CDC coordinator, where the interest is explicitly expressed for reforming your curriculum. This process is accompanied by a group of experts in mainstreaming, accredited by the educational institution.

b) The CDC is constituted or ratified, composed of teachers from the participating educational program themselves who show willingness for collaborative work, as well as knowledge in the curricular design by competences.

c) An intervention process is designed through three lines of training and education: environmental education for sustainability, mainstreaming of the environmental axis and curriculum design (graduation profile, teaching skills, academic program and didactic sequence).

d) Work with the teachers participating in the socialization and management of instruments 1 and 2. These are the result of collective reflection in action research, so they are suitable for generalization in any higher level educational program of the UAGro.

e) A work schedule is structured for the process of updating each program under the leadership of a coordinator.

2. Diagnosis of the presence of the environment in the curriculum:

a) Instrument 1 is applied for the diagnosis and assessment of the level of presence of the environmental axis (consisting of knowledge, skills, attitudes and values) in the educational program or learning unit; It applies to each coordinator of the educational program, as well as to the teachers who are members of the committee.

3. Curricular mainstreaming of the environmental axis:

a) Based on the assessment of the results of instrument 1, instrument 2 is applied to teachers of the educational program to propose elements of the environmental axis, feasible to be incorporated into the competence of their learning unit.

b) The discharge profile is adapted with the incorporation of environmental concepts. The committee advises teachers to review the skills and unit program and incorporate the cross-axis components, when feasible and relevant.

c) The sum of all components provides an overview of the curriculum. Ideally, the axis elements are present in a range between 76% -100% of the learning units at each stage of training. It is desirable that there be a gradualness in the inclusion of each component in the learning units by training stage; this means a presence of knowledge in the institutional training stage; skills in the professional training stage; and attitudes and values in the integration and linking stage, without this orientation becoming a conditioning factor.

4. Development of the didactic sequence with the mainstreaming of the environment:

a) Once the environmental axis is mainstreamed in the graduation profile and in the competences of the learning units, the group of experts and the CDC design a proposal to accompany the entire teaching staff to "permeate" its sequence didactic

b) Once the work is completed, the CDC is maintained through an improvement plan for a constant evaluation of the operation of the educational program, as well as the training and continuous evaluation of the teaching staff.

Discussion

The relevant results can be summarized in three ideas: identification of teacher training needs, strategies for mainstreaming and the proposal to start a new research process.

It was found that the teachers that make up the CDC require participation in training and updating processes on issues of environment, mainstreaming and curricular design, for a better conceptual understanding and leading the task of mainstreaming. There are studies that show a similar need for teacher training, such as the Center for Environmental Management and Ecology [Cegae] (2017), Clavijo (2018) and Mora (2012). It is possible to refer to the work of Aznar et al. (2018) at the University of Valencia, Spain (2016-2017), to include sustainability as a transversal dimension in the curriculum, involving teachers of the Master's Degree in Secondary Education. These authors indicated that sustainability and education for sustainable development had already been integrated; however, the training programs for teachers did not consider methodologies of didactic transposition to address socio-environmental problems in class. They concluded on the

need to strengthen the learning of sustainability contents, procedures and attitudes to implement them in the classroom, and that teacher training processes are the most appropriate strategy.

The second premise is that until the end of the second cycle, the mainstreaming of the environmental axis had not been achieved. However, Piza et al. (2018), in a research analogous to that found in this document, they identified the needs of teachers on the issues of environment, transversality and teacher competencies. In conjunction with a committee of experts, the workshop-course called Curricular transversality of the environmental axis was designed, with the participation of 24 teachers from the UAGro School of Accounting and Administration; It concluded with the development of the Marketing Unit III learning program. This contribution is significant and it will be essential to integrate it into a third scheduled intervention.

Finally, a third research cycle is proposed, divided into four stages: conformation of the CDC, diagnosis of transversality, curricular mainstreaming of the environmental axis, and the mainstreaming of the didactic sequence or class plan. Some similar investigations also propose a systematization of the works. In 2005, the Universidad Nacional del Nordeste, in Argentina, developed a pilot stage; He was interested in a process of curricular environmentalization, with the purpose of reorienting with an environmental, social and participatory awareness the graduation profiles of the curricula of the Faculties of Medicine (Medicine, Nursing and Kinesiology), and Engineering (Electromechanical and Civil). The Center for Environmental Management, a unit of the university, was in charge of the project, which consists of six phases of intervention: diagnosis, diagnostic evaluation of the faculties, preparation of a proposal, implementation, monitoring of the environmentalization project and evaluation of the curricular environmentalization; as well as a participatory and permanent phase of awareness and awareness. It highlights that curricular modifications have been achieved in the thematic objectives and contents of 13 subjects. This proposal is interesting because it raises the possibility of implementing a case-problem that addresses some environmental problem at the global, national and regional scales. Unlike other works, it does not stay in the curriculum, but seeks to transform the pedagogical-didactic practice to influence from the classroom (Cegae, 2017).

Similar experiences have been documented in Spain and Argentina on working groups that seek to transform university curricula. Barrón, Navarrete and Ferrer-Blas (2010) present the case of the sectoral Commission for environmental quality, sustainable development and risk prevention of the Conference of Rectors of Spanish Universities (CRUE), which has the task of incorporating sustainability in all areas of knowledge. This work refers to permanent intervention

activities to establish criteria and protocols, disseminate support materials for teachers, promote learning processes, develop tools for

Lacre and Mangione (2004) reported on an experience at the National University of San Luis, Argentina, as a member of the Curriculum Environmentalization Network of Higher Studies, in the construction of a theoretical methodological framework for these purposes. Until the publication of his work he had advanced in subjects and curricula of the careers of Geology, Biology, Education and Biochemistry, along with the realization of Curriculum Environmentalization Days, aimed at the university community. They proposed five stages: a) development of a qualitative and quantitative methodology to carry out an environmental diagnosis of the curriculum; b) diagnosis of the degree of environmentalization in the subjects; c) design of a model to environmentalize the professional practices of the curricula; d) knowledge of the environmental impact of environmental practices, and e) publication of the conclusions in network meetings.

The above proposals are similar to those presented here in terms of the importance that the authors give to curricular mainstreaming as a means of addressing the environmental problem, as well as dividing the intervention into stages or phases, highlighting the training and involving to teachers, students and managers as the main actors in the research process. However, there are notable differences in that they do not contemplate institutional collegiate work to make changes in the graduation profile, and that these are linked to the development of student competencies; nor do they document whether the incorporation or addition of environmental elements by the teacher in each learning unit is allowed, according to their training and professional experience.

Conclusions

The institutional facilities for the development of this research are underlined; highlights the problem generated by an inappropriate or inaccurate management of concepts - both curricular and environmental - that lead to a deep reflection on the academic work of universities, in the inescapable social commitment to the integral training of their students, future decision makers .

Although the development of environmental mainstreaming has been minimal, it is considered positive because of the teacher's participation as the main actor and generator of information. A limitation of the research is that the same CDC did not participate in the first and

second cycle, so the level of awareness of the 12 participants of the first research cycle cannot be specified.

The serious planetary environmental problem we are experiencing demands greater commitment from higher education institutions in generating reliable and relevant information for their due attention. The central administration of the UAGro is required to promote continuous training processes with themes related to social emergencies; also, that it stimulates the efforts of the teachers who are trained and manage to reach mainstreaming in their didactic sequence or class plan.

The results obtained on the experience of 15 CDC participants allow us to consider that the interdisciplinary constitution of these collegiate bodies is relevant to work on the strategy of curricular mainstreaming. The pending task is that this type of academic work be considered in the administrative policies of the university.

Acknowledgment

Finally, we thank the teachers who make up the participating CDC for their contributions and disposition, especially to the programs of Information Sciences and Technologies, Accounting and Administration.

References

Aparicio, J. L. (2014). *Propuesta metodológica para diagnosticar la transversalidad del eje medio ambiente en Programas Educativos de Nivel Superior: el caso de la UAGro*. (tesis de doctorado). Universidad Autónoma de Guerrero, Guerrero, México.

Aparicio, J. L., Rodríguez, C. y Beltrán, J. (2014). Metodología para la transversalidad del eje medio ambiente. *Revista Iberoamericana de Ciencias Sociales y Humanísticas*, *3*(6), 1-20. Recuperado de http://www.ricsh.org.mx/index.php/RICSH/article/view/28/65.

Aparicio, J. L., Torres, A., Sánchez, E. y Gutiérrez, J. (2015). Los comités de diseño curricular (CDC) y reforma de planes de estudio bajo el enfoque basado en competencias en la UAGRO. *Foro de Estudios sobre Guerrero*, *1*(2), 233-236. Recuperado de http://fesgro.mx/journal/articulos/Educacion_T2_1.pdf.

Arias, M. A. y Ramírez, R. T. (2006). Educación Ambiental y Formación Docente: Crónica de un proyecto no anunciado. *Revista Maestros de Ayer, Hoy y Siempre*, 4-11. Recuperado de http://www.anea.org.mx/docs/Arias-CronicaProyectoNoAnunciado-EA.pdf.

Aznar, O., Calero, M., Martínez, M. P., Mayoral, O., Ull, A., Vázquez, V. and Vilches, A. (2018). Training Secondary Education Teachers through the Prism of Sustainability: The Case of the Universitat de Valéncia. *Sustainability*, *10*(11), 1-14. Retrieved from doi.org/10.3390/su10114170.

Barrón, A., Navarrete, A. y Ferrer, D. (2010). Sostenibilización curricular en las universidades españolas. ¿Ha llegado la hora de actuar? *Revista Eureka sobre Enseñanza y Divulgación de las Ciencias*, *7*(4), 388-399. Recuperado de http://www.redalyc.org/html/920/92013009018/.

Bocco, G. y Urquijo, P. (2013). Geografía ambiental: reflexiones teóricas y práctica institucional. *Región y Sociedad*, *25*(56), 75-101. Recuperado de http://www.scielo.org.mx/scielo.php?script=sci_abstract&pid=S1870-39252013000100003&lng=es&nrm=iso.

Cárdenas, J. M. (2013). *Guía para Universidades Ambientalmente Responsables. Responsabilidad Ambiental Universitaria: Compromiso y oportunidad*. Perú: MINAM. Recuperado de https://centroderecursos.cultura.pe/sites/default/files/rb/pdf/Guia%20para%20universidades%20ambientalmente%20responsables.pdf.

Centro de Gestión Ambiental y Ecología [CEGAE]. (2017). *Educación: ambientalización curricular*. Argentina: Universidad Nacional del Nordeste. Recuperado de http://cegae.unne.edu.ar/index.htm.

Ceulemans, K. and De Prins, M. (2009). Teacher's manual and method for SD integration in curricula. *Journal Clean Prod*, *18*(7), 645-651. Retrieved from doi.org/10.1016/j.jclepro.2009.09.014.

Clavijo, D. (2018). Competencia del docente universitario en el siglo XXI. *Revista Espacios*, *39*(20).

Colmenares, A. y Piñero, M. (2008). La investigación acción, una herramienta heurística para la comprensión y transformación de realidades y prácticas socio-educativas. *Laurus*, *14*(27), 96-114. Recuperado de http://www.redalyc.org/articulo.oa?id=76111892006.

Conferencia de Rectores de Universidades Españolas [CRUE]. (2005). *Directrices para la Sostenibilización Curricular*. Valladolid, España: Conferencia de Rectores de

Universidades Españolas. Recuperado de https://www.uam.es/servicios/ecocampus/especifica/descargas/CRUE_sostenibilizacion_curricular.pdf.

Díaz, F., Lule, M., Rojas, S. y Saád, S. (1990). *Metodología de Diseño Curricular para la Educación Superior*. (1.ª ed.). México: Trillas.

Domínguez, M. C., Medina, A. y Sánchez, C. (2011). La innovación en el aula: referente para el diseño y desarrollo curricular. *Perspectiva Educacional. Formación de Profesores*, *50*(1), 61-86. Recuperado de http://www.perspectivaeducacional.cl/index.php/peducacional/article/view/15.

Espejel, R. A., Castillo, R. I. y Martínez, F. H. (mayo, 2011). Modelo de educación ambiental para el nivel medio superior, en la región Puebla-Tlaxcala, México: un enfoque por competencias. *Revista Iberoamericana de Educación*, *55*(4), 1-13, Recuperado de www.rieoei.org/expe/3705Espejel.pdf.

Fernández, J. M. y Velasco, N. (2003). La transversalidad curricular en el contexto de la enseñanza superior. *Agenda Académica*. *10*(2), 61-69. Recuperado de https://revistascientificas.us.es/index.php/fuentes/article/view/2403.

Galochet, M. (2009). El medio ambiente en el pensamiento geográfico francés: fundamentos epistemológicos y posiciones científicas. *Cuadernos geográficos*, *44*, 7-28. Recuperado de https://www.redalyc.org/articulo.oa?id=17111823001.

Giannuzzo, N. (2010). Los estudios sobre el ambiente y la ciencia ambiental. *ScientiaeStudia*, *8(1)*, 29-156 Recuperado de http://www.scielo.br/scielo.php?pid=S1678-31662010000100006&script=sci_arttext.

González, E. (2000). Los desafíos de la transversalidad en el currículum en la educación básica en México. *Tópicos de Educación Ambiental*, *2*(6), 63-70. Recuperado de https://dialnet.unirioja.es/servlet/articulo?codigo=203622

González, E. y Arias, M. A. (2015). La investigación en educación ambiental en México: una década a debate. En Castillo, A., Reyes, J. y Castro, E. (coords.), *Geometrías para el futuro* (pp. 38-60). México: Editorial Universitaria.

Lacre, H. y Mangione, A. (2004). Ambientalización curricular de los estudios superiores, Experiencia piloto en la Universidad Nacional de San Luis. Trabajo presentado en el 1.º Congreso de Educación Ambiental para el Desarrollo Sustentable en la República

Argentina. Provincia de Córdoba, 6 y 9 de mayo de 2004. Recuperado de http://www0.unsl.edu.ar/~geo/p-geoambiental/geo/docs/produccion/exp_piloto.pdf.

Latorre, A. (2003). *La investigación-acción. Conocer y cambiar la práctica educativa* (1.ª ed.). Barcelona, España: *Graó*

Lozano, R. (2008). Diffusion of sustainable development in universities' curricula: an empirical example from Cardiff University. *Environmental Management for Sustainable Universities, 18*(7), 637-644.

Mora, W. M. (2012). Ambientalización Curricular en la Educación Superior: Un estudio cualitativo de las ideas del profesorado. *Revista de currículum y formación del profesorado*, *16*(2), 77-103. Recuperado de https://www.ugr.es/~recfpro/rev162ART6.pdf.

Moreno, T. (2011). Didáctica de la Educación Superior, nuevos desafíos en el siglo XXI. *Perspectiva Educacional, Formación de profesores*, *50*(2), 26-54.

Piza, V., Aparicio, J. L., Rodríguez, C., Marín, R., Beltrán, J. and Bedolla, R. (2018). Sustainability in Higher Education: A Didactic Strategy for Environmental Mainstreaming. *Sustainability*, *10*(12*)*, 1-12. Retrieved from doi.org/10.3390/su10124556.

Programa de las Naciones Unidas para el Medio Ambiente [Pnuma]. (2006). *Valoración del daño ambiental*. Ciudad de México, México: Programa de las Naciones Unidas para el Medio Ambiente. Recuperado de http://www.pnuma.org/gobernanza/documentos/Valoracion_Dano_Ambiental.pdf.

Santamaría, O. y Bravo, M. (2015). Ambientalización curricular de las instituciones de educación superior. Ponencia presentada en el Simposio Sustentabilidad en la Formación Tecnológica. Zacatenco, Ciudad de México, del 27 de mayo al 8 de septiembre de 2015.

Stubbs W. and Cocklin C. (2008). Teaching sustainability to business students: shifting mindsets. *International Journal of Sustainability in Higher Education*, *9*(3), 206–21. Retrieved from doi.org/10.1108/14676370810885844.

Tovar, M. y Sarmiento, P. (2011). El diseño curricular, una responsabilidad compartida. *Colombia Médica*, *42*(4), 508-517. Recuperado de http://www.redalyc.org/articulo.oa?id=28321543012.

Universidad Autónoma de Guerrero. [UAGro]. (2004). *Modelo Educativo y Académico de la UAG.* México: Edición Especial, Gaceta Universitaria.

Universidad Autónoma de Guerrero [UAGro]. (2012). *Diseño, Evaluación y Actualización de Planes de Estudio de Licenciatura (en el marco del Modelo Educativo y Académico de la UAG).* México: Universidad Autónoma de Guerrero.

Universidad Autónoma de Guertero [UAGro]. (2017). *Segundo Informe de Labores. Dr. Javier Saldaña Almazán. Rector (2013-2017).* México: Universidad Autónoma de Guerrero. Recuperado de https://www.uagro.mx/hcu/informes/2do_Informe.pdf.

Velásquez, S. y Jairo, A. (2009). La transversalidad como posibilidad curricular desde la educación ambiental. *Revista Latinoamericana de Estudios Educativos*, *5*(2). 29-44. Recuperado de https://www.redalyc.org/pdf/1341/Resumenes/Abstract_134116861003_2.pdf.

Yus, R. (1996) *Temas transversales: hacia una nueva escuela* (1.ª ed.). Barcelona, España: Graó.

Anexos

Instrumento 1. Diagnóstico sobre la vinculación del eje transversal medio ambiente en el programa educativo o unidad de aprendizaje con fundamento en el Modelo Educativo de la UAGro ~~MEUAGro~~

<table>
<tr><td colspan="8"></td></tr>
<tr><td>Programa Educativo:</td><td colspan="2"></td><td rowspan="2">Fecha:</td><td></td><td></td><td></td><td rowspan="2">Núm. de encuesta</td><td rowspan="2"></td></tr>
<tr><td colspan="2"></td><td>Día</td><td>Mes</td><td>Año</td></tr>
<tr><td colspan="8">Coordinador del CDC: ( ) Docente: ( )</td></tr>
<tr><td colspan="8">Unidad de aprendizaje:</td></tr>
<tr><td colspan="8">Competencia:

Nota: Cuando conteste el coordinador se referirá al perfil de egreso del PE, y el docente a su (s) unidad de aprendizaje correspondiente.</td></tr>
</table>

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

Instrucción: Analice los elementos del eje ***medio ambiente*** y señale con una **X** en qué grado están vinculados con el perfil de egreso

	Elementos del eje *medio ambiente*	Muy vinculado con el perfil de egreso (3 puntos)	Parcialmente vinculado con el perfil de egreso (2 puntos)	Poco vinculado con el perfil de egreso (1 punto)	No se vincula con el perfil de egreso (0 puntos)
CONOCIMIENTOS	Conoce los fundamentos y conceptos básicos sobre la biodiversidad (interrelación del aire, agua, suelo, flora, fauna silvestre, y ecosistemas).				
	Identifica los conceptos sobre los recursos naturales que tienen el estado de Guerrero, México y el mundo.				
	Distingue actividades para el aprovechamiento de los recursos naturales.				
	Relaciona las causas y consecuencias de problemáticas ambientales.				
HABILIDADES	Analiza situaciones relacionadas con el impacto ambiental.				
	Desarrolla proyectos de desarrollo sustentable.				
	Aplica métodos para mitigar los efectos de los problemas ambientales.				
	Promueve el uso de tecnologías limpias (ecotecnias).				

	Trabaja con creatividad y rigor científico en la solución de problemas ambientales.				
ACTITUDES Y VALORES	Valora la importancia de la biodiversidad.				
	Se conduce con ética y respeto en la conservación y cuidado del medio ambiente.				
	Desarrolla una cultura de responsabilidad socioambiental en la búsqueda de alternativas de solución de los problemas ambientales.				
	Toma iniciativas en la construcción de soluciones a problemas ambientales a través del trabajo colaborativo.				
Subtotal					

Muy vinculado (18 - 26 puntos) | Parcialmente vinculado (9 – 17 puntos) | Poco vinculado (1 - 8 puntos) | No se vincula (0 puntos)

Fuente: Elaboración propia con base en Aparicio *et al.* (2014)

Instrumento 2. Propuesta del docente para la transversalización del eje medio ambiente en su unidad de aprendizaje

Programa Educativo:		Fecha:	Día	Mes	Año	Núm. de entrevista	
Unidad de aprendizaje:							
Etapa de formación:							
Competencia:							
Nombre del docente:							

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

Instrucción: Analice los elementos del eje ***medio ambiente***; si tiene una propuesta o sugerencia adicional, viable de incorporar en su unidad de aprendizaje, favor de escribirla en la columna derecha.

	Elementos propuestos del eje *medio ambiente*	**Propuesta del docente**
CONOCIMIENTOS	Conoce los fundamentos y conceptos básicos sobre la biodiversidad (interrelación del aire, agua, suelo, flora, fauna silvestre y ecosistemas).	
	Identifica los conceptos sobre los recursos naturales que tienen el estado de Guerrero, México y el mundo.	
	Distingue actividades para el aprovechamiento de los recursos naturales.	
	Relaciona las causas y consecuencias de problemáticas ambientales.	
HABILIDADES	Analiza situaciones relacionadas con el impacto ambiental.	
	Desarrolla proyectos de desarrollo sustentable.	
	Aplica métodos para mitigar los efectos de los problemas ambientales.	
	Promueve el uso de tecnologías limpias (ecotecnias).	
	Trabaja con creatividad y rigor científico en la solución de problemas ambientales.	
ACTI	Valora la importancia de la biodiversidad.	

	Se conduce con ética y respeto en la conservación y cuidado del medio ambiente.	
	Desarrolla una cultura de responsabilidad socioambiental en la búsqueda de alternativas de solución de los problemas ambientales.	
	Toma iniciativas en la construcción de soluciones a problemas ambientales a través del trabajo colaborativo.	

Fuente: Elaboración propia con base en Aparicio *et al.* (2014)

Rol de Contribución	Autor (es)
Conceptualización	**José Luis Aparicio López**
Metodología	**José Luis Aparicio López y Columba Rodríguez Alviso «igual»**
Software	**Columba Rodríguez Alviso**
Validación	**Columba Rodríguez Alviso «principal» y José Luis Aparicio López «que apoya»**
Análisis Formal	**Columba Rodríguez Alviso**
Investigación	**José Luis Aparicio López y Columba Rodríguez Alviso «igual»**
Recursos	**José Luis Aparicio López**
Curación de datos	**Columba Rodríguez Alviso**
Escritura - Preparación del borrador original	**José Luis Aparicio López y Columba Rodríguez Alviso «igual»**

Escritura - Revisión y edición	**José Luis Aparicio López y Columba Rodríguez Alviso «igual»**
Visualización	**José Luis Aparicio López y Columba Rodríguez Alviso «igual»**
Supervisión	**José Luis Aparicio López «principal» y Columba Rodríguez Alviso «que apoya»**
Administración de Proyectos	**José Luis Aparicio López «principal» y Columba Rodríguez Alviso «que apoya»**
Adquisición de fondos	**Columba Rodríguez Alviso**