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The current state of the planet's environmental deterioration calls for formal educational contexts to implement effective environmental proposals which nurture action competence. The aim of this paper is to examine the educational proposals in formal contexts that have been published in the two research journals of greatest impact on Environmental Education during the period 2008–2013, and to analyse how they contribute to the development of action competence. Special attention is paid to research (i) based on real participation by students; (ii) promotes reflection on the complexity of environmental issues; (iii) facilitates critical thinking; (iv) encourages autonomous and responsible decision-making and (v) involves communities. Our results show that these approaches can help improve the development of action-focused environmental education and bring to light a series of challenges for future research.

Keywords: action competence; educational proposals; environmental education research; formal educational contexts

Introduction

Presently, reports from international organizations such as GEO-5 (2012), UNEP (2012), the World Bank (2013), the Worldwatch Institute (2013) and IPCC (2014), amongst others, point to important environmental problems which we must tackle in order to ensure a sustainable future. These challenges include rising levels of pollution – which go beyond territorial borders – climate change, the degradation of ecosystems, the destruction of resources and the extreme poverty and disease which so many people suffer. The underlying causes of these problems are related to human lifestyles and are linked to political pressure for continuous economic growth (Daly 1992; Giddens 2009; Latouche 2011), based on the developed world's never ceasing hyper-consumption, as if the Earth's resources were endless (Sachs 2008; Bardi 2011). In this regard, it is necessary to acknowledge the influence of wider social structures and institutional arrangements on behavioural choices of individuals. Additionally, a broader framework for environmental education is also necessary in order to take into account the role of education in addressing changes to such structures and arrangements (Robottom 1987; Gough 1992).

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Achieving sustainable development requires changes in the policies of countries and the need for international agreements (Jackson 2009; Klein 2014), in addition to changes in habits and lifestyles of communities. From the educational sphere, schools can and should provide an opportunity to encourage the development of sustainable lifestyles in collaboration with communities so that they become more just, more responsible and more respectful towards the environment. Education can develop the capacity to think critically, ethically, and creatively in appraising environmental situations and to develop the capacity and commitment to act individually and collectively in ways that sustain and enhance the environment (Stevenson and Stirling 2010). The contribution that Environmental Education (here in after EE) can make at all educational stages is crucial. Its breadth and inclusivity stem from the complexity of environmental realities and problems (Berryman and Sauvé 2013) while playing a significant role in developing basic competencies such as autonomy and personal initiative or learning to learn (Hacking, Scott, and Barratt 2007; Mogensen and Schnack 2010).

Thus, interest in EE is growing and its field has been reviewed on numerous occasions. Some authors, such as Hines, Hungerford, and Tomera (1986\1987), worked on meta-analysis, by studying the correlates of responsible environmental behaviour, while Zelezny (1999) analysed educational interventions. Some years later, Bamberg and Möser (2007) also looked at factors influencing environmental behaviour. Osbaldiston and Schott (2012) measured different interventions for promoting pro-environmental behaviour, and Lokhorst et al. (2013) focused on the commitment to action of individuals. Some narrative reviews have also been carried out: Volk and McBeth's (1998) studied the components of environmental literacy, while other reviews focused on environmental sensitivity and significant life experiences (Chawla 1998; Sward and Marcinkowski 2005). Rickinson (2001) carried out an extensive review of studies pertaining to sensitivity, knowledge, attitudes, and behaviour. Heimlich and Ardoin (2008) conducted a literature review focused on new models for behavioural change. Recently, Gifford (2014b) conducted a major review of environmental psychology issues and Stern, Powell, and Hill (2014) conducted another on environmental education programs.

Notwithstanding, after 40 years of research in the field, there are still unanswered questions, aspects that require further study, and certain gaps (Reid and Scott 2013). Achieving environmentally significant behaviour is dauntingly complex, both in variety and causal influences (Stern 2000).

Moving forward in EE calls for reflecting on how the teaching and learning processes are based on different paradigms, theories and studies. In fact, a debate began in the 90s on the different models of research and how epistemological and methodological orientations to educational inquiry set the terms on which knowledge is produced (Robottom and Hart 1993), which are issues that other authors also note (Flogaitis and Liriakou 2000; Wals and Dillon 2013). As Mogensen and Mayer (2005) point out, the research paradigms correspond to a conception of the world and essentially define their methodology: (a) a dominant positivist paradigm, where reality is objective and the experimental method, via a control of variables, allows us to discover the true nature of observed reality – to describe it and make it widespread; it uses quantitative methods; (b) an interpretative paradigm, where objective reality does not exist, but is subjectively constructed; and where knowledge is also subjectively constructed, even though there may be inter-subjective views, and thus realities, between groups of people with similar values, contexts and cultures; it uses

qualitative methods, and (c) a sociocritical paradigm that somehow tries to integrate the extreme positions of the two above, and to link them up in a more complex view of reality, where reality is, in fact, perceived as objective but complex, its representations and meanings changing according to historical and social circumstances; and using mainly mixed methods.

In this way, different studies and theories have tried to explain the development process of pro-environmental behaviour (Gifford 2014a). Heimlich and Ardoin (2008) identify two current lines of investigation in this field. Some research in EE explores models for behavioural change that lead to predicable changes (Kollmuss and Agyeman 2002) and are layered with assumptions that the educator can use to manipulate variables. Other research addresses behaviour from the perspective of individual obstacles to achieving attitudes that are both personally and environmentally beneficial and include multiple forms of knowledge as part of the equation (Clover 2002).

In the last decades, numerous authors support a change in the main objective of EE (Jensen and Schnack 1997; Stables and Scott 2002; Englund, Öhman, and Östman 2008; Huckle 2008; Ferreira 2009). It should focus towards the development of action competence, based on reflection, critical thinking and student participation.

Within this framework, action competence is a complex and dynamic educational ideal in a democratic perspective (Schnack 2000) that was formulated within the Danish critical health and environmental education research in response to the educational model of behaviour modification (Jensen and Schnack 1997). It is included inside the educational paradigms (Schusler et al. 2009) with emancipating characteristics (Wals and Dillon 2013), that stress the importance of strengthening the capability of the learners to reflect and take a standpoint. So, Schnack (2000) defines action competence as 'a capability – based on critical thinking and incomplete knowledge – to involve yourself as a person with other persons in responsible actions and counter-actions for a more humane world'.

They also consider that action should be consciously taken and targeted, since they are intentions based on experiences (Jensen and Schnack 1997). The action competence approach seeks to form a basis for decisions and choices that are connected to the community and dialogue (Mogensen and Schnack 2010). And, as these authors note, where the action is addressed to solving the problem or changing the conditions or circumstances that created the problem in the first place, combining the critical process of reflection and inquiry with an empathetic and optimistic vision of potential, the result is a search for solutions and a positive direction. Like all competence, it integrates practical skills, knowledge, motivation, ethical values, attitudes, emotions and other social components and conducts that come together to achieve efficient action in a given context (Perrenoud 2010), acquired solely through the action and that can only be evaluated in a diverse action context.

It seems, therefore, that a paradigm to promote a complex and critical view of EE is necessary, as well as the development of educational proposals for learning situations related to the real world and that foster compromise from the systemic view of problems. This approach implies a teaching and learning model based on social learning (Lave and Wenger 1991; Wals 2007), that implies new student (and teacher) roles, where their interests and needs are taken into account (Barratt-Hacking, Barratt, and Scott 2007; Mogensen and Schnack 2010). If we understand the environment as a system made up of physical, socio-cultural and emotional factors that are all interrelated, it is essential to use the EA models that provide a holistic view

of the world and of the environment. These real-world situations should be integrative at a global or interdisciplinary level (Mogensen and Mayer 2005; Wals 2007), and involve student participation in the classroom and in the resolution of environmental issues (McCallum, Hargrieves, and Gipp 2000; Mogensen and Schnack 2010). All this needs to be carried out using critical thinking, embracing complexity and studying future alternatives (Mogensen and Mayer 2005; Wals 2007; Kyburtz-Graber 2013), encouraging autonomous and informed decision-making through participation (Wals 2007; Stevenson and Stirling 2010).

Consequently, it is necessary to use models that prepare students for individual and collective action. As a result, it is also necessary to create learning communities for action and establish positive interactions between the school and the community to execute actions in favour of the environment (Hart 1992; Wals 2007).

The integration of new perspectives in formal educational contexts requires researchers and practitioners to have access to useful information on how to implement educational strategies which can help to achieve this objective. As Mogensen and Schnack (2010) note, to improve the quality of focus on competency for action, we must concentrate on improving teaching and learning. A concern regarding what is done in education to ensure that students – fare not only informed and aware, but capable of acting sustainably when faced with current and future environmental problems, has inspired the present literature review on this subject.

The aim of this review is to examine the educational proposals in formal contexts that have been recently published in the two research journals of greatest impact on EE and to analyse the contributions they make to the development of different elements that are part of action competence. To do so, we have analysed, synthesised and made contributions to the main characteristics and findings from studies on the effectiveness and value of educational strategies within varied pedagogical frameworks, by referring to the recommendations of experts in this field, as shown throughout the work. We hope to help other researchers to design and develop new studies, encourage researchers and educators to reflect on their practices, to explore current trends and challenges in EE, and to offer new ideas for future work.

Methodology

In this *purposive* review (Cooper 1988; Randolph 2009) we have conducted a recent literature review, using as sources the two journals with the highest impact on environmental education, and therefore the ones that set trends in this field (*Journal Citation Reports* by the *Science and Scholarly Research* division of *Thomson Reuters*). We selected papers from *Environmental Education Research* and *Journal of Environmental Education* during the period 2008–2013.

The main phases of the review process are explained in Table 1 (adapted from Bennett et al. 2005 and Randolph 2009). The selection and analysis was done by means of a personal analysis and common discussion of all the authors. During the selection process, abstracts of all articles published in these journals in the period 2008–2013 were read and only those papers that met the requirements set out below were selected. Thus, we considered 375 articles in total and selected 38 for analysis, each of which presented original research from an approach which fitted the objective of this review. We selected those papers that met the following criteria: (i) they evaluated/investigated educational proposals in the EE framework; (ii) they were

Table 1.   Main phases of the review process.

	Stages		
1	Planning and objective formulation	•	Establishment the framework
		•	Identification our review research objective
		•	Development inclusion criteria
		•	Production the protocol for the review (to establish the overall plan and the categories of analysis)
2	Data collection, evaluation and previous analysis	•	Searching, screening and initial review of papers
		•	Characterising and synthetizing
		•	Classifying and creating data tables
		•	Obtaining of preliminary findings
3	Analysis and interpretation	•	Keywording and defining the in-depth review criteria
		•	Profound study of the research papers
		•	Making descriptive statistics, tables and figures
		•	Analysis and interpretation of the results
4	Presentation	•	Structuring information and presentation of results and conclusions

Source: Adapted from Bennett et al. 2005, Randolph 2009.

implemented in formal contexts (including environmental programs with the direct involvement of schools) and (iii) they did not merely focus on conceptual knowledge about the environment, but they deal with others issues, such as attitudes, behaviour, emotions, or decision-making. Here it should be noted that all the research dealing with the study of environmental problems in their proposals was included because of its relevance in the context of action competence. The quality of the works was ensured based on the requirements for publication by the selected journals

The review was carried taking into account the main foci that a review should be based on: research methods, theories, practices and research outcomes, or applications (Cooper 1988; Randolph 2009). First of all, the research and educational proposals were synthesised and characterised, in order to later analyse the data. As a basis for analysing the educational proposals within the context of action competence, the following criteria were used:

- *Participation*: It encourages the participation of students, which includes from formulation of questions or making suggestions to decision-making in solving the problems or in the process of teaching and learning, where students are involved actively, they express their opinions and take part in the decision-making, individually and collectively, in the process.
- *Involvement of the student body*: It arises from students' needs and concerns, aiming to connect with their interest.
- *Social learning*: It uses learning in groups and cooperating teams.
- *Real issues*: It practices relations with the real world (through real experiences, hands-on learning, outdoors, etc.).
- *Interdisciplinary perspective*: Issues are dealt from different inter-connected disciplines.

Table 2.   Educational suggestions of reference authors and of earlier reviews.

	Guidelines of references authors	Conclusions of earlier reviews
Participation	Democratic and participatory ideas in relation to teaching–learning (McCallum, Hargrieves, and Gipp 2000; Mogensen and Schnack 2010)	Student-centred learning (Stern, Powell, and Hill 2014)
	Conexion between active participation and democracy (Hart 1992)	Active and constructive involvement learning (Vosniadou 2001)
	Active and experiential learning (Huckle 1991)	
Student involvement	Students' own worldview (Mogensen and Schnack 2010)	Emotional connections (Stern, Powell, and Hill 2014)
	Engaging children (Barratt-Hacking, Barratt, and Scott 2007)	Learner motivation (Vosniadou 2001)
Social learning	Group collaboration (Frisk and Larson 2011)	Collaborative group discussion (Rickinson 2001)
	Social learning (Wals 2007)	Participation in the social life of the school (Vosniadou 2001)
	Situated learning: Legitimate peripheral participation (Lave and Wenger 1991)	
Real issues	Societal issues and environmental problem-oriented (Mogensen and Schnack 2010)	Active and experiential engagement in real-world environmental problems (Stern, Powell, and Hill 2014)
	Environmental problems (UNECE 2005)	Outdoor experience (Rickinson 2001)
	Problem-solving NEEAC (2005) Link between educational processes and real life (Wals 2007)	Real life and culturally relevant (Vosniadou 2001)
Interdisciplinary approach	Cross-curricular, even holistic (Mogensen and Mayer 2005)	A multidisciplinary approach (Stern, Powell, and Hill 2014)
	A multidisciplinary approach (Hungerford et al. 2003)	
	Interdisciplinary and comprehensive approach which will permit a proper understanding of sustainability problems (Wals 2007)	
Complexity	Understanding of interconnectedness (Frisk and Larson 2011)	
	Environmental problems, including their economic, ecological and social implications (UNECE 2005)	
	Culture of complexity (Mogensen and Mayer 2005)	
	To understand the complex nature of the environment (Wals 2007)	
Critical thinking	Systemic, critical and creative thinking and reflection (UNECE 2005)	
	Systems thinking (Huckle 1991; Wals 2007; Frisk and Larson 2011)	
	Critical thinking (NEEAC 1996)	
	Approach of environmental problems in critical and relational dimensions (Kyburtz-Graber 2013)	

Table 2.   (*Continued*).

	Guidelines of references authors	Conclusions of earlier reviews
Action	Long-term, foresighted reasoning and strategizing (Frisk and Larson 2011) Action-orientation (deHaan 2006; Wiek, Withycombe, and Redman 2011) Work on the impact of decisions (UNECE 2005) Action competence approach (Jensen 2002; Mogensen and Schnack 2010) Effective decision-making skills (NEEAC 1996) Make their own choices for developing possibilities to act (Wals 2007) To make informed decisions and to develop the capacity and commitment to act individually and collectively (Stevenson and Stirling 2010)	
Community	Change-agent skills (Frisk and Larson 2011) New and productive relationships between students and teachers, between schools and communities (Wals 2007) Responsibility in creating communities different from the ones they inherited (Hart 1992)	

- *Complexity*: It is based on the culture of complexity, that is, students tackle their own understanding of problems/complex situations and look for relationships, interactions, different points of view and consider possible actions.
- *Critical thinking*: It encourages critical analysis through different perspectives, reflecting on conflicts of interest. This approach can range from the critical handling of information to the analysis of the complexity of situations and be aware of their role in society.
- *Actions*: They deal explicitly with the study of possible actions/solutions targeted at effecting real change regarding the environment, the analysis of student lifestyles, behaviour, decision-making and actions.
- *Community*: It involves the community, different members of the educational community (not just the students), or even groups outside the educational community, and uses an approach based on social change.

These criteria for analysis were taken from educational suggestions by reference authors where there exists broad consensus in the EE (see Table 2). However, it should be noted that these criteria may have different levels of achievement. All of them are fundamental pillars for the development of action competence, whereby we have provided examples that can help to develop this competence.

In the text revision process, we paid special attention to prominent ideas and proposals; that is, the data appearing in the titles, keywords and abstracts, as well as the relevant information from the full texts of the articles. Only information that appears in the text explicitly was taken into account for the analysis.

The information extracted from the articles was exported to Microsoft Excel 2014, where it was categorised and coded for its statistical descriptive analysis, to obtain percentages, tables and figures.

Characteristics of the researches[1]

Throughout the review process we have come across works with varied approaches and situated in diverse contexts; notwithstanding, we can identify a lack of research located beyond the so-called 'First World' (see Figure 1). Papers originating in Europe and North America represent 73% of the published papers. We have found a few studies from other contexts, such as Asia (Yavetz, Goldman, and Pe'er 2009; Karpudewan, Ismail, and Roth 2012; Gottlieb, Vigoda-Gadot, and Haim 2013; Lee et al. 2013), the African continent (Silo 2013), or Latin America (Schneller 2008), and only one case study involving different countries, in university settings from the USA, Netherlands, UK and Sweden (Sriskandarajah et al. 2010).We further wish to note the number of articles with a female first-named author, 65% of the total selection. This could imply an impulse towards a different perspective in EE, compared

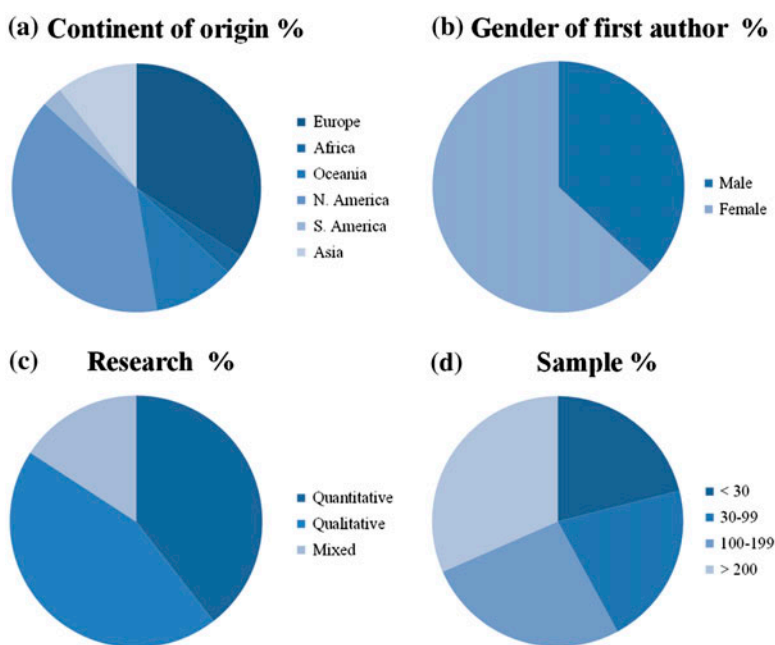Figure 1.   (a) Percentage of authorship (first author) by gender, (b) Percentage of researches by continent of origin, (c) Percentage of researches by type, (d) Percentage of researches by sample, (e) Percentage of researches by duration of educational action, (f) Percentage of researches by school setting, (g) Percentage of researches by object of study, (h) Percentage of researches by topic of educational action.
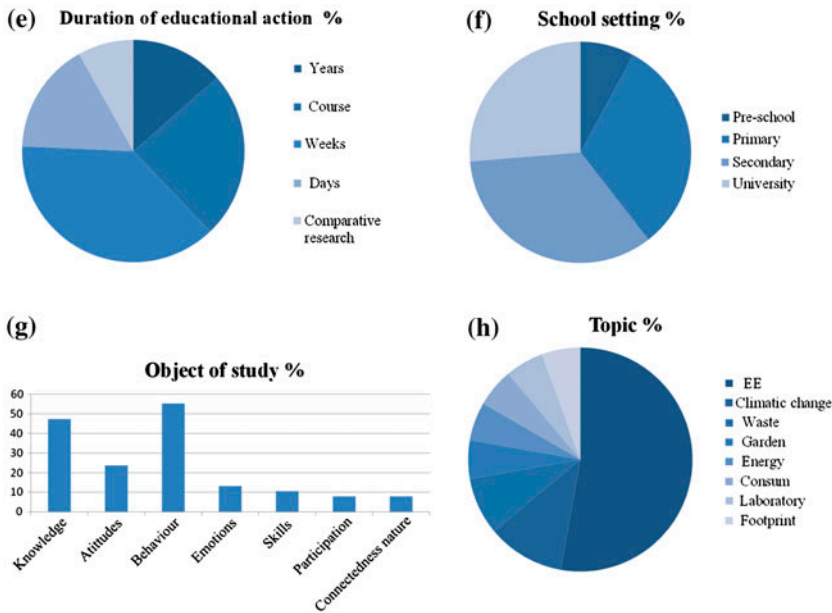
Figure 1.   (*Continued*)

with the androcentricity common to science in general (Hesse-Biber 2007; Gough 2013), although such an analysis falls beyond the scope of this review.

There is a clear interest in working with students at all educational stages (see Figure 1), but there is a lack of research focused on pre-school, despite many studies pointing to the importance of EE in the early years (LaHart 1978; Wells and Lekies 2006). We found only a few studies which included other community stakeholders (24%). The actual opportunity to study the role of schools as active, relevant agents in the development of the community has not been fully realised (Mogensen and Mayer 2005, Novo 2006; Vega and Álvarez 2012).

With respect to research design, in the past a lack of more interpretative, constructivist qualitative research has been identified (Hart and Nolan 1999; Rickinson 2001); however in the present review we have found a fairly equal distribution between qualitative and quantitative research (Figure 1). Quantitative studies share a similar design (see Table 3) varying in the object of study and statistical analysis. The qualitative studies have more diverse approaches and more open-ended results, which gives leeway for more creative research suggestions in the field (Robottom and Hart 1993; Wals and Heymann 2004; Hart 2013).

While quantitative studies are limited to the use of questionnaires, the qualitative and mixed studies selected use a large variety of data, with the majority using different types within the same work of research. These can be (adapted from Flick 2004):

(1) Verbal: mainly interviews (Cook 2008; Schneller 2008; Ballantyne and Packer 2009; Hadzigeorgiou et al. 2011; Harness and Drossman 2011; Porter, Weaver, and Raptis 2012; Schelly et al. 2012; Cutter-Mackenzie and

Table 3. Characteristics of quantitative researches.

First author	N	I	Instrument	Sources used in the instrument[a]	Reliability (α)	AC	AR	Object	Design study
Dimopoulos (2008)	332	32	Ecological Questionnaire	Dimopoulos and Pantis (2003)	0.72	NP		K, O (concern, locus control, commitment)	CG
Johnson (2008)	729	16	The Environment Questionnaire (TEQ)	ENV (Bogner and Wiseman 1999), NEP (Dunlap et al. 2000)		TT	FA	A	CG
Moseley (2008)	102	23	Environmental Education Efficacy Belief Instrument (EEEBI)	Science Teaching Efficacy Beliefs Instrument Form B (STEBI-B), Enochs and Riggs (1990), EEEBI (Sia 1992)	0.82 0.72	TT AN	CR	O (Beliefs: teaching expectancy, efficacy)	NECG
Carrier (2009)	109		Knowledge scale	Children's Environmental Attitudes and Knowledge Scale (Leeming et al. 1995).	0.59	AN		K, A, B, O (Comfort-level)	NECG
			Children's Attitudes Toward the Environment Scale	Children's Attitudes Toward the Environment Scale (Musser and Malkus's 1994)					
			Self-report behaviours test	Children's Environmental Attitudes and Knowledge Scale (Leeming et al. 1995).	0.82				
			Comfort-level instrument	Own development	0.69				
Nicolaou (2009)	12	16	Questionnaire	Hernandez et al. (2000), Korfiatis et al. (2004), Milfont and Duckitt (2004).	0.9	CH		O (Concern)	
Yavetz (2009)	214	66	Ecological literacy questionnaire	Yavetz and Pe'er (2002) Bradley, Waliczek, and Zajicek (1999) Morrone, Mancl, and Carr (2001), Schindler (1999)	0.81 (B) 0.86 (A) 0.78 (K)	AN TT	CR	B, A, K, O (Impact of studies, worldview)	
Johnson (2010)	6843	19	2-MEV Scale	2-MEV, (Bogner and Wilhelm 1996)	0.54–0.77	TT	FA	A, B, K	CG

Table 3. (*Continued*).

First author	N	I	Instrument	Sources used in the instrument[a]	Reliability (α)	AC	AR	Object	Design study
Teisl (2010)	800	15	New Ecological Paradigm (NEP)	NEP (Dunlap et al. 2000)			CR FA	A	NECG
Ernst (2011)	385	27	Children's Connection to Nature	Cheng (2008)	0.87	AN		O (Connectedness with nature)	
			Nature Connectedness Inventory	Mayer and Frantz's (2004) Musser and Malkus (1994)	0.73				
Rioux (2011, 2013)	150, 102	33	Brief Inventory of Values	BIV (Pilote 2006; Stern, Dietz, and Guagnano's 1998)	0.81–0.87		CR FA	K, B, O (Awareness, Emotional involvement)	CG
			Behaviour questionnaire	Own development (Rioux 2007).	0.82				
			Awareness questionnaire	Neighbourhood attachment scale (Bonnes et al. 1997);Rioux and Mokounkolo (2005)					
			Intention to act	Own development					
Darner (2012)	27	24	Motivation toward the environment scale (MTES)	MTES (Pelletier et al. 1998; Villacorta, Koestner, and Lekes 2003).		NP		O (Motivation)	
Karpudewan (2012)	263	23	New Ecological Paradigm (NEP)	NEP (Dunlap et al. 2000)	0.71	TT		A, B	CG
			Behaviour scale	Own development					
Porter (2012)	66	17	Post-Instruction Teacher Survey	Own development	0.84	AN TT		K	NECG
Skinner (2012)	310	56	Teacher-reports of Classroom Engagement	Classroom Engagement measure of students' participation (Skinner, Kindermann, and Furrer 2009)			FA	K, O (Motivation and engagement)	
			Garden learning outcomes test	Own development	0.88				
			Perceived competence	Student Perceptions of Control Questionnaire (Skinner, Wellborn, and Connell 1990)	0.73				
			Intrinsic motivation	Self regulatory Styles Questionnaire (Ryan and Connell 1989)	0.88				
			Autonomy orientation	Self-Regulatory Styles Questionnaire (Ryan and Connell, 1989)	0.85				

Author	N	I	Variable	Source		Analysis	Object	Design
			Academic Engagement Academic Self-Perceptions	Skinner, Kindermann and Furrer (2009). Ryan and Connell (1989), Connell and Wellborn (1991), Furrer and Skinner (2003)				
Fröhlich (2013)	176	32	Behaviour scale	General Ecological Behaviour Scale (GEB)(Kaiser, Oerke, and Bogner 2007)	0.85	TT	B, O (connectedness with nature, emotions)	CG
			Connectedness with nature	INS (Schultz et al. 2004)				
			Situational emotions	Gläser-Zikuda et al. (2005), Meissner and Bogner (2011)	0.73–0.93			
Karaarlsan (2013)	33	9	Daily need satisfaction scale (DNSS)	La Guardia et al. (2000), Darner (2007)	0.65–0.78		O (autonomy, competence, and relatedness)	
Gottlieb (2013)	130	66	Ecological worldview	NEP scale (Dunlap et al. 2000)	0.81	AN	B, O (Ecological worldview, personal norms)	CG
			Perceived behavioural control and behavioural intentions	Own development	0.79–0.91			
			Personal norms	Vining and Ebreo's (1992)	0.79			
			Proenvironmental behaviour	General Ecological Behaviour scale (Kaiser 1998)	0.88			
Lee (2013)	119	25	Questionnaire	Children's Environmental Attitudes and Knowledge Scale, (Leeming and Dwyer 1995).	0.80	AN	A, B, K	CG
Lieflländer (2013)	264		Inclusion of nature in self (INS) scale (no es likert)	INS, (Schultz 2002)		NP	O (Cognitive Beliefs, nature connectedness)	CG

Notes: N: Number of people sampled. I: Number of items (ignoring sociodemographic variables).
AC: Analysis of comparison of samples by TT = t-Test, NP = Non-Parametric Tests, CH= Chi-square tests, AN= Univariate/Multivariate Analysis of Variance/Covariance).
AR: Analysis of relationship among variables by FA = Factor Analysis, CR = Correlation/Regression.
Object: A= Attitudes, B = Behaviours and actions, K= Knowledge and understanding, O = Others.
Design study: CG = Control group, NECG = Non-equivalent Control group.
[a]The references for this sources are specified in the reviewed articles.

Edwards 2013; Karaarslan, Ertepınar, and Sungur 2013; Niebert and Gropengiesser 2013; Silo 2013) with the subjects themselves or with their teachers, but also group discussions (Karaarslan, Ertepınar, and Sungur 2013; Öhman and Öhman 2013);

(2) Observations (Ballantyne and Packer 2009; Karpudewan, Ismail, and Roth 2012; Skinner, Chi, and the Learning-Gardens Educational Assessment Group 2012; Niebert and Gropengiesser 2013; Ruiz-Gallardo, Verde, and Valdés 2013; Silo 2013) made by the researchers or by teachers;

(3) Student output, such as photos (Tsevreni 2011; Silo 2013), drawings (Cook 2008; Silo 2013), reports (Nicolaou et al. 2009; Karaarslan, Ertepınar, and Sungur 2013), portfolios (Lee et al. 2013), stories (Hadzigeorgiou et al. 2011; Tsevreni 2011) or writings (Balgopal and Wallace 2009)

(4) Academic success (Tsevreni 2011; Arreguín-Anderson and Kennedy 2013; Ruiz-Gallardo, Verde, and Valdés 2013); or

(5) Digital data (Arreguín-Anderson and Kennedy 2013; O'Gorman and Davis 2013).

The type of data analysis employed in the qualitative studies, however, is not always specified and content analysis and coding methodology is common (Kumler 2010; Harness and Drossman 2011; Arreguín-Anderson and Kennedy 2013; Karaarslan, Ertepınar, and Sungur 2013; Lee et al. 2013; O'Gorman and Davis 2013). Other methods include metaphor analysis (Niebert and Gropengiesser 2013), pragmatic discourse analysis and epistemological movement analysis (Öhman and Öhman 2013). Some papers subject their coded data to a statistical analysis (Schneller 2008; Kumler 2010; Ruiz-Gallardo, Verde, and Valdés 2013). To further validate their procedures, some studies use different types of triangulation (Schneller 2008; Kumler 2010; Arreguín-Anderson and Kennedy 2013; Karaarslan, Ertepınar, and Sungur 2013) or consult experts in the field (Nicolaou et al. 2009; Porter, Weaver, and Raptis 2012; Niebert and Gropengiesser 2013).

Quantitative research makes it possible to mainstream results and reach conclusions regarding different factors involved in the EE teaching and learning processes, such as the role of the teacher (Teisl et al. 2010) or of feelings (Fröhlich, Sellmann, and Bogner 2013). It also contributes to the long-term effects of education (Darner 2012; Rioux and Pasquier 2013). However, it is necessary to point out that qualitative and mixed studies, which fall within the interpretative and sociocritical paradigms, have turned out to be more valuable for carrying out research on the development of action competence. These studies use educational strategies (see Figure 2) that largely correspond to the conditions recommended (such as participation or critical thinking). Additionally, they evaluate aspects that are difficult to tackle through research that is exclusively quantitative, such as reflection on mental models (Niebert and Gropengiesser 2013), participation (Silo 2013) or resilience (Sriskandarajah et al. 2010). Likewise, they interpret the results openly; making it possible to know what is taking place in the government processes of students in the participative strategies (Öhman and Öhman 2013) or how students perceive the transfer of knowledge to their everyday life (Karaarslan, Ertepınar, and Sungur 2013).

Regarding the object of study (see Figure 1), the researches especially address aspects related to behaviour. In this sense, as Wals et al. (2014) note that initially much research in EE focused on the effectiveness of EE activities in changing

(a)

(b)

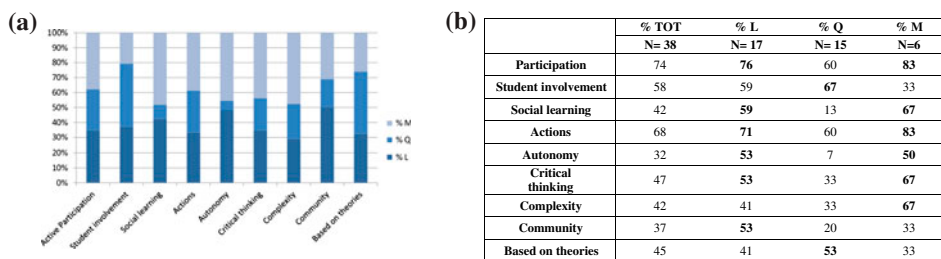|	% TOT	% L	% Q	% M
	N= 38	N= 17	N= 15	N=6
Participation	74	**76**	60	**83**
Student involvement	58	59	**67**	33
Social learning	42	**59**	13	**67**
Actions	68	**71**	60	**83**
Autonomy	32	**53**	7	**50**
Critical thinking	47	**53**	33	**67**
Complexity	42	41	33	**67**
Community	37	**53**	20	33
Based on theories	45	41	**53**	33

Figure 2. (a) Comparison of the percentage contributed by each type of study to the total researches that worked these aspects in their educational proposals, (b) Percentage of studies by their type (total/qualitative/quantitative/mixed) that worked these aspects in their educational proposals.

Notes: *N*: number of studies, TOT: total studies, *Q*: quantitative studies, *L*: qualitative studies, *M*: mixed studies.

individual environmental behaviours, based on the ill-founded assumption of there being a simple linear relationship between knowledge, awareness, attitude, and environmental behaviour, but this has been revealed to be a too simplistic explanation of what affects people's actions. In this study we found works that deal with this approach (47%), but they also look into new factors such as the relationship with interests, commitments, beliefs, worldviews, emotions, language or culture, which may help us to understand the responses of people to environmental problems (Stevenson and Stirling 2010).

We find measurements of classic variables associated with behaviour, such as behavioural intention. Another important issue in this regard is the possible relationship between intentions and behaviour. Some authors, like Gifford (2014b), doubt that pro-environmental-reported behaviour matches current behaviour particularly well. Certain researches included in this review measured real variables, such as energy consumption or battery collection. But, such measurements are limited to very specific situations, so it is not possible to extrapolate the results to other contexts.

We also found research that studies other objects like adopting the decision to take action, or the ability to act, which are more fitting with action-focused EE, since as Mogensen and Mayer (2005) indicate, its evaluation should be related to the willingness and ability of students to form their own criteria, make decisions and choose a consequent action.

According to Wals et al. (2014), progress in the field of EE leads us to research focused on the understanding of the learning processes and the capacities of individuals and communities needed to help resolve complex socioecological issues. Thus, six of the selected studies focus on learning conditions, especially in the role of teachers, and 15 of them evaluated, in one way or another, the development of capacity, including basic skills for action competence, such as participation or decision-making.

The duration of the studies is also important. Most of them compare data from before and after the educational action, and in some case researchers launched their study after the implementation of a successful proposal (Schelly et al. 2012). We have found only six works that study this impact in the longer run, with the implications that this entails for results evaluation of learning and persistence.

Practical applications of theoretical approaches

Theories represent a key pillar in the substantiation, design and interpretation of findings of EE research. Throughout this review we have come across papers focused on theory-driven applications. Out of the works reviewed, 45% used theories to explain or to build their research, and seven of the studies paid particular attention to this topic. Among these, we have found a variety of approaches. Some of these use the theories of behaviour most often found in EE, such as the theory of planned behaviour (Ajzen 1988, 1991), or the behavioural change theory (Bandura 1977). These studies, with a classical psychological appsroach, are still deal with the relationship between knowledge, attitude and behavioural intention. Thus, these theories can serve as a basis for evaluating the effectiveness of environmental learning programs in a variety of settings, as Johnson and Manoli (2008, 2010) does with Bogner and Wiseman's Model of Ecological Values (2003).

In contrast, other studies stem from new frameworks that can help to lay the groundwork for an EE. These studies focus on exploring the links with key aspects of changing lifestyles such as motivation or skills development (Heimlich and Ardoin 2008). In this respect, attention is drawn to three papers that deal with the use of the self-determination theory (Deci and Ryan 1985, 2000). Skinner, Chi, and the Learning-Gardens Educational Assessment Group (2012) worked on a model of intrinsic motivation and engagement from this theory in garden-based education. They evaluated an environmental program based on tasks with active ingredients (holistic, integrated, hands-on, project-based, cooperative, experiential learning activities) in a US middle school. Their results showed patterns of positive and significant correlations with potential academic outcomes such as learning and achievement, and with other important outcomes such as engagement in science and school, and academic self-perceptions. Darner (2012) also studied in the US the effect on college students of a Biology course guided by the self-determination theory. Her study seems to suggest that students in the theory-guided course experience less amotivation than students in the comparison section. Both findings seem to show that this theory can provide a useful foundation for the empirical exploration of the motivational impact of environmental educational programs (Skinner, Chi, and the Learning-Gardens Educational Assessment Group 2012). In Turkey, Karaarslan, Ertepınar, and Sungur (2013) used the self-determination theory to support the basic psychological needs of pre-service science teachers in an environmental science course. As an educational strategy, they used a case study related to their local environment and their daily life situations. Their analysis revealed significant gains: positive relation between autonomy and competence, sense of confidence in action or collective generation of ideas.

In the review process we also found other approaches stemming from more innovative theoretical perspectives centred on cultural, linguistic and ethnic aspects (Stevenson et al. 2013). Silo (2013) found that the cultural historical activity theory can help improve student participation, while Arreguín-Anderson and Kennedy (2013) worked within the critical Latino theory and critical race theory (Delgado 1995), identifying a strong connection between students' cultural background and the development of environmental literacy. Niebert and Gropengiesser (2013) helped students to understand complex problems through Lakoff and Johnson's theory of metaphor (Lakoff and Johnson 1980). Hadzigeorgiou et al. (2011) also uses a theory linking language and cultural history (Kieran Egan's theory) (Egan 1997) to give

meaning to the effectiveness of an educational proposal based on storytelling for teaching kindergarten children. These papers recognise the importance of language and discourse in EE, all too often an invisible agent, shaping and structuring theories and practices, visions, and actions (Berryman and Sauvé 2013).

Characterisation of educational proposals and their contributions to EE

To characterise the educational proposals we have focused on three categories: role of students that is promoted, educational practices and conditions posed and factors related to learning in EE:

Role of the students

We have come across a clear tendency to promote active participation and student-centred (97%) practices. Only one author studies the long-term effect of an awareness-raising campaign (Rioux and Pasquier 2013) and the conclusions recommend giving priority to cross-curricular education, which in itself would represent a change from other more traditional styles of teaching.

We have also observed a strong desire by researchers to connect with the interests and needs of students from the earliest stages. Of all the studies reviewed, 58% tried to improve their involvement in environmental programs through their emotions, interests, beliefs or worldviews, because, as stated by Vosniadou (2001), learning requires the active and constructive involvement of the learner.

With regard to social learning, it is worth noting that 46% of the proposals state that they organise the students into groups. However, only half of them really mention working cooperatively or creating apprentice communities. All these aspects are of interest for analysing the actual participation of students in the proposals.

Educational practices and their contributions to EE

It is clear that researchers prefer to carry out proposals based on real issues (97%), through outdoor experience, experiential learning or issue-based learning.

Rickinson (2001) had previously reported the benefits of Outdoor experiences. Researchers seem to follow this pattern; throughout this review we found that almost 30% of the papers are based on place-based learning in outdoor settings. Such practices could be particularly beneficial to some groups. Carrier (2009) showed that outdoor environmental strategies can improve the results of boys, and Ruiz-Gallardo, Verde, and Valdés (2013) and Skinner, Chi, and the Learning-Gardens Educational Assessment Group (2012) demonstrated its benefits with at risk students. Two of the reviewed researches (Ernst and Theimer 2011; Liefländer et al. 2013) study the effect of such methodologies for connecting with nature, highlighting its relationship to environmental concerns and promoting sustainable behaviour (Schultz 2002; Frantz et al. 2005). Both studies achieved significant results, especially among younger students. It also appears that emotions are an important factor to consider in this type of proposal. Cook's work (2008) shows that students' affective engagement with the field of the environment is influenced by values, ideologies and an implicit concern. Fröhlich, Sellmann, and Bogner (2013) underline the influence of situational emotions on the intention for sustainable consumer behaviour after a student-centred intervention in an outdoor experience.

Stern's recent review (2014) on EE program evaluation highlights the use of experiential learning for EE, recognising its value for EE (Crew 1987) and also for the development of action competence (Mogensen and Mayer 2005). The successful EE actions discussed here use experiential learning for a number of reasons: to increase pro-environmental attitudes and behaviours (Schneller 2008); to impulse action (Tsevreni 2011) or to work on the resilience of communities (Sriskandarajah et al. 2010). Cutter-Mackenzie and Edwards (2013) also showed its usefulness in kindergarten. They connected experience, knowledge and values as a basis for becoming knowledgeable about the environment. Of special interest in this regard is Ballantyne and Packer's (2009) comparative study. They found that experiential learning provides the most engaging, effective, and enduring learning experiences, while allowing integration within classroom strategies that can also be carried out within the confines of the school grounds.

Another characteristic common to many of these proposals is an integral, inter-disciplinary approach (31%), often focused on a comprehensive vision of an issue/problem and its possible solutions (23%), using projects (12%) or case studies (9%).

There are also studies that consider the benefits for EE of different educational techniques, such as storytelling. Hadzigeorgiou et al. (2011) showed their potential as a cognitive tool, and in improving the intention to participate in pro-environmental activities. Tsevreni (2011), also through storytelling along with other techniques, developed an action model without scientific knowledge that caused children to gain self-confidence regarding their right to express their opinion, to become more involved in the community and to be further emancipated. And Balgopal and Wallace (2009) improved the environmental literacy of their students working with essays about dilemmas.

The usefulness of ICT stands out, not only in collecting information for research projects, but also as an educational tool. Nicolaou et al. (2009) showed how on-line research and interactive learning can contribute to the development of decision-making skills. Gottlieb, Vigoda-Gadot, and Haim (2013) demonstrated the use of the ecological footprint calculator in encouraging ecological behaviour, stressing the connection between environmental problems and the critical examination of social, economic, political, and behavioural issues. The calculator has the potential for developing an interdisciplinary, holistic science which teaches relevant decision-making skills. O'Gorman and Davis (2013) showed its further use in recalibrating personal resource consumption.

Three papers look at the role of EE in inclusion, specifically with 'at risk' students. Through garden-based learning, Ruiz-Gallardo, Verde, and Valdés (2013) improved academic outcomes and personal behaviour learning, while Skinner, Chi, and the Learning-Gardens Educational Assessment Group (2012) increased student engagement and self-perception. Harness and Drossman (2011) demonstrated how producing environmental videos might enhance environmental literacy. These studies give us examples of how EE, in addition to providing a holistic education, can contribute to current educational problems.

Factors related to learning in EE

Of particular interest are the research papers that look at factors related to learning in EE, framed within the context of their respective research projects. We looked at examples that focused on common-place factors such as gender (Carrier 2009) or

age (Ernst and Theimer 2011; Liefländer et al. 2013). Also, the educational choices seem to be a factor that influences the effect of the environmental proposals. Liefländer et al. (2013) examined differences in the connection with nature of a sample of German children of different ages (9–10-year-old pupils and 11–13-year-old pupils) and academic tracks after an environmental education program on water. They found that younger children and university-track pupils had higher connection scores than older children and general-education-track pupils, respectively. Kumler (2010) compared the types of actions science and social studies students see as salient in the context of sustainable land use. Specifically, she examined how knowledge outcomes might differ between US high school science and social studies students after an EE curriculum intervention. Her results indicated that science class students compared to social studies, showed less diverse knowledge of actions in support of sustainable use.

In the review process we also found research focused on the role of the teacher. Teachers are a key factor for improving the teaching and learning processes. Porter, Weaver, and Raptis (2012) studied which conditions (NGO-directed or teacher-directed) lead to better a understanding of climate change. She concluded that the teacher-based setting resulted in significantly higher knowledge gain. Teisl et al. (2010) also showed that student environmental attitudes did change in different directions depending upon who taught a course.

It would be interesting to complete these results by studying the influence of factors such as the training or methodology used by the educators, for previous studies show the insecurity and low level of knowledge of teachers regarding the environment or of teaching strategies in the field of EE (Forsthuber, Motiejunaite, and de Almeida Coutinho, 2011; Forbes and Davis 2008). In this review we have also found some evidence of this problem. Thus, Yavetz, Goldman, and Pe'er (2009) compared the environmental knowledge of pre-service teachers in Israel at the beginning and end of their studies. Their work shows the deficiencies of university studies regarding knowledge of the environment and the achievement of environmentally responsible behaviour patterns.

However, we have come across proposals for improving some of these educational weaknesses. Thus Moseley and Utley (2008) improved their environmental teaching outcome expectancy through the application of a Globe curriculum based on interdisciplinary Hands-on learning, albeit he was not able to improve his confidence in his ability to teach this subject. On the other hand, Arreguín-Anderson and Kennedy (2013) managed to increase the importance of language and culture in the teaching of EE for the development of environmental knowledge among teachers in training with an educational proposal based on an interdisciplinary wild life conservation program.

Developing action competence

All these educational proposals make contributions towards achieving action competence. Nevertheless, it is necessary to highlight those which explicitly show approaches that help to educate citizens to be able to adopt informed decisions and act to solve present-day and future problems in a democratic manner. In this regard, the development of this competence requires approaches that foster participation, reflection, critical thinking and the involvement of the community (Mogensen and Mayer 2005), as can be seen from the following examples:

Participation

As we have already stated, throughout this review we have come across a clear tendency to promote active participation or student-centred practices. However, the development of action competence requires a wider approach to the term 'participation', where students are truly involved in the teaching and learning process (Hart 1992; McCallum, Hargrieves, and Gipp 2000; Mogensen and Schnack 2010). In this regard, Silo (2013) examined how Botswanese children participated in the primary school's environmental management activities and his study revealed a lack of dialogue between teachers and children; the teachers tended to view children's participation in environmental management activities in a very limited way. Schelly et al. (2012) also highlight communication as a basic pillar for the process. They studied the case of a large public high school in the US, which managed to encourage an energy conservation culture. They found that giving staff members and students an ownership in and responsibility for participating in decisions made throughout the school enhances efficacy, and a sense of efficacy has been found to differentiate those who act in response to their environmental concern and those who do not in both an individual and group context. This evidence seems to indicate the need to encourage proposals where all the members of the educational community, especially the students, have the power to express their opinion and where they are given the chance to make decisions. However, only 15% of the works reviewed explicitly state that the students participate in the adoption of decisions.

Another basic pillar for participation has to do with peer interaction; 46% of the proposals state that they organise the students into groups, which could favour social learning and a socially constructed nature of knowledge (Lave and Wenger 1991; Wals 2007). However, only half of them really mention working cooperatively or creating apprentice communities.

The proposals reviewed here encourage participation through different strategies, such as: games in pre-school (Cutter-Mackenzie and Edwards 2013), virtual learning communities (O'Gorman and Davis 2013) or the development of experiences (Tsevreni 2011). Rickinson (2001) states that this approach can be particularly useful when implementing methodologies based on dilemmas and debates. Öhman and Öhman (2013) analysed a participatory approach in a Swedish upper secondary school about climate change through student discussions. Their analyses show how students can cooperatively improve the understanding of a complex environmental problem. But as other authors defend (Cooke and Kothari 2001; Wals 2010), not all are advantages. Accordingly, Öhman and Öhman (2013) also state that participatory approaches do not necessarily mean that knowledge becomes more diverse, and that teachers must pay attention to governing processes among students and occasionally challenge the common view in order to allow for alternative possibilities and outlooks.

In addition to improving cognitive learning, participation can also contribute toward the acquisition of democratic values. Mackey (2012) addressed the development of these values in a study carried out in New Zealand. She explored the research data as a platform for discussion on protecting and promoting kindergarten children's rights to participate in acquiring and sharing knowledge, making decisions and taking action. Children in the study were able to demonstrate their ability to comprehend concepts and issues, often seeking out adults for more information and guidance. She suggests that listening to the children's voices and hearing their con-

cerns allows for a more open exploration of issues that are relevant to their lives. Tsevreni (2011) also relates participation and involvement. Her study focused on environmental education without scientific knowledge in an urban context. The study showed that children were conscious of their exclusion in the city because they didn't participate in decisions and they could not move freely. Through cooperative work and promoting critical thought and imagination, children gained self-confidence regarding their right to express their opinion and demand, thus promoting children's emancipation and involvement in the community.

A reflection on the complexity of environmental issues

To introduce the culture of complexity in EE involves the actual understanding of problems/complex situations and paying attention to the relationships and processes and not just to the result. It involves building our own representation of the world taking into account the different points of view and interests and the environment-society-economy relationships (Mogensen and Mayer 2005; Corneya and Reid 2007). In other words, it requires an initial personal reflection that makes it possible to obtain a global view of the situation, as a starting point to analyse and provide solutions to the different environmental situations. Therefore, 49% of the studies reviewed deal with the complexity of the environmental problem, 31% explicitly state that they do so from an interdisciplinary or globalised approach.

The analysis of complex environmental problems through a holistic view enables students to understand the difficulties in order to try to solve them (Mogensen and Mayer 2005; NEEAC 2005; UNECE 2005). Eight studies in this review deal specifically with environmental problems. The majority (Balgopal and Wallace 2009; Harness and Drossman 2011; Darner 2012; Porter, Weaver, and Raptis 2012; Niebert and Gropengiesser 2013; Öhman and Öhman 2013) use a participative methodology based on social learning and communication and all of them achieve a better understanding of the problem. The work by Niebert and Gropengiesser (2013) in this respect is worth highlighting. They gave students access to their metaphorical conceptions and let them reflect on their mental models about a complex and abstract environmental phenomenon. This re-experiencing and reflecting helped students to understand climate change. These works not only show the effectiveness of these approaches for improving understanding, but also their relationship with the acquisition of basic skills for the development of a competence for future action. In this way, Balgopal and Wallace (2009) increased their students' ecological education and related it with their ability to recognise dilemmas and potential decisions (and their ecological consequences). Harness and Drossman (2011) point out that students more readily adopt environmentally responsible conducts when provided with opportunities to develop their own understanding of connections between personal actions and associated environmental consequences.

It is also important to understand the relationship between environment-society-economy and the conflicts of interest they involve. We have found examples of how educational proposals can make these relationships explicit and how they can be beneficial for the EE process. Thus, Karpudewan, Ismail, and Roth (2012), through activities focused on economic and societal aspects of the experiment/activity to the local and global community, obtained statistically reliable changes in environmental attitudes and in self-reported environmental behaviours. Gottlieb, Vigoda-Gadot, and Haim (2013) used the ecological footprint to bridge the gap between natural sciences

and social disciplines, dealing with the connection between environmental problems and the critical examination of social, economic, political, and behavioural issues. Through this approach, they obtained significant results related to personal norms and behavioural intentions. And Darner (2012) obtained positive results in increasing environmental self-determined motivation through an action training in which students were given opportunities to discuss the how and why of certain behaviours and their likely effectiveness, addressing the problems from both scientific and social aspects.

Critical thinking

In a globalised world where ideology and neo-liberal economic thought prevail, a world characterised by an avalanche of information that is difficult to analyse, the development of critical thinking is fundamental for educating citizens who are committed to the environment and to people. This way of thinking is understood to be related with the efficient use of skills for informed decisions (Kincheloe 2008). It is necessary to have proposals that specify and analyse in a critical way the complexity of the environmental problem and how economic and socio-cultural factors influence the life-styles of communities (Uzzell and Rathzel 2009). Furthermore, they must also acknowledge the different positions and values that guide human behaviour towards the environment (Elliott 1995). Critical thinking must be combined with the language of possibility, to join the critical process of reflection and inquiry with an empathetic and optimistic vision of potential, a search for solutions, and a positive direction (Mogensen and Schnack 2010).

In this review we have not come across any articles dealing specifically with the handling and critical analysis of information, although the approaches they use, generally, require the use of this competence. Harness and Drossman (2011) worked with their students on a film-making project and regarding the sources of information, they highlighted students' construct knowledge about the environment through social processes that include interrelated influences from school, family, and the media. This clearly pinpoints the need to assist students to interpret and analyse information, not only that provided in education centres, but also the one they receive from other areas of their daily life.

In general, the articles reviewed reveal a critical approach towards the situation and its relation to personal, business, political and institutional decisions, but only 42% specifically says they encourage critical thinking in some way and none specifically values its achievement. This could perhaps be due to the difficulty to assess it. In spite of this, we have found examples of how the inclusion of critical thinking can be beneficial for EE. The educational intervention of Ruiz-Gallardo, Verde, and Valdés (2013) achieved an increase in students' academic success. They did it through a garden-based project where their students started to spontaneously formulate questions and compare activities and results, thus fostering critical thinking. Dimopoulos, Paraskevopoulos, and Pantis (2008) also saw an improvement in locus control, understanding and concern through a program that uses values clarification and critical thinking.

The development of critical thinking also involves a reflexive approach to the social-environmental problem and to the relations between the different acting agents. Therefore, the proposals described in the previous sections make valuable

contributions to this theme, especially those that deal with dilemmas and debates (Balgopal and Wallace 2009; Öhman and Öhman 2013).

Equally interesting are those proposals that show students their role in environmental problems in a critical way. Sriskandarajah et al. (2010) reported four cases where learners confront their epistemic beliefs as they reflect on the connections of their own personal experience matters with the behaviour of systems of which, as learners, they are component parts. Karaarslan, Ertepınar, and Sungur (2013) also showed that if students are aware of their role in the system both as problem creators and solvers, they could feel more competent to find solutions (Darner 2007). With this same approach, Harness and Drossman (2011) state in their study that students more easily adopt responsible behaviour towards the environment.

Actions based on independent decision-making

The development of a competence for individual and collective action requires prior critical and collaborative reflection on lifestyles and environmental problems. The result is the adoption of decisions towards people and the environment that are informed, participative and responsible. Many authors agree that a crucial feature in EE is that the students participate in decision-making processes (Hart 1992; McCallum, Hargrieves, and Gipp 2000; Mogensen and Mayer 2005), which can help to improve cognitive processes and prepare individuals for a democratic life (Dewey 1916).

Of the articles reviewed, 32% attempt to develop skills that encourage the analysis of student lifestyles, autonomy or decision-making. These approaches seem to influence the acquisition of knowledge, attitudes and behaviours related to EE. Thus, Johnson and Manoli (2008, 2010) achieved statistically significant changes toward more pro-environmental perceptions, using an environmental program designed to help students construct ecological understandings, develop positive feelings for the natural world, and make choices about their personal environmental behaviours and actions. Lee et al. (2013) used conceptual and procedural knowledge for building an energy-saving house through hands-on learning activities. They also encouraged their students to consider how they could develop strategies for reducing energy consumption in their homes. They obtained positive effects on students' knowledge, attitudes, and behaviour, referring to this issue.

However, there are few examples that include the evaluation of these capacities (reflection on students' lifestyles, autonomy or decision-making). In Cyprus, Nicolaou et al. (2009) evaluated the effectiveness of a series of computer-based learning activities that provide appropriate scaffolding to 11–12 years old students in developing decision-making skills. They used a Web-Based Inquiry Science Environment, which supports student inquiry and interactive learning, allowing them to search easily for the necessary information, keep track of their steps in the overall workflow, take notes, and communicate with others (Linn, Clark, and Slotta 2003). The teaching intervention proved quite successful in enhancing the decision-making skills of the participating children. Moreover, students' performance on the environmental concern questionnaire correlated with the improvement of the decision-making skills. Their results indicate that students were able to apply what they learned in unfamiliar contexts, as the test was specifically used to isolate the effect of the learning intervention by using a different context. O'Gorman and Davis (2013) also used the ICT tools to provide opportunities to recalibrate personal

resource consumption, in this case with pre-service teachers in Australia as part of a strategy for learning about sustainability. They explored the possibilities of trans-disiciplinarity such that the arts would provide a new lens through which to examine the sustainability problem. They concluded that the use of an ICT tool such as this, combined with a critical stance to education and curriculum integration may have a profound impact on future teachers' emerging understanding of and commitment to sustainability. Karaarslan, Ertepınar, and Sungur (2013) used a case study related to their local environment and their everyday life, where students had the opportunity to analyse their role in the system. They obtained significant benefits: a positive relationship between autonomy and competency, a sense of confidence in action and collective construction of ideas.

Getting the community involved

School can provide an opportunity to help in developing sustainable lifestyles leading to communities that are fairer and environmentally responsible, but this requires that the educational actions become involved with the community, that they include group actions, seeing students as transforming agents and that they transfer the knowledge acquired in the classroom to their real life.

However, the studies reviewed do not seem to be sufficiently ambitious in this respect. Only seven of the studies reviewed include, besides the students, other members of the educational community, therefore losing the possibility of studying the effects of the actions in a wider context. Only 34% of the works reviewed involve boosting changes in the community. They refer, consequently, to students as agents of change or of benefits and applications for the community.

Transforming a community requires group actions; however Kumler (2010) points out in his study that students tended to know and undertake individual rather than collective actions. This seems to indicate the need for educational proposals that have a bearing on this aspect.

Of special interest is the research by Schelly et al. (2012) who studied the case of a large public high school in the US, which managed to foster an energy conservation culture. Their conclusions highlight that the success of the enterprise is due to cultural modelling, and that conservation and education can have a synergistic relationship. In this regard, Schneller (2008) also contributes through experiential and service learning approaches. In the short-term, their course participants acquired a heightened awareness of environmental issues, augmented their environmental perceptions and consciousness, and complemented all this with environmentally responsible behaviours. Two years later, their students retained pro-environmental attitudes and behaviours and unexpectedly exhibited an expanded role in intergenerational learning. Sriskandarajah et al. (2010) illustrate the learning potential of experiential learning to improve the relations between the socio-ecological system. Their case studies on the resilience of learning systems in universities in the USA, Netherlands, UK and Sweden highlight the role that experiential learning strategies can play in transforming the relationships that people have with nature through their own personal and shared processes of transformative learning. They show how service learning takes place through a cycle of action and critical reflection as students work with others to apply classroom learning to community problems and then reflect upon their experience to achieve the community's objectives and deeper understanding and skills for themselves (Eyler and Giles 1999).

Conclusions and challenges

This review, focused on EE research carried out in formal contexts, makes it possible to indicate certain advances in the field of EE during the past few years. From the educational sphere the development of action competence can be strengthened through critical thinking, autonomous decision-making, participation, and the interrelation between schools and communities (Mogensen and Mayer 2005). This generates the establishment of learning communities for action, which are essential elements for change. Thus, the results from the research reviewed have revealed valuable contributions that require greater attention from educators and researchers in order to improve the development of action competence:

- Educational proposals that show the complexity of environmental issues are necessary. For this reason we must address this problem by highlighting its different dimensions and interrelations, where the scientific, economic, and social aspects are particluarly relevant.
- Opportunities should be provided to reflect on these issues through critical thinking, transforming information into knowledge, analysing environmental problems from different angles. The actual role of people in these issues and the influence of the socio-cultural and economic factors on their lifestyles should be shown.
- Action should be based on independent and informed decision-making, so that it can assist in the transfer of knowledge to the different contexts and to recalibrate our every day actions. ICT tools can be helpful here.
- Educational proposals based on dialogue and real participation help to foster involvement, to acquire democratic values and to create a culture of sustainability. This requires that students (and others members of the community) build knowledge collaboratively, that they can express their opinions and participate in the decision-making process. Therefore, interaction with the community and collective actions must be encouraged from the school, helping to create committed groups and networks which can maintain sustainable conditions and lifestyles whilst building knowledge. Experiential learning seems to have great potential for improving the relationship between the social-ecological systems.

Moving forward in the field of EE implies also following new paths. This review has revealed the need for:

- Including realities from outside the 'First World', involving all members of the community and studying the long-term effects of educational proposals.
- Fostering interpretative and socio-critical research, with creative visions in their approach and interpretation of results, involving objects of study that reflect the complexity of human actions.
- Promoting research focused on the development of capacities and skills and on learning conditions that especially study the role of students and teachers (including their training or the methodology/approach that they use in the processes)
- Carrying out research and making educational proposals that base their designs and evaluations on theories. They should use approaches that aim to educate

autonomous and responsible citizens, without dismissing contributions from classical paradigms, such as the theory of self-determination (Deci and Ryan 1985, 2000), and those that use innovative perspectives focusing on cultural, ethnic, and linguistic features, which can help us to understand their actions and lifestyles.

We should also note that in carrying out this review we have highlighted what we consider to be the most relevant points for action-focused EE and in doing so, some aspects inevitably fall beyond our scope. We should further note that the restriction of our sources to two journals imposes another limitation. These journals were chosen for their trend-setting status in EE research and practice. However, it is clear that the present analysis and results have been moulded by the foci and preferences of these journals. It is also worth noting that the type of sample chosen only allows exploring trends and challenges.

Without doubt, after four decades of EE research, it is evident that we still have a long way to go and that an action-focused EE is still faced with many challenges. We concur with Gough (2013) in asserting the importance of reflexivity in the practices of environmental education researchers, who must open up new avenues for recognising the workings of power in the ways we construct our world and its possibilities, and toward developing more effective social change practices (Lather 1991). We are moving toward a world where globalisation is ever increasing; economically, socially and environmentally. Environmental problems do not tend to respect borders; thus we must develop studies in diverse contexts and global educational approaches aimed at promoting sustainable lifestyles as part of action competence.

Finally, we would like to stress that this work hopes to become a point of reference in developing educational proposals which encourage action-focused EE in formal contexts. We want to contribute to a transition towards schools and communities which are informed and aware of the socio-environmental deterioration of our planet, and take action individually and collectively. It is not possible to know how citizens will act or what problems they will be faced with. The only thing that can be done from the school is to set the bases for their future action; that is, to be in charge of the development of competences that can help them make sustainable decisions in a democratic way.

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Note

1. In this section the most important characteristics of the investigations are described. The results allow only the exploration of trends in the field of research proposals in formal EE contexts.

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