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Ethnopharmacology in Elementary, Primary and Secondary Education: Current Perspectives and Future Prospects

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10.1 Introduction

The concept of ethnopharmacology covers two distinct but closely interwoven aspects: *uses* and *knowledge*. These aspects appear to be part of the same thing but this is not the case. Uses are a matter of fact that can be documented through observation and respond to both traditional knowledge and recent short-term external factors. Traditional knowledge, on the other hand, may be fully operational or simply appear as a vague memory of a more or less happy past (Rivera and Obón, 1998). This distinction is particularly pertinent in an educational context because it is essential but not easy to determine what is substantial and what is merely accidental.

Traditional knowledge (TK), as far as it is related to biodiversity, merges both culture and nature, thus becoming part of natural and cultural heritage (Pardo de Santayana and Gómez, 2003). It represents a part of the intangible heritage that is not written in books, but

instead is in the collective memory of the community, orally transmitted from generation to generation (Fajardo *et al.*, 2008). Each TK system in its ethnobiological facet is local and unique. It aims to solve problems affecting the local community, although some are largely common to humankind. Each local community has its own way of adapting to its environment, and operating and managing its local resources, which is reflected cultural heritage linked to biodiversity and is of great importance and should be preserved (Pardo de Santayana *et al.*, 2012; Morales *et al.*, 2011).

At the beginning of the 21st century European rural populations are undergoing both erosion and loss of TK as a result of the disappearance of oral transmission systems of such knowledge, which in turn is linked to dramatic changes in lifestyles (Quave *et al.*, 2012). Technological progress, together with the abandonment of rural life over the past 50 years in Europe, has been beneficial for urban societies but nevertheless has brought about a process of transculturation. This has resulted in a sharp decline in rural customs and practices, and in the loss of the knowledge which is part of European (and any other) cultural and natural heritage. Currently, the direct transmission and the skills related to the traditional knowledge system (TKS), which for centuries were based on oral transmission and experience, are broken (Fajardo *et al.*, 2008; Verde *et al.*, 2009, 2010). This presents a challenge for different societies globally and for European ones specifically, which undoubtedly must react to the erosion and loss of this local knowledge. This knowledge, eminently practical, ecological and local, is condemned to immediate disappearance if not transmitted in an appropriate manner to the next generation. The transmission failure would entail an irreparable loss of biocultural diversity and potential resources to address new challenges, such as those derived from global change, mass migration and the emergence of resistance to current drugs.

At this point, it is important to remember that from the biomedical point of view, which is widely adopted in North America, Europe and some other countries as the healthcare model, knowledge and practices recorded in the context of ethnopharmacology are considered marginal. However, reality has set in, forcing western countries to create a new concept of alternative and complementary medicines, which can fit, even in the European urban world, the TK that we discussed earlier. This is part of what the European Medicines Agency named traditional herbal medicinal products (THMP), whose use is well-established in European markets (EMA, 2013), but, of course, only a part!

No doubt part of this knowledge already is no longer useful for our urban society, but some is practical, including the use as drugs of biological (plants, animals and fungi) and non-biological (minerals) materials, which are part of what is called traditional medicine and local popular medicine. Hence the responsibility to locally transmit those that are local knowledge systems and to globally transmit those that are global traditions.

While self-medication might not be widely promoted, it should be recognised that herbal medicines are more sustainable and less expensive than other pharmaceuticals. To provide access to these local resources as a complement to standard drugs that the official healthcare system makes available to citizens is in itself interesting from the point of view of sustainability and the conservation of TK, as well as improving overall community health status. Experiences in Latin America show the possibilities for the coexistence of both standard drugs and traditional medicines (Mignone *et al.*, 2007; Vanderbroek, 2013). In addition, there are complex links between the knowledge and use of medicinal plants and the concomitant use of pharmaceuticals (Giovannini *et al.*, 2011).

Information from global media such as TV, radio and the internet gives people a new way of treating certain diseases, especially chronic diseases and those involved in ageing

(Leonti and Casu, 2013). The need therefore arises to critically confront this torrent of information with directly transmitted (word and experience) practical knowledge. How can this be achieved? Which mechanism or transmission belt can replace the system of TK? Educational, humanitarian, social and healthcare NGOs who develop specific tasks in this regard can help to do this (Verde and Fajardo, 2014).

10.2 Ethnopharmacology: a multidisciplinary subject for education

Recent efforts to incorporate general ethnobiology and ethnobotany in the curriculum in higher levels of education have succeeded, most notably in graduate and postgraduate courses in European and American universities (Bennett, 2005; Rivera, 2008). However, ethnobotany has not yet been introduced at elementary and secondary levels (McClatchey and Bridges, 2014; OSN, 2014). It is worth highlighting the work developed in Ireland, where in the late 1930s the new Republic initiated a series of activities for school children to 'interview' their families. Fionna Shannon (Centre for Pharmacognosy and Phytotherapy, UCL School of Pharmacy, London) is working on the review of the formularies recorded during this period with a focus on medicinal plant uses. Between 1935 and 1970 the Irish Folklore Commission compiled information on diverse aspects of Irish TK, including 'folk medicine' (Briody, 2007). These data have been used also for dissemination books (see Allen and Hatfield, 2012).

However, different experiences occurred in different countries, and have been developed on the initiative of individual teachers and under very different approaches, for example education for health, environmental education, education for diversity, etc. (Verde *et al.*, 2004a, 2005; Vilá, 2014). This work was often linked to research projects within a framework of collaboration between universities and centres of secondary education (Verde and Fajardo, 2002, 2003a, 2003b; Vallejo *et al.*, 2007; Valdés *et al.*, 2008; Pérez *et al.*, 2009) and in most cases was considered a transversal subject (Verde *et al.*, 2005, 2009). Occasionally these initiatives were part of international projects financially supported by the European Commission, for example the Local Food: Nutraceuticals in the 5th Framework Program (Verde *et al.*, 2004b). They often had the aim of raising awareness and bringing students into direct contact with their natural environment, and of showing the curricular, educational and behavioural benefits, for students and teachers, who may have to learn and teach through the world of plants from a different perspective outside the classroom (Blair, 2009; Ahmed *et al.*, 2011; Laaksoharj *et al.*, 2012; Ruíz-Gallardo *et al.*, 2013). These experiments were carried out primarily in urban areas, where the majority of the European population resides, and in the context of strong transculturation of younger European generations.

The need to recover and transmit traditional practical knowledge of medicinal plant uses (see above) leads one to ask what contents and subjects should be incorporated and taught at different educational levels (Table 10.1). Ethnopharmacology is a multidisciplinary form of learning about TK and biosciences (Etkin, 2001; Heinrich *et al.*, 2006; Reyes-Garcia, 2010), therefore it is possible to incorporate concepts ranging from chemistry (composition and characteristics of the active principles) to social sciences (history of medicinal plants) and biology (description and identification of the botanical or zoological species of medicinal use) and health. Furthermore, the possibilities for incorporating this discipline in the curriculum of formal education are extremely broad and range from local food, health and botany to chemistry, history and literature (Verde *et al.*, 2004b; 2010).

Table 10.1 Proposal for basic knowledge and skills content (Figure 10.1) in the field of ethnopharmacology adjusted to different educational levels.

Course objectives	Overlapping disciplines	Pre-primary and primary	Lower and upper secondary	Post-secondary vocational (health)	Tertiary (undergraduate/graduate)
Knowledge					
Concept of ethnopharmacology	Ethnobiology, phytotherapy	-	Be	Be/m	Bm/d
History of medicinal plant (and other natural products) drug use	History, history of medicine and pharmacy	Te	Te	Be/m	Bm/d
Medicinal plants in different cultures	History, social	Te	Te	Be/m	Bm/d
Plant-based drugs in biomedicine	Pharmacognosy, pharmacology, pharmaceutical technology	-	Te	Bm/d	Bm/d
Systems of traditional knowledge	Anthropology, ethnobotany, social	Te	Te	Be/m	Bm/d
Systems of traditional medicine	Medical anthropology, ethnobotany, social	-	Te	Be/m	Bm/d
Ethical issues of plant drugs development and use	Bioethics, biology, social	-	Te	Be/m	Bm/d
Skills					
Field and laboratory methods	Biology, laboratory	Te	Te	Bm/d	Bm/d
Identification of medicinal plants (and other natural products)	Botany, science, technics, zoology	Te	Te	Bm/d	Bm/d
Recognition of local toxic plants and poisonous mushrooms and animals	Botany, science, zoology	Te	Te	Bm/d	Bm/d
Local food production and consumption within the framework of the Mediterranean diet	Food science and technology, nutrition, science, social	Te	Te	Bm/d	Bm/d
Traditional methods of collecting, processing and conserving medicinal plants	Biology, science, technics, pharmaceutical technology	Te	Te	Bm/d	Bm/d
Rational use of natural medicines	Biology, patient safety, social	Te	Te	Bm/d	Bm/d
Legal framework for ethnopharmacology	Pharmaceutical legislation, social	-	-	Bm/d	Bm/d
Applications to non-humans (veterinary, farming)	Chemotherapeutics, technics, veterinary	-	Te	Bm/d	Bm/d

B, basic; d, deep; e, elementary; m, middle; T, transversal.

Ethnopharmacology courses are taught at various European and American universities (Gillespie, 1995; UIO, 2014) with a value of three to ten credits and including specific subjects such as:

- the concept and history of ethnopharmacology
- plant-based drugs used in western medicine that originated in traditional medicine
- professional and non-professional traditional medicine
- traditional healers and ethnic pharmacopoeias
- theories about chemical ecology
- human diets
- field and laboratory methods as well as ethical issues and IP rights
- medicinal plant conservation
- transculturation
- medicinal plants, natural products and their pharmacological effects.

Courses are usually part of biological and health education programmes, but are open to any students with adequate academic backgrounds. A general prerequisite or recommendation for attending ethnopharmacology graduate and undergraduate courses is a basic knowledge of botany, pharmacognosy and pharmaceutical chemistry.

10.3 Developing an ethnopharmacological curriculum: some strategies

Ethnopharmacology is a useful tool to assist students at different levels in a comprehensive training process, and can be incorporated in the curriculum using basic (unidisciplinary, interdisciplinary) or transversal approaches, as shown in the experience of developing such a curriculum in Spain (Table 10.1; Gillespie, 1995; Bennet, 2005; Vallejo *et al.*, 2006; Rivera, 2008; Valdés *et al.*, 2008; Pérez *et al.*, 2009; Verde *et al.*, 2009, 2010; González, 2014).

Educational programmes in Europe are structured into different levels (Eurostat, 2014a) according to International Standard Classification of Education (ISCED) fields and student age (UNESCO, 2014):

- Levels 0 and 1: Pre-primary and primary education for children aged 3–12 years.
- Levels 2 and 3: Lower and upper secondary education. The entrance age is 13 years and typical duration varies from 5 to 6 years.
- Level 4: Post-secondary non-tertiary/vocational education, which includes 16–20-year-old students. This broadens the knowledge of ISCED Level 3 graduates or prepares students for direct entry into the labour market.
- Levels 5 and 6: First and second stages of tertiary education, provided by universities and other higher education institutions to students aged usually over 18.

A key objective of all educational systems is to equip students with a wide range of skills and competences. This encompasses not only basic skills such as reading and mathematics, but also more transversal skills such as information and communications technology, entrepreneurship (Eurostat, 2014b) and health education (Verde *et al.*, 2010). This transversal set of skills and competences is acquired in different subjects, primarily focusing on basic skills. The degree of breadth, depth and detail in which the matter is addressed either in transversal or basic form at the different educational levels, leads to a distinction into elementary, intermediate and deep learning.

In countries such as Spain different educational reforms (LOGSE, 1990; LOCE, 2002; LOE, 2006; LOMCE, 2014) have not included changes to the curriculum to generate learning based on functional competencies. Thus, skills are mostly acquired outside the educational system. However, within secondary education an optional course of applied botany was developed (administrative resolution from 25 May 1994) that focuses on teaching–learning processes based on the study of economic plants and the relationships between humankind and plant communities. The contents includes biodiversity and numerous plants uses, such as industrial, food, construction and ornamental, medicine and pharmacy, and plant crops.

Currently the legislation in force, due to ideological, political and technical issues, has not left space for the specific development of ethnopharmacology in pre-primary, primary or secondary education as a basic subject. However, incorporating such a topic is possible through natural sciences such as biology and chemistry in primary, secondary and post-secondary education (including vocational). A great handicap for the implementation of ethnopharmacological contents within these subjects may be the already overloaded curriculum (Coll, 2007), the inappropriate distribution of schedules and the irrational assignation of relative relevance for different subjects. Each year teachers should consider only a selected repertory of contents and how to implement them, taking into account the differences between the official curriculum proposal and its translation into the classroom, and contrasted with other aspects such as the curriculum learned and the skills acquired by students (Duschl and Hamilton, 1992).

A very promising strategy to connect with local TK would be to work from the context of the students, from their own experience and thoughts, so that they can take positions on their ethnobiological or ethnopharmacological heritage. It is possible to introduce ethnopharmacology in educational institutions through specific projects leading students to collect local remedies of popular medicine starting from a conceptual framework proposed by the teacher (Vallejo *et al.*, 2006). With such an approach, starting from objectives and ethnobiological methods, students can interview their families and people in their social environment as part of an investigation involving different areas. From the educational point of view, the process should be inspired by scientific models that focus on the following points: defining and enclosing a problem, designing a research project, bibliographical documentation and analysis, field work and elaboration of conclusions (Vallejo, 2004). Ethnopharmacological topics are a resource for learning scientific methods, including problem solving, and developing values around the ethnobiological knowledge. They are also an excellent tool in large cross-curricular subjects such as environmental education, health education, consumer education and moral and civic education.

Teachers may consider methodological aspects, such as using taxonomy of skills to organize the goals of ethnopharmacology, a strategy for properly structuring the contents and putting special emphasis on students' existing ideas about cultural biodiversity (Figure 10.1). An example of these ideas might be 'all natural things are good and safe'. Teachers should encourage cognitive conflict so that the student critically appraises this belief. This would help to build coherent knowledge schemes, integrating health, environment and tradition, from the experience of the student. Thus, it will lead to an appropriate behavioural change. The students' ideas come from their interaction with the social and natural environment, and academia. The main characteristics of students' preconceptions are their stability over time, their relative internal consistency and their generalization in the student group, hence they have great influence on the teaching and learning process. The students' psycho-evolutionary period following taxonomies and some models of Piaget and Ausubel, such as Bloom's taxonomy for the cognitive domain (Carr *et al.*, 1994), should be taken into account.



Figure 10.1 Secondary education students developing skills using traditional methods in the greenhouse at Los Olmos High School, Albacete, Spain (image: A. Verde).

Another more ambitious and effective way to introduce ethnopharmacology is through specific school cross-curricular projects (PCC, proyecto curricular de centro). In Spain the PCC is the annual programme for every school where each centre can incorporate specific contents in the curriculum in an autonomous way, as a core idea (ITE, 2104). As ethnopharmacology covers contents ranging from chemistry to the history of medicinal animals and plants, and is based on tradition and cultural heritage, it lends itself to cross-curricular teaching (Verde *et al.*, 2010; González, 2014). Thus subjects as different as science, social science, biology, physics, chemistry, history, language and literature, and even others could be involved in a common project. The consensus of the whole educational community (teachers, parents, students and educational authorities) is fundamental in this issue, as it involves not only teaching staff and students, but also families. This consensus is largely dependent on the existence of a good leadership and the cooperation of all those involved. The curriculum needs to be organized from a philosophical and educational point of view that analyses local knowledge as a joint platform for teaching and learning scientific and humanistic education. The difficulties for implementing this proposal reside in the leadership of more motivated staff, their training and research capacity, as well as the development of curricular materials that enable the integration of the contents (Verde and Fajardo, 2003b; Verde *et al.*, 2004b). An easier alternative to this proposal is the organization of cultural weeks or specific science fair days focusing on ethnopharmacology, which could include different activities and could spread outside the school (Figure 10.2).

Secondary vocational education and training offer opportunities for ethnopharmacology-related activities. Work-based learning, notably apprenticeship and other models, helps to facilitate the transition from learning to work. This requires a clear regulatory framework defined by the educational authorities at the different levels (local, national and European), which

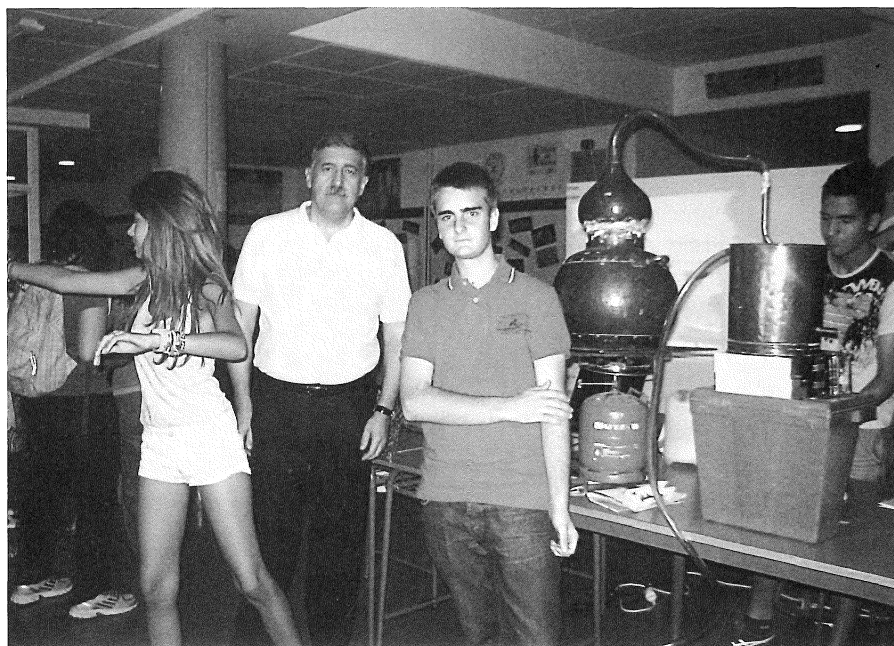


Figure 10.2 Secondary education students using traditional essential oil distillation facilities at the science fair at Los Olmos High School, Albacete, Spain (image: A. Verde).

clarify the roles for the different players and must be an integral part of the entire education system, focusing here on health and health-science related vocations (European Commission, 2012).

10.4 Conclusions

Currently there is a lack of space for the development of ethnopharmacology in pre-primary, primary or secondary education as a specific subject. However, it is possible to find options for learning ethnopharmacological knowledge, competences and skills using different interdisciplinary and transversal approaches, as is demonstrated by numerous experiences in this field. This chapter highlights the importance of working from the context of the student and, more ambitiously, through school cross-curricular projects, a unique Spanish legal framework.

The benefits of such an interdisciplinary ethnopharmacological approach in the various curricula of pre-primary, primary and secondary education include:

- *social benefits* like the active promotion of the link between generations, the reduction of excess local demand for health services, adding value to local products (e.g. the Mediterranean diet), promoting healthy life styles and promoting responsible medication use
- *cultural benefits*, including the maintenance and promotion of traditions and the local knowledge system, improved knowledge about local biodiversity, knowledge and appreciation of local natural resources
- *educational benefits* like learning about interdisciplinary cooperation of the various stakeholders (teachers, students, families) and facilitating the learning of other subjects.

Local communities could appreciate and add value to their TK as an essential part of their identities. In addition, teachers will have a great tool available that will facilitate interdisciplinary work and, finally, health authorities could promote the rational use of traditional herbal medicines as a less expensive way to assist health care in developing and developed societies.

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