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# What kinds of knowledge, knowing and learning are required for addressing resource dilemmas?: a theoretical overview

*Chris Blackmore* *

*Open Systems Research Group, Systems Department, Faculty of Technology, The Open University, Milton Keynes MK7 6AA, UK*

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ABSTRACT

This paper considers what kinds of knowledge, knowing and learning are required for addressing resource dilemmas in the context of sustainable development. It also explains why and how the SLIM project focused on *social learning* for managing water resources. The range of learning theories that informed SLIM are discussed, as is the historical pattern of lineages, relationships and discontinuities among these and other theories. Whilst conceptions of social learning are contested, most perspectives raise questions about the nature of knowledge and knowing. It is argued that becoming aware of our assumptions regarding learning, knowing and how we develop knowledge, can help us find out more about what we need to know.

The nature of resource dilemmas, implications for learning, what learning involves, its interdisciplinary nature and its history of ideas are all considered. An overview of learning theories is given, explaining their potential relevance for researchers, policymakers and practitioners in environmental contexts. The discourse, theory and practice of social learning and factors that influenced the choice of social learning theories by SLIM researchers are discussed. The paper concludes by considering how understanding what social learning involves can contribute, in a practical way, to dealing with resource dilemmas.



## 1. Introduction

Resource dilemmas arise when there are competing claims on the use of natural resources (Röling and Woodhill, 2001; Röling, 2002; SLIM, 2004a). These dilemmas can be about resources that are water, air or land-based or involve management of wastes, biodiversity or even light or noise pollution, depending on what is counted as a natural resource. Resource dilemmas should ideally be contextualised by the idea of sustainable development, where social, economic and environmental issues have to be brought together in decision making and action to meet current needs, without compromising the ability of future generations to meet their own needs (WCED, 1987). Sustainable development is a contested idea that has many different interpretations and responses but all proponents of it agree that it requires society to change (Hopwood et al., 2005). What and how stakeholders in a situation need to change, what they need to know and hence what they need to learn to resolve a resource dilemma, varies from one situation to another but there are some common principles (see below).

In this paper I have differentiated knowledge, knowing and learning because most theoretical perspectives on learning raise significant questions about the nature of knowledge and our processes of knowing and each has a role in addressing resource dilemmas. Distinctions of knowledge, knowing and learning and the relationships among them are contested, bringing into question which theories are used to explain these terms in a particular situation. Knowledge as in 'a body of knowledge' can be synonymous with information or understanding. It can also refer to a state of knowing but

* Tel.: +44 1908 653585; fax: +44 1908 652175.
E-mail address: c.p.blackmore@open.ac.uk.
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there are different ways of knowing with different degrees of rationality ranging from scientific and philosophical to more intuitive and innate. Knowledge might be learned or directly perceived. There are many theories about what enables us to know or to develop knowledge. There is also a wide range of ideas coming from many different disciplines, about what constitutes learning. Why do these distinctions matter in the context of addressing resource dilemmas? I will argue that becoming aware of our assumptions about how we learn and know and how we develop knowledge can help us to find out more about what we need to know and the possible limits of knowledge and knowing.

My starting point will be to discuss the nature of resource dilemmas and what this implies for what is required to address them. A brief overview of learning theories and an account of their development is then given. Of the many theories of how learning happens or can happen, some are more relevant to the contexts of resource dilemmas and sustainable development than others. The SLIM project approach, presented in this and other papers in this issue, has focused on a particular kind of 'social learning' as most relevant. An overview of the learning theories, including social learning theories, used by the SLIM project is given and contextualised within a broader range. I explain, from my perspective, why certain theoretical choices were made by SLIM researchers in preference to others. Even within the SLIM project, a range of theories informed the project's research and affected what was noticed, recorded and experienced in some different situations. The SLIM project valued and worked with these differences (see the editorial for this issue).

SLIM researchers adopted mainly a praxis-based approach, where their theory and practice informed each other. By focusing primarily on theory in this paper I am not advocating its separation from practice. But I am suggesting that through understanding a range of theories, by becoming increasingly aware of theories in use and making theoretical assumptions apparent, SLIM had a choice of conceptual, and potentially methodological, tools to use in different situations.

## 2. The nature of resource dilemmas and what is required to address them

Resource dilemmas have proliferated in many parts of the world in the last few decades as forces of consumerism and globalisation and our technological capabilities have increased. Over this time the quest for knowledge and knowing about ourselves and the Earth has continued apace. Understanding the effects of people's resource-based activities on their interconnected environments and each other has raised many challenges for scientists, policymakers, educators and a range of other practitioners. Issues of environment, economy and equity have arisen around the use and re-use of water, air and land-based resources that are shared by many, and around the management of wastes. The experiences of the SLIM research teams in Italy, France, the Netherlands and UK give examples of these issues in the context of water (see Toderi et al., 2007; Steyaert et al., 2007; Jiggins et al., 2007; Collins et al., 2007). Further examples are described in the work of organisations such as the International Institute on Environment and Development (IIED, 2006), the International Institute for Sustainable Development (IISD, 2006) and the Organisation for Economic Co-operation and Development (OECD, 2006) regarding for instance agriculture, forestry, land use, drylands, biodiversity and livelihoods, mining, water, environment and security, fisheries and wastes.

Ownership, control and use of many natural resources have become increasingly contested among multiple stakeholders with worldwide trends in globalization, democratisation, decentralisation and urbanisation and calls for further democratic reform (Benjaminsen et al., 2002; Castro and Nielsen, 2003). The challenge of managing resource dilemmas is not only one of sharing available resources and managing existing conflicts. It is also about managing in situations of scientific uncertainty and sometimes in ignorance about the nature and future of these resources, e.g. regarding the systemic causes and effects of climate change or of wars that have a natural resource dimension. As Harremoës et al. (2002, p. xv) commented "Knowing enough, and acting wisely enough, across the full range of environmental and related health issues seems daunting. The interconnections between issues, the pace of technological change, our limited understanding and the 'time to harm and then to heal' of ecological and biological systems that can be perturbed over decades by our technologies together present an unforgiving context." Bateson (1972) also argued that we could never know about all the feedback loops involved in these contexts.

The range of human activities in which not only environmental and sustainability issues arise but specifically resource dilemmas, where there are competing claims on the use of natural resources, is very broad. In the context of water, the SLIM project identified six conditions as characteristic of those where resource dilemmas arise: (i) *common pool resources* are involved, (ii) *multiple stakeholders* make different claims on the resource, (iii) there is *interdependence* among stakeholders, (iv) there is *controversy*, (v) there is *complexity* where issues arise from multiple causes and effects and 'the problem' cannot easily be measured or monitored and (vi) there is *uncertainty*: in complex situations, surprise is to be expected (SLIM, 2004a). Air and land-based resource dilemmas, including issues around wastes, can be characterised by similar conditions (Open University, 2006).

Contemporary curricula are one means to appreciate the many different kinds of knowledge, knowing and learning that are currently perceived as needed to address resource dilemmas (Scott, 2002). Examples include knowledge of the Earth's life support systems and the ways human activities do or can affect natural cycles, knowing when and how to intervene for environmental conservation and protection, knowing how to facilitate a multi-stakeholder negotiation regarding a scarce resource, learning what kind of use of natural resources or management of wastes is likely to be sustainable in the longer term. Many formal education programmes have systematically developed curricula for natural resource management and environmental decision making in the context of sustainable development (e.g. CENRM, 2006; Cranfield University, 2006; Open University—see Blackmore and Morris, 2001.) There is not space to include details of these curricula here but to give an indication: a UK-based publication on professional practice for sustainable development (WWF, 2000) identified the following

series of themes as those needed in developing sustainable professional practice:

- joined-up and integrated thinking;
- good management;
- efficient use of resources;
- good science;
- social responsibility.

Most curricula focused on managing natural resources in the context of sustainable development are multidisciplinary and transdisciplinary. The SLIM project's 'Watercourse' (SLIM, 2004b) is a case in point. There is therefore a broad range of learning outcomes that are relevant to natural resource management and sustainable development. SLIM chose to focus particularly on 'social learning' associated with resource dilemmas at catchment scale where there were competing claims for use of water (Röling, 2002; Röling and Woodhill, 2001; SLIM, 2004a). The rationale for that focus is explained in detail elsewhere (see Ison et al., 2007).

Non-formal learning is equally important in addressing resource dilemmas, which are widely acknowledged as needing participation in decision making and action by multiple stakeholders. The European Commission has legislated for this to happen first through development of a Convention on access to information, public participation in decision making and access to justice in environmental matters (the Aarhus Convention, UNECE, 1998) and subsequently through development of associated Directives to implement the Convention. There has also been increasing recognition of the need for not just individual but also collective action. In the case of water catchments SLIM identified a need for a particular kind of collective action—concerted action (see Section 4 and Steyaert and Jiggins, 2007). But stakeholders in a particular catchment do not necessarily know about this concerted action, why it is needed or how it can take place. Vickers (1976) claimed that every culture has its own body of knowledge and ways of knowing and this might well apply to specific groups of practitioners in relation to catchment management. But the multiple stakeholders involved do not necessarily share a single culture and have different values and beliefs. Hence a need for learning and the characteristics of resource dilemmas demand not just individual but social learning.

## 3. What does learning involve?

> *''The word 'learning' undoubtedly denotes change of some kind. To say what kind of change is a delicate matter.''* Gregory Bateson (1972, p. 283).

Notions of learning can be traced back to very early philosophers, psychologists and biologists. Many chapters, even whole books have been written on theories of learning and knowing (e.g. Hergenhahn and Olson, 1993; Merriam and Caffarella, 1991/1998; Brockbank and McGill, 1998; Illeris, 2002; Ison et al., 2000; Finger and Asun, 2001). Most focus on individual theories and theorists and what links and differentiates them and on epistemology, the branch of philosophy concerned with the nature of knowledge. Questions about what learning and knowledge are, where learning takes place and how it can be facilitated can be philosophical or theoretical in nature but also have some very practical dimensions. There are too many contributors to mention here. But to give a sense of a historical lineage, note that over 2000 years ago Plato believed knowledge was innate and inherited, while Aristotle believed that it came from sensory experience. Later, but still going back a few hundred years, Hobbes and Locke opposed the idea that knowledge was innate and instead focused on the senses. Mill later challenged a unique focus on sensory stimulation and added suggestions about completely new ideas emerging from others. Around the same time Darwin influenced learning theories with his insights into the ability of behaviour to adjust to environment and into biological continuity of the development of humans and non-human animals.

Today's theories of learning have all drawn on older theories to some extent, a process that has included disagreement as well as expansion of ideas. For instance Bateson (1972) critiqued some of Darwin's ideas and his own ideas about learning (discussed in the next section) have been very influential. Our changing context has led to new ideas and many academic disciplines have contributed to learning theories. Besides philosophy, psychology and biology, mentioned previously, neuroscience, cybernetics, computer and information science, sociology, political science, behavioural science, cultural anthropology, management science, genetics and many different disciplines of education have all contributed and staked their claims to ideas about how we learn or could learn.

Practitioners also have made contributions to theories of learning, not just to its practice. The contributions of educators, whose professional role includes facilitating learning, is one example. Another example—'learning process approaches', as opposed to following 'blueprints', comes from management and cybernetic traditions but often applies in policy circles (Korten, 1980). Uphoff (1992, p. 12) drew on ideas from Korten and others in the following description: ''A learning process approach is appropriate for most areas of human activity. It presumes that neither the ends nor the means of social interventions can be fully known in advance, and that understanding and consensus on them must be built up through practical experience. Mistakes are unavoidable and some failures are bound to occur, but with ongoing evaluation, results can be improved.''

While learning theory is undoubtedly a very rich terrain, some see its diverse theoretical traditions as problematic, for instance in gaining a sense of intellectual coherence in adult education (Finger and Asun, 2001). Moreover, individual theorists or academic disciplines have sometimes, directly or indirectly, contributed to more than one set of ideas or contributed similar ideas, so it can be misleading to categorise theories and attribute them very specifically to individuals, groups of individuals or academic disciplines. But many attempts have been made at categorising and organising learning theories to compare and contrast different ideas and practices and to attempt syntheses of ideas. Hergenhahn and Olson (1993) use Kuhn's notion of paradigms to differentiate. They organise their review of major learning theories around

functionalist, associationistic, cognitive and neurophysiological paradigms, having previously acknowledged other 'schools' of thinking (e.g. behaviourism). Merriam and Caffarella (1991/1998) chose four 'orientations' to learning–behaviourist, cognitivist, humanist and social/situational to explore viewpoints, purpose and roles in education and manifestations in adult learning. Finger and Asun (2001) included UNESCO, pragmatism, humanism and Marxist Adult Education in the main historical traditions in adult education. Entwistle and Hounsell (1975) suggested a continuum from behaviourism to humanism. Wenger (1998) associated learning with neurological functions (neurophysiological theories) psychological theories (behaviourist, cognitive, constructivist and social learning) and theories that were moving away from exclusively psychological (activity, socialization and organizational).

I mention these categorisations to give some signposts for those interested in reading more about learning theories and to indicate a complex and rich terrain of ideas that can be organised in different ways. Each grouping and discussion of traditions tells a different story. (I will not expand and describe all these distinctions here as they are not directly relevant to this paper but to assist anyone coming across these theories for the first time, a summary of the main ideas and questions they might raise in environmental contexts are included as an appendix to this paper, see Appendix A, Table 1.) Categorising learning theories through the lens of 'social learning' is, in my view, problematic because many learning theories have evolved over time to become less individually and more socially focused. The disciplines owning and developing learning theories have also changed over time, influenced by new scientific findings about why, what and how people do and do not learn, including about what lies in individual and social domains. Learning theorists have also responded to changing environments, societies, technologies, and academic communities. Changing epistemological trends, particularly from positivism to constructivism, are a part of this changing context.

There has been much cross-fertilisation of ideas. Aspects of some theoretical traditions, for instance behaviourist, cognitive or cybernetic, permeate many other theories. But even these three traditions have informed each other as they have each evolved and new theories have emerged from syntheses of these and other theories. Hence learning theories are not mutually exclusive and do not have clear-cut boundaries if different generations of theories in particular traditions are taken into account. One example here is that appreciative systems, learning systems, complex adaptive systems, organisational learning, knowledge management and cybernetic theories overlap but depending on whether a first or second-order approach or positivist or constructivist epistemology is assumed can also be quite different. Most of this group have also been informed by cognitive theories. A second example of the unclear boundaries of these theories is that traditional behaviourism is distinguished from situated learning by where learning is considered to take place but both can be linked to different kinds of social learning. I will discuss social learning further in the next section.

The questions that these theories can help to raise and address have emerged in many different environmental contexts. For instance Harremoës et al. (2002) reflected on the use or need for the precautionary principle in many different 20th Century contexts, ranging from fisheries to use of asbestos to chemical contamination of the Great Lakes in the USA. They included as one of their 'late lessons from early warnings' "to ensure 'lay' or local knowledge, as well as relevant specialist expertise in the appraisal" and "to identify and reduce institutional obstacles to learning and action". Theories or models, such as actor network theory, knowledge management, learning systems, levels, orders and loops of learning, organisational and social learning, can all be used to focus on these lessons.

Sunita Narain, Director of the Centre for Science and Environment in New Delhi, also emphasised the importance of learning, this time in local water management, when she accepted the World Water Prize in Stockholm in August 2005. She commented that "I accept this award on behalf on the thousands of water engineers and water managers all over the world, especially in Asia, Africa and Latin America. These people are discounted in the formal knowledge system of the world ... it is clear that the management of water, and not scarcity of water, is the problem in many parts of the world ... the solution, practised diversely in different regions, lies in capturing rain in millions of storage systems – in tanks, ponds, step-wells and even rooftops – and to use it to recharge groundwater reserves for irrigation and drinking water needs ... Water is not about water. Water is about building people's institutions and power to take control over decisions."

Narain (2005) highlighted water management as the biggest co-operative enterprise in the world and her focus on participation, institutions and power as well as learning is one echoed by many working in water management (Röling and Woodhill, 2001; Yetim, 2002; IUCN, 2000; Tippett et al., 2005). Theories and models of learning underlying this perspective include those that take account of contexts, group processes and collective learning and action. In this focus lies a key part of the rationale for SLIM's concentration on a particular kind of social learning.

## 4. The discourse, theory and practice of social learning and SLIM's focus and contributions

> "*What if we assumed that learning is as much a part of our human nature as eating and sleeping, that it is both life-sustaining and inevitable? And what if, in addition, we assumed that learning is a fundamentally social phenomenon, reflecting our own deeply social nature as human beings capable of knowing?*" Etienne Wenger (1998, p. 3).

Wenger (1998) elaborated what he referred to as a social theory of learning, taking the position described in the above quote. He distinguished this kind of learning, that defines learning as a social and historical process, from a theory of social learning that focuses primarily on collective learning.

This kind of discussion is part of a 'discourse' around social learning that can be traced back many decades and looks set to continue well into the future. A discourse is described by Dryzek (1997, p. 8) as "a shared way of apprehending the world. Embedded in language, it enables those who subscribe to it to interpret bits of information and put them together into

coherent stories.'' Wenger (2004) commented that ''The production of a theoretical discourse is a consequential activity to the extent that it enables new ways of seeing, thinking, talking, and therefore acting.'' Discourses change over time as new knowledge and understanding are developed. As a result of this overall discourse on social learning, what was meant by it 50 years ago is only one of its meanings in currency today.

Bandura is often credited as establishing the concept of social learning (Bandura and Walters, 1963; Bandura, 1977) though its roots can be traced back much further. Bandura was heavily influenced by behaviourist approaches, which originated in the late 1890s and were prevalent up to the 1970s, particularly by the work of Miller and Dollard (1941) who focused largely on learning through imitation. But he broke with tradition in observational learning by proposing that learning was continuous and not dependent on reinforcement and that much human behaviour was self-regulated. Bandura (1986) went on to develop what became known as a social cognitive theory that emphasised that much information people gain comes from interactions with others (Hergenhahn and Olson, 1993). Over this same period and subsequently, many developed different ideas about social learning from other perspectives. For example, Freire (1970) focused on learning through dialogue and informal interaction in his concern for oppressed people. Schön (1971), Hutchins (1970) and others were debating 'the learning society' and Vickers (1968), who went on to write about social learning and learning systems (Vickers, 1987), was focusing on value systems, public policy making and social process. From the 1950s onwards Bateson's work on learning theories using cybernetic principles influenced many other theorists. Learning and its context were seen by Bateson as inseparable and among his many contributions to learning theories were ideas about communication, logical types and learning levels (Bateson, 1972).

Danish author Knud Illeris, in his classic text on contemporary learning theory (Illeris, 2002), identified many who had brought social and societal factors to the fore of their work and who in so doing also, in his view, made contributions to learning theory. They ranged from Marx to Habermas to Wenger to Jarvis, to Giddens and Beck to many others. Examples of social learning theories, developed and used explicitly in the context of addressing resource dilemmas and sustainable development, have come from Finger and Verlaan (1995) who developed a conceptual framework for social–environmental learning, Daniels and Walker (1996) who considered collaborative learning and improving public deliberation in ecosystem-based management and Woodhill and Röling (1998) who looked into the human dimension in learning our way to more sustainable futures. This work has since been built on and besides those directly involved in the SLIM project there are many others who have written about social learning (e.g. Grove-White, 2005; Keen et al., 2005; Tippett et al., 2005; Leeuwis and Pyburn, 2002; Finger and Asun, 2001; LEARN Group, 2000; Wildemeersch et al., 1998).

There is a social dimension in nearly all theories of learning, even if they are centred on an individual. What distinguished social learning for SLIM, in terms of interactive learning among interdependent stakeholders in the context of integrated management and sustainable use of water at catchment scale, was that it could be characterised by

1. Convergence of goals, criteria and knowledge, leading to more accurate mutual expectations, and the building of relations of trust and respect. If social learning is at work, then the emergence of agreement on concerted action for sustainable water use should be observable.
2. Co-creation of knowledge needed to understand issues and practices.
3. A change in behaviours, norms and procedures arising from development of mutual understanding of issues as a result of shared actions such as physical experiments, joint fact-finding and participatory interpretation (SLIM, 2004a).

SLIM's focus was primarily on a particular kind of collective learning that led to not just collective action but concerted action, using the metaphor of a concert where all performers have different roles that need to brought together in a particular way and at a particular time for favourable outcomes to emerge (see Ison et al., 2007).

de Laat and Simons (2002) plotted learning processes against learning outcomes at both individual and collective levels and distinguished four kinds of learning as a result: (i) individual learning; (ii) individual learning processes with collective outcomes; (iii) learning in social interaction and (iv) collective learning. De Laat and Simons focused primarily on collective learning where both learning processes and outcomes were collective, as did SLIM. Wanting to understand how people learn collectively, in groups, is different from wanting to understand how, say, a social context affects an individual's learning. But both may be important to a given situation and in practice many definitions of social learning acknowledge both these aspects but to differing degrees. In addition to a focus on interactive learning (SLIM, 2004a) there was recognition of the other forms of learning mentioned by de Laat and Simons but not as a primary focus. In this respect SLIM's position was in accord with Illeris (2002) who noted a move in recent years to focus on 'interaction processes' with increased interest in social learning and social constructionism (discussed below) and claimed ''In this situation it is important to maintain a conception of the internal psychological processes as an integrated part of learning'' (p. 144).

What constitutes evidence of social learning, who learns, how, with whom and for what purpose are all questions that can be theorised in different ways. Even theories of social learning differ from each other concerning where changes taking place in learning occur and what constitutes evidence of learning. Changes in behaviour, changes in a learner and changes in learners' relationships with others and/or their environments may all provide evidence of social learning depending on which theory is being used. Where a learning theory is focused is also partly epistemological, i.e. what theories of knowledge and knowing underpin it. Cook and Brown (1999, p. 387), in making a distinction between knowledge and knowing, describe knowing as ''the epistemic work that is done as a part of action or practice''. They build on observations of others, including John Dewey and Geoffrey Vickers, and take the position that knowing does not focus on what we possess in our heads but on our interactions with the things of the social and physical world.

As mentioned above, social constructionism, which many link to epistemology, has become increasingly popular in recent years. It lies at the opposite end of the philosophical spectrum from positivism (Gergen, 1994; Hibberd, 2001). It rejects objectivist ideology and recognises a subject as social, not individual (Hibberd, 2001). It accounts for explanations that knowledge is socially constructed. As Illeris (2002, p. 125) said ''Social constructionists do not deny that learning processes occur internally in an individual. But they find it uninteresting, because the nature of these processes and the content of them are always determined by relations in the social field.'' Social constructionism extends some of the ideas of constructivism (Papert and Harel, 1991). Some view social constructionism as an epistemological position, others as a sociological theory and others as a learning theory but most agree that it has been influential in bringing about changes in learning theories and practice in the past couple of decades. For instance, several theories of learning have now evolved into their second and third generations including those associated with knowledge management (Snowden, 2002) and activity theory (Engeström, 1999). Taking account of changing contexts and ideas of social construction has been part of this evolution of ideas. Another aspect of changing context has been captured by Giddens (1990) and Beck (1992) who claim that over time our society has become increasingly *reflexive* with much more examination and reform of social practices particularly in the face of new risks, including environmental risks, e.g. those associated with climate change. Reflection of different kinds is an integral part of many models of individual and collective learning, e.g. in those of Mezirow (1990), Argyris and Schön (1974). Reflexivity as used by Giddens and Beck refers to the idea of 'mirroring' in the sense of keeping in focus the significance of an action or examination on itself rather than as 'afterthought' (Illeris, 2002). The focus on ideas of social construction and reflexivity have certainly increased in recent years and influenced ideas about social, including societal learning. But both are models or ways of seeing the world and as such still open to critique (Winner, 1993; Preuss, 2005).

So where in overall terms did the SLIM project fit into this evolving discourse on social learning? As a researcher who participated both in one country team of the SLIM project, including in case studies and at the whole project level through a series of work programmes, I can only offer an analysis of SLIM's starting conditions and contributions to social learning theory from my own perspective but further details can be found in other papers in this issue. SLIM researchers came from a wide range of cultural, disciplinary and practitioner perspectives with both commonalities and differences. Between us we were aware of many learning and social learning theories and following Dryzek's (1997) definition of discourse we certainly tried to develop a shared way of apprehending the world regarding social learning as well as respecting others' ways, as discussed in various interim project reports, e.g. van Dijk (2001), Jiggins (2002). Fig. 1 is a variant of a figure that appears in the editorial of this issue and indicates how each country team had its own theoretical perspective as well as contributing to and being influenced by a shared approach that was negotiated through the work programmes. This diagram was developed in one of the earlier work programmes.

Each SLIM team accounts for its approaches, including their theoretical perspectives, in other papers in this issue (Toderi et al., 2007; Steyaert et al., 2007; Jiggins et al., 2007; Collins et al., 2007). Here I concentrate on some of the common elements in our social learning theories. Links to learning systems theories, adaptive management, social constructionism and double loop learning are either explicit or implicit in the statement of common elements in Fig. 1. Learning systems theories are evident in drawing on processes of interaction among multiple users, in the suggestion of purposeful activity and in considering the context of problems or messes rather than adopting an approach that assumes problems are known. Adaptive management can be linked to the focus on adaptation and transformation. Social constructionism is implicit in the focus on drawing on processes among multiple users. Double loop learning is also implied in that an alternative policy instrument leading to concerted action at catchment scale challenges norms rather than reinforcing a 'more of the same' approach.

As already mentioned, SLIM's interests, initially at least, were in theories of social learning rather than social theories of learning that focused more at the level of the individual. SLIM also focused initially on learning associated with purposeful action. Other focuses emerged later in the project and included developing the potential to act in other

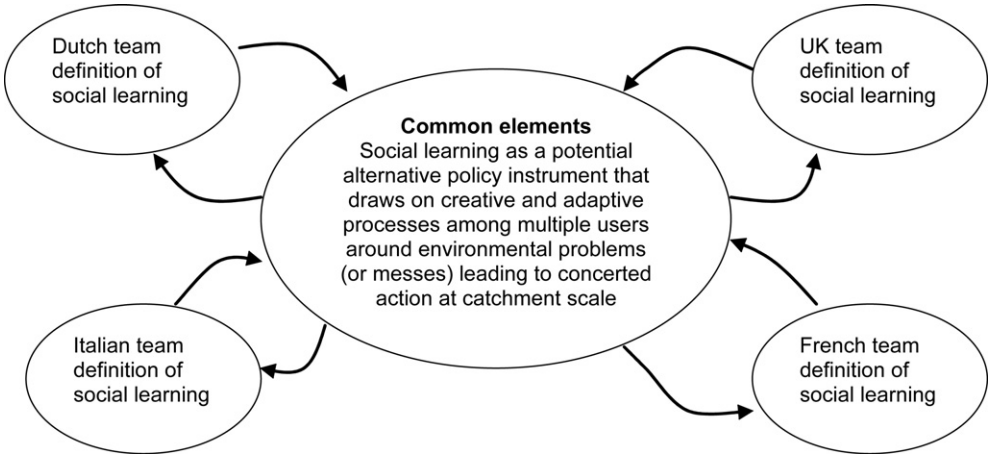


**Fig. 1 – Country team and common elements of SLIM's ideas about social learning (from Jiggins, 2002).**

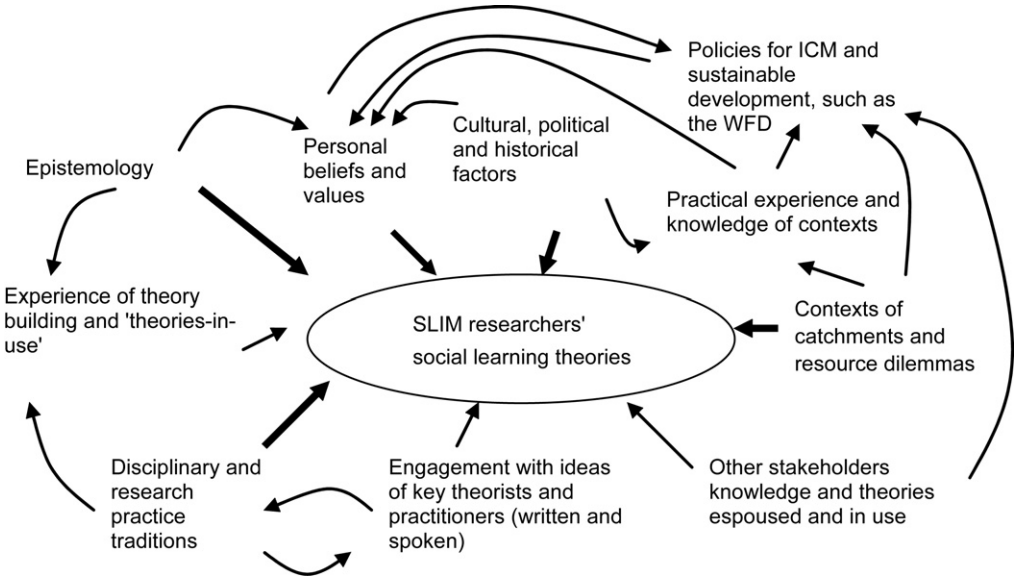


**Fig. 2 – Diagram to show some of the factors influencing SLIM researchers' choices and use of social learning theories from the author's perspective. (Thicker arrows indicate stronger influences, WFD: Water Framework Directive, ICM: integrated catchment management.)**

situations at a later time, and hence take on more challenging transformations, such as those called for under the Water Framework Directive (SLIM, 2004a). There were however many other links to learning theories in SLIM's overall approach and some challenges to different theories. For instance, the whole team was influenced by the French experience with actor network theory and the role of objects in learning as exemplified by the role of the Maraîchine cattle in social learning (Steyaert et al., 2007).

Ideas from second-order cybernetics, in particular the ideas of Maturana and Varela (1987), had influenced SLIM team members from several different countries. Drawing on these traditions the group as a whole was more comfortable with the systemic idea of structurally coupled dualities than with polarised dualisms (e.g. with respect to theory and practice and subjectivity and objectivity). However, some of those coming from biophysical sciences traditions challenged prevailing assumptions regarding constructionism. Experiential learning theories were frequently in evidence and processes of reflection in and on action were generally valued, particularly in cross-country team visits to case studies in the international work programmes. Wenger's ideas on 'learning *as* practice', drawn from theories of situated learning, also permeated the project as a whole. In researching social learning it meant that we were more focused on processes of interaction in practices in catchments than explicitly on learning.

SLIM's overall research approach was also influenced by grounded theory, i.e. beginning with a research situation and developing and using theory as it emerged in the research process. Country teams both drew on and contributed to the common elements of the project's approach to researching social learning. It would be misleading to suggest that all teams adopted the approaches they did for just one reason or another. Each team had its own history, culture and traditions as well as being influenced by individuals' values, beliefs and experiences. The country team papers in this issue, already mentioned, give further details and in Fig. 2. I have also tried to capture some of the influences on SLIM researchers' choices and use of social learning theories already discussed. (This diagram does not have the joint ownership and negotiated agreement of Fig. 1 and another SLIM researcher might well portray it differently.)

SLIM researchers were able to not just use but to adapt some of their learning theories in the light of their findings. There was also some synthesis of the theories used by different researchers both within and among the country teams, some of which are discussed further by Steyaert and Jiggins (2007).

## 5. How does understanding what is involved in social learning contribute to dealing with resource dilemmas?

As researchers, it can be important to understand that our beliefs are underpinned by theory of some sort, even if we are by nature very practical. Our theories may be constantly changing with our practice or we may get stuck and become limited in the way that we ask questions and organise data, what structures and relationships we notice or what meaning we take from a situation. SLIM researchers' positions were at various times as observer, participant–observer and co-researcher with other stakeholders in the case study situations. These different roles present some different challenges. For an observer what is observed and how is important, for the participant–observer there is an additional judgment to be made on why, when and how to participate. For a co-researcher more is at stake if called upon to facilitate others rather than just observe.

The need for facilitating public participation in environmental decision making has been recognised through initia-

tives such as the European Union's Aarhus Convention and subsequent Directives (UNECE, 1998) but the nature of people's participation needs close scrutiny in order to see what it does and does not achieve. Woodhill (2002), in the context of Australian Landcare, is among those who has found that participation alone is not enough to lead to the changes necessary to address issues of environment and natural resource management. Interactions among interdependent stakeholders that go further and bring about institutional as well as local level change are also needed in many contexts. These interactions have been recognised by SLIM (2004a) and others (Woodhill, 2002; Keen et al., 2005; Leeuwis and Pyburn, 2002) as social learning.

Setting out to work with others to improve a situation – where there are resource dilemmas characterised by common pool resources, multiple stakeholders, interdependence, controversy, complexity and uncertainty – through social learning, requires a clear picture of what might be involved that can be negotiated with others in a purposeful way and enable commitment to a mutually agreed learning process. To many people learning still suggests instruction as much as, if not more than, construction. Stakeholders may also have had more experience of purposive processes, where goals are imposed from outside a system of interest, rather than purposeful processes, where they can set goals as well as seek them. In SLIM's experiences, a dialogue with other researchers, policymakers and in some cases other stakeholders can be enabled by making assumptions apparent about what constitutes learning or social learning and how it relates to ongoing activity and practices. This dialogue can begin to address questions such as 'How can interactive learning processes be valued and supported?'

SLIM's focus was on social learning associated with concerted action, appropriate to the resource dilemmas faced and interdependency of stakeholders. Röling (2002), who had a key role in the SLIM project, has linked interaction and concerted action with the idea of a sustainable society, which he defines as a society based on agreements to control our own behaviour in the context of 'the eco-challenge'. Röling and his colleagues take the position that a sustainable society must be capable of concerted action. The SLIM project has generated understanding of what social learning can contribute to bringing about concerted action in the face of resource dilemmas. However the theoretical assumptions underlying a position of *advocating* social learning for concerted action in the context of resource dilemmas, which SLIM has taken (discussed by Steyaert and Jiggins, 2007) lie as much in theories of action and in theories of sustainable development as in theories of social learning and go beyond the scope of this paper. Argyris and Schön (1974) distinguished between two kinds of theories of action—'theories in use' and 'espoused theories'. The SLIM project as a whole aimed for congruence in theories it used and espoused, both in its country team work and at the whole project level in its work programmes. The degree to which it achieved this congruence has been commented on elsewhere, for instance in SLIM's mid-term review in 2001 and in Ison et al. (2007) and Steyaert and Jiggins (2007). In advocating its particular theory of social learning, built on many others, SLIM comes from a position of not just espousing it but having used it. The details of how are in the following papers in this issue.

## 6. Conclusions

Social learning draws on many traditions of theory and practice. SLIM researchers brought with them to the project understandings of a range of these traditions and engaged with other theories in the course of the project. They also took part in and developed a discourse on social learning that enabled them to interpret what they found into coherent stories in their case studies. In some cases SLIM researchers also used their understandings of social learning to facilitate interactive processes that led to concerted action. Common to all the country teams' theoretical perspectives was an idea of social learning as a potential alternative policy instrument that draws on creative and adaptive processes among multiple users around environmental problems (or messes) leading to concerted action at catchment scale. These contributions from SLIM offer many insights into what kind of knowing, knowledge and learning can be required for addressing resource dilemmas in the context of managing water resources in a sustainable way at catchment scale.

Further work is needed to see whether the distinctions made by SLIM researchers and their focuses in researching social learning apply more broadly. Many have recently called for a shift from localised participatory approaches to more systemic social learning approaches. This is because the role of participatory processes in addressing resources dilemmas, and in environmental decision making more generally, has become both increasingly recognised, through initiatives such as the Directives derived from the Aarhus Convention (UNECE, 1998) and increasingly under critique, because of their limitations (Woodhill, 2002; Grove-White, 2005; Keen et al., 2005; Leeuwis and Pyburn, 2002; Finger and Asun, 2001; LEARN Group, 2000). In this setting, understanding that social learning can be understood not just as one approach but as many, depending on which aspects of interaction and learning are in focus, may give researchers and other stakeholders in researching social learning some choices of tools to use, as appropriate to their contexts. Understanding what is involved in social learning in different contexts may also enable it to be both valued and facilitated. The challenges involved in addressing resource dilemmas look set to increase over time and learning more about social learning looks likely to be one of them.

A particular focus in SLIM's findings is how institutions constrain or enable concerted action. Decades ago writers such as Vickers (1973) focused on the scope and roles of the educator and values, norms and policies in making institutions work. Today many are still seeing a need to identify and reduce institutional obstacles to learning and action (e.g. Harremoës et al., 2002) and are still focusing on values, norms and policies. But understanding and facilitating learning for institutional and social change, to be able to meet the challenges of addressing resource dilemmas and sustainable development, is no longer seen as primarily the domain of educators. Scientists, policy makers and researchers all have a role. Perhaps an understanding among these practitioners of the kinds of knowing, knowledge and learning that might be required and how they can be developed might make 'knowing enough, and acting wisely enough' (Harremoës et al., 2002) seem a little less daunting?

## Appendix A

Some of the key focuses in a range of learning theories and models are summarised below, alphabetically, along with names of some of those who developed the ideas. I have included some of the questions that these theories might raise in environmental contexts. I use the adjective 'environmental' here in the sense of including biophysical dimensions of our environment alongside others. Referencing all the theorists goes beyond the scope of this paper but further details can be found through an Internet search. All those listed of course had a great deal more to say than is indicated in this table. Many individuals moved on to reformulate ideas over their careers and some are associated with more than one theoretical tradition or model. Many other theorists and practitioners who are not listed have also contributed to each tradition. My purpose here is not to be comprehensive but to try to draw out a broad range of ideas about how and where learning takes place, to contextualise theories of social learning and SLIM researchers' view of social learning. Note that while all of the theories included below have contributed to ideas about learning some (such as adaptive management and organisational learning) have also contributed ideas to other activities such as management. As discussed in Section 3 categorisation of learning theories is problematic because of the evolution of ideas. Several sources (given below) have been used in developing this table but misinterpretations are my own. Other authors might also have described and grouped them differently.

**Table 1 – Theories, theorists and models of learning and their focuses**

| Theories or models of learning | Main idea concerning learning | Examples of associated theorists | Questions this theory might raise in an environmental context |
|---|---|---|---|
| Activity theory | Cultural–historical theory that explains how people learn to perform activities. Three generations of this theory can be identified. Started with a focus on artefact-mediated and object-oriented action, moved on to explain collective human activity systems and then interacting human activity systems | Vygotsky, Leont'ev, Engeström | How might we learn to modify our activities (e.g. transport, food production) to reduce adverse effects on our environments and each other? |
| Actor network theory | Attempts to explain both social and technological evolution partly by providing a conceptual framework to integrate human and non-human factors in social processes suggesting both have agency. One of several traditions that has led to a focus on the role of objects in learning | Latour, Callon, Law | Which mediating objects might enable us to interact to address environmental issues? |
| Adaptive management and complex adaptive systems | Focuses on learning how to effectively influence the *resilience*, *adaptability* and *transformability* of social–ecological systems through understanding the dynamics involved. Informed by cybernetics | Gunderson, Holling, Folke | What dynamics do we need to understand to be able to influence social–ecological systems? |
| Appreciative systems | Focuses on the learning process of appreciation as distinct from action and on developing individual or collective 'appreciative settings', i.e. readinesses to see and value, in order to make reality and value judgments. The appreciative system was described as 'in endless development . . . in far from consistent . . . physical, social and personal worlds' | Vickers | How might we include environmental factors in our appreciation of situations? |
| Behaviourist | Observable changes in behaviour of a subject provide evidence of learning | Watson, Skinner, Pavlov, Bandura, Hebb | What changes in individuals' behaviour provide evidence of environmental learning? |
| Cognitive | Change occurs within a learner. Cognitive processes usually refer to mental processes associated with knowing | Piaget, Hutchins | How can we better develop environmental knowledge and knowing? How is cognition distributed in environmental situations? |

**Table 1 (*Continued*)**

| Theories or models of learning | Main idea concerning learning | Examples of associated theorists | Questions this theory might raise in an environmental context |
|---|---|---|---|
| Constructivist | Individuals construct their own knowledge and understanding of the surrounding world through learning | Piaget, Papert, Bruner, Vygotsky | What processes are needed to enable people to construct environmental knowledge and understanding? |
| Cybernetic | Focuses on systems, communication, control and regulatory feedback. First-order cybernetics assumes an observer of a system can stand outside a system of interest, the position also adopted in traditional behaviourist theories of learning. Second-order cybernetics includes an observer in a system-of-interest and assumes that individuals are structurally coupled with their environments. Examples of learning theories developed from second-order cybernetics include conversation theory in which 'teachback' forms an important part of learning | Wiener, Bateson, von Foerster, Pask, Maturana, Varela | How can we communicate about our different worlds? What kinds of intervention might be needed where we have positive feedback effects (e.g. in relation to society's actions and climate change)? |
| Domains and dimensions of learning | Three different key aspects contribute to learning. Bloom focused on cognitive (knowing), conative (doing) and affective (feeling). Illeris on cognitive, social and emotional | Bloom, Illeris | How do these domains and dimensions contribute to our environmental learning? |
| Emotions in learning | Focus both on the role of emotions in learning and on emotional learning. Emotional aspects are an integral part of some learning theories (e.g. as one domain of learning, in theories informed by cognitive neuroscience and in transformative learning) but have also become a focus in their own right, e.g. in emotional intelligence | Rogers, Egan, Goleman, Maturana, Varela | How can we work constructively with our emotions to reduce adverse effects of human activity on our environments? |
| Experiential learning and learning styles | Knowledge is produced through transformation of experience. Kolb and Fry (after Lewin) represented this kind of learning in a cycle around (i) concrete experience, (ii) observation and reflection, (iii) formation of abstract concepts and (iv) testing in new situations. Each stage with an associated style of learning. Schön's distinction between 'reflection on action' and 'reflection in action' presents an alternative way of thinking about reflection as part of experiential learning. Mesirow emphasised critical reflection in transformative learning leading to changing meaning structures and perspectives | Lewin, Kolb, Fry, Dewey, Freire, Schön, Mesirow | Can we learn our way to purposeful action through transformation of our experiences and perspectives? If so, how? What is the role of critical reflection? |
| Instructivist | Learning takes place as a result of teacher-led instruction. Opposite of constructivism | Skinner, Carroll, Bloom, Engelmann | How can we recognise both strengths and limitations of instruction in environmental situations? |

**Table 1 (*Continued*)**

| Theories or models of learning | Main idea concerning learning | Examples of associated theorists | Questions this theory might raise in an environmental context |
|---|---|---|---|
| Knowledge management | Range of theories with different epistemological assumptions and focuses. Linked to organisational learning. Three generations of knowledge management theories and practice have been identified. First generation focused on knowledge sharing and knowledge transfer, second generation focused on knowledge creation, tacit and explicit knowledge, third generation informed by social constructionism and complex adaptive systems | Polanyi, Nonaka, Takeuchi, Brown, Duguid, Stacy, Snowden | How can we develop knowing and knowledge that will support purposeful environmental action? How do we create a context in which this kind of knowing and knowledge might be developed or emerge? |
| Learning and epistemological development | Learners progress through developmental stages in how they view knowledge, from dualism to relativism | Piaget, Perry, Salner, Magdola Baxter | Does a theory of epistemological development help us to understand how we do and think, act and interact in relation to our environmental actions? If so, how? |
| Learning systems | Considers learning as systems made up of interconnected elements and processes different system levels and structurally coupled with learning environments. Draws on cybernetics. Learning in different systems at different levels leads to ideas of public learning, learning society, institutional learning | Vickers, Schön, 'Hawkesbury', Checkland, Open University, Maturana, Varela | What elements and processes comprise our learning systems? What and whose purposes do and could these systems of interest serve? How can we affect the contexts of our learning systems in order to improve effectiveness, efficiency and ethicality of our environmental actions? |
| Learning webs | Learning can be facilitated by ready access to educational resources through a learning web (e.g. access to educational objects and educators, skill exchanges and peer-matching communications networks), to help learners define and achieve their own goals | Illich | How can we improve access to educational resources to enable stakeholders in an environmental situation to work purposefully? |
| Levels and orders of learning | Level I – first order learning – routine learning and knowing that takes context as given. Level II – second-order learning – not confined, learning about the context of level I learning and knowing about learning and knowing. Level III learning takes another step back to learn about the contexts of level II. Kitchener suggests level III is about epistemic cognition and deals with *knowing about the nature of knowledge* | Bateson, Kitchener, Maturana, Varela | How can we bring about second-order change? How can we learn and know how to support environmental knowing and learning better? |
| Loops of learning | Single loop learning involves superficial change that allows 'more of the same' to continue without challenging underlying norms, policies and objectives which remain unchanged. Double loop learning challenges norms, policies and objectives and underlying values may change. Triple loop learning is concerned with the context for double loop learning | Argyris, Schön | How can we go forward differently and/or do 'more of the same' better? |
| Neurophysiological | Focuses on the human brain and nervous system, concerned with stimulation and optimisation of memory | Hebb, Edelman, Sylwester | How does how we function as humans affect how we perceive our environments? |

**Table 1 (*Continued*)**

| Theories or models of learning | Main idea concerning learning | Examples of associated theorists | Questions this theory might raise in an environmental context |
|---|---|---|---|
| Organisational learning | Individuals learn within an organisational context and organisations learn in their own right. Organisational systems, structures, policies and memory are in focus | Argyris, Schön, March, Olson, Senge, Brown, Duguid, Nonaka, Takeuchi | How can we develop organisations as contexts which support individuals' and groups' environmental action? |
| Progressive and/or radical education | Learning requires broadening of intellect, informal interaction and development of problem solving and critical thinking skills, rather than memorization and attempts at direct transfer of knowledge and skills | Dewey, Freire | What condition and skills enable us to take purposeful action? |
| Social constructionist | Builds on constructivist ideas but focus is on the perception that construction of the surrounding world occurs socially rather than individually | Papert, Gergen, Berger and Luckman | How can we facilitate social construction of a sustainable society and environmental action? |
| Situated learning | Knowing and learning are located in processes of co-participation, i.e. in a situation rather than in heads of individuals | Lave, Rogoff, Brown, Collins and Duigud, Wenger | What environmental practices are we involved in with others and how can we improve them? |
| Social learning | Range of ideas from those that explain what and how social interactions contribute to individual learning to those that focus on collective learning to those that include both | Bandura, Woodhill, Röling, Illeris, Wenger, Finger, Daniels and Walker, Wildemeersch, SLIM | How can we support individual and collective action that will improve our environmental situations? |

Developed and adapted from Wenger (1998), Ison et al. (2000), Brockbank and McGill (1998), Illeris (2002) and Blackmore (2005).

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**Chris Blackmore** is a senior lecturer in Environmental and Development Systems in the Open Systems Research Group at the UK's Open University. Her current research and teaching is about systems approaches to environmental decision making, with particular interest in learning systems and communities of practice. She develops open learning course material and has worked on several European research projects. Her background was originally in environmental sciences/education, later sustainable development education. Before joining the Open University she worked in Nigeria, Lesotho and Sierra Leone.