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Communities of practice and participatory action research: the formation of a synergy for the development of museum programmes for early childhood

Maria Ampartzaki^{a*}, Maria Kypriotaki^a, Catherine Voreadou^b, Antonia Dardioti^b and Iasmi Stathi^b

^aDepartment of Preschool Education, University of Crete, Rethymno, Crete, Greece; ^bThe Natural History Museum of Crete, University of Crete, Iraklio, Crete, Greece

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This study explores the integration of two key ideas and working frameworks: a community of educational practice formed by the synergy between a natural history museum and a university department of pre-school education, which undertook participatory action research aimed at the creation of innovative museum programmes for young children. Data analysis and the evaluation of the research process show that the community was able to bring its situated knowledge into question and interrogate propositional knowledge by means of re-evaluating the learning targets, the nature of children's activity, the nature of interaction between adults and learners, and the nature of resources used in existing and newly designed programmes offered to young children. Participatory action research enabled the community to monitor the implementation of theory with scientific rigour and formulate a new 'knowledge strategy', which in theoretical terms will guide future developments.

Keywords: communities of practice; participatory action research; museum education; early childhood; constructionism

Aims of the paper

Action research and communities of practice are working frameworks increasingly used in educational research to indicate the participants' efforts to negotiate knowledge, improve situations and find effective solutions to issues and problems. This study aims to contribute to the discussion developed by Hammesley (2004, 2005) and O'Grady (2011) regarding the power of communities of practice to become agents of educational research and interrogate propositional as well as situated knowledge. We are going to argue that a community of educational practice can bring its situated knowledge into question and interrogate propositional knowledge by means of participatory action research. This will be discussed with reference to a community of practice case study, the synergy between the education team of a museum and the academic researchers of a university department.

*Corresponding author. Email: m_ampartzaki@hotmail.co.uk

Communities of practice in a new perspective

In their book *Cultivating Communities of Practice*, Wenger, McDermott, and Snyder (2002) further develop the idea of professionals constituting a body with a distinctive identity that is defined by the rules of professional practice. The idea here expands to include communities which can be purposefully set up to, 'share a concern, a set of problems, or a passion about a topic, and [...] deepen their knowledge and expertise in this area by interacting on an ongoing basis' (Wenger, McDermott, and Snyder 2002, 4). It is not necessary for the community to be informal (Wenger 1998) or to result in an apprenticeship (as in Lave and Wenger 1991); people are actively encouraged to participate at different levels and according to their abilities, with this being their own choice and a personal decision to join in and embrace a particular type of membership (see Chapters 2, 4, and 9 in Wenger, McDermott, and Snyder 2002). Communities of practice might adopt a variety of strategic intents; one of them could well be knowledge-stewarding and/or fostering innovations (Wenger, McDermott, and Snyder 2002). Within this context, a community of practice might adopt participatory action research as a tool for achieving its targets. The present study therefore focuses on a community of educational practice – that is, a group of individuals who make a collaborative research effort to foster innovations in their educational practice. In what follows we are going to further explore this compatibility between the two ideas (communities of practice and participatory action research).

Participatory action research is an inclusive and egalitarian type of research in which all participants are considered to be competent and capable of participating in the research process, albeit in different modes and at different levels. It might include professional or academic researchers who interact with other participants in order to generate knowledge through reflection upon actions and work strategies. Participation and action based on research towards the ultimate goal of improvement and transformation are the main constituents of participatory action research. Participants are stakeholders who identify and address real-life problems in order to find viable solutions that liberate and improve their practices and modes of existence. The research process is systematic and cyclical. Several phases of action and reflection follow the identification of an issue or situation until a widely acceptable outcome is reached. Reflection during this collaborative process leads to the construction of new meanings and knowledge, which integrates the values and beliefs of the community that then initiates and implements the research outcomes (Hall 2001; Heron and Reason 2001; Kindon, Pain, and Kesby 2007a, 2007b).

The idea of creating a community of practice is congruent with doing participatory action research because the two share many of the same ontological, epistemological and methodological assumptions and both of them can serve the same kind of social purposes.

Ontological assumptions refer to the principles that affect our way of being, the way of viewing our relationships with others. Action research investigates the way we act in relation to others; it is a 'we-I' form of inquiry. Interaction and mutual influence are expected to be part of the research process, so it is believed that there is no 'value-free way' to investigate situations (McNiff and Whitehead 2006, 26). Communities of practice perceive their functionality in a similar way since a community's effectiveness depends on a variety of interpersonal factors (defining the 'we-I' relationship) such as collegiality, trust, mutual respect, a sense of belonging, and so forth (Wenger, McDermott, and Snyder 2002).

Epistemological assumptions refer to the way we understand knowledge and learning. For both action research and a community of practice, knowledge is not a certain, fixed and unquestionable end product but is rather constructed through a collaborative process. It is therefore considered to be value-laden, tacit as well as explicit, social as well as individual, and dynamic since it resides in multiple situations, processes and sources, which it changes and transforms along with human nature and activity (see Heron and Reason 2001; McNiff and Whitehead 2006; Wenger, McDermott, and Snyder 2002). In action research, knowledge is negotiated although not everything can become the subject of negotiation. In a similar way, although community-based knowledge initiatives are built on the participants' existing culture, the negotiation of knowledge is their primary goal and the dialogue between inside and outside perspectives is critical for the effectiveness of this endeavour (Wenger, McDermott, and Snyder 2002).

In terms of methodology, action research and knowledge development in communities of practice are conducted by the self in collaboration with others. Research, knowledge development and knowledge dissemination are done by practitioners who consider themselves agents of change. The methodology of research and work is open-ended (it can develop in a variety of directions yielding a variety of results) and the process constitutes the methodology itself. There are multiple ways of searching and working within a situation and they evolve progressively and collaboratively as people participate in the process. The process of research or work is developmental and involves cycles of action and reflection. In both cases (action research and communities of practice), change is understood as an improvement in practice. Solutions cannot be applied in all situations but at the theoretical level they become hypotheses that can be tested in the same context or by other researchers elsewhere (Altrichter, Posch, and Somekh 1993; McNiff and Whitehead 2006; Stringer 2007; Wenger, McDermott, and Snyder 2002).

Both action research and the community of practice aim at improving social contexts. Whilst participatory action research is oriented towards the overthrow of irrationalities, injustices and other forms of unsatisfactory living, communities of practice could equally target workplace practices, and through the ongoing democratic evaluation and assessment of learning and knowledge could achieve the improvement of social situations, formations or order (see Hall 2001; Kindon, Pain, and Kesby 2007b; McNiff and Whitehead 2006; Snyder and Wenger [2004] 2010; Wenger, McDermott, and Snyder 2002).

A synergy for the development of museum programmes for young children

Research collaborations and partnerships between different knowledge experts (such as scientists, teachers, museum educators and academic researchers), which have been reported in the literature, aim at the development of museum education according to contemporary pedagogical demands (see, for example, Christal et al. 2001; Hannon and Randolph 1999; Nakamura, Erickson, and Ford 2002). Synergies between museum staff and academic researchers aim at the collaborative definition of problems and issues, the search for viable solutions, and the development of appropriate interventions and educational programmes (see, for example, Freidus 2007; Gajić and Miliutinović 2010; Lemelin 2002; Lemelin and Benze 2004; see also Clark and Button 2011; Robin et al. 2002). However, there is a limited number of studies that present us with research collaborations involving the development of

museum educational programmes for young children. Moreover, there is a limited number of studies presenting the work of communities of practice or action research within museums and/or in the context of museum education (see, for example, Lemelin 2002; Høg Hansen and Mousouris 2004). The subject of participatory action research organised by a museum community of practice for the development of educational programmes has not yet been fully explored.

Challenges for the development of museum educational programmes

Museums belong to the 'non-formal' sources of science education, where learning occurs within organised settings (e.g. programmes) developed on the basis of some sort of learning rationale (Halkia and Theodoridis 2008; see also Keller and Dror 1995; Lucas, McManus, and Thomas 1986). Museums can complement formal schooling, contribute to the development of habits of lifelong and autonomous learning, promote scientific literacy, provide public education and allow citizens access to 'valid, research-based knowledge' that is a feature of a democratic society (Lemelin and Benze 2004, 469; see also Bamberger and Tal 2008). Thus, teachers around the world are strongly advised to take advantage and make effective use of the multi-sensory learning environments offered by local institutions such as museums and science centres since the development of scientific literacy can begin in early childhood and continue throughout schooling (Department for Children, Schools and Families 2008; Department of Education and Skills and Qualifications and Curriculum Authority 2004; Ministry of Education 2007; National Research Council 2011; National Curriculum Board 2008).

There are numerous important requirements for today's museum education. Just like schools and other educational institutions, museums are called to respond to the diversity of contemporary communities and to organise inclusive and culturally responsive experiences taking into account individual differences and the cultural features of students' home communities (Shepherd 2009; Stanislaw 2005; Coffee 2008).

The challenge – especially for museums with a scientific focus – is to complement school learning by offering learning experiences that expand pupils' vision and learning. According to Hodson there are three main kinds of learning that pupils should achieve in science education: 'conceptual understanding' or 'learning science' (which refers to laws, theories, facts, etc.); 'procedural knowledge' or 'learning about science' (which is learning about the nature of science, and the ways it interacts with the economics, culture and politics of society); and 'investigative expertise' or 'learning to do science' (i.e. to solve scientific problems by asking questions, planning, carrying out observations, measuring, analysing and interpreting data) (Hodson 1996, 131–132; Hodson 2003, 5; see also Lemelin and Benze 2004, 469). These three dimensions are integrated into standards, curriculum documents and policies for science education in the contemporary world, to support pupils' meaningful learning in science and the development of scientific literacy (Barker 2004; Department of Education and Skills and Qualifications and Curriculum Authority 2004; Ministry of Education and Religious Affairs 2003; National Academy of Sciences 1996; National Research Council 2011; National Curriculum Board 2008; Ministry of Education 2007; New Zealand Ministry of Education 2007; Fthenakis, Eitel et al. 2008; Fthenakis, Schmitt, Daut et al. 2009; Fthenakis, Schmitt, Eitel et al. 2009; Fthenakis, Wendell, Daut et al. 2009; Fthenakis, Wendell,

Etiel et al. 2009). Museums can usefully complement the work of formal education since it has been reported that schools tend to focus more on conceptual understanding and neglect the other two aspects of learning in science (Lemelin and Benze 2004).

To contribute fully to scientific education, museums need to organise rigorous research into the development of educational programmes and the way they affect learning through specific pedagogical actions. Lack of expertise, time and resources frequently restricts a museum's educational work and its ability to design theoretically grounded educational programmes that respond to contemporary challenges. Based on this realisation, in spring 2010 the education team at the Natural History Museum of Crete, which belongs to the University of Crete, decided to start a collaboration with the Department of Pre-school Education from the same university in order to develop a new and inclusive museum practice for children of pre-school age. In this study we focus mainly on the methodological details of this synergy, drawing on selected findings from Phase A of the project. The full account of Phase A and its pedagogical implications will be the focus of a different study.

The characteristics of synergy

When the synergy with the Department of Pre-school Education was formed, the Natural History Museum of Crete already had its own education team that was working on the design and implementation of educational programmes for young children based on the existing museum exhibits. Thus, the museum had already developed a community which included the three elements that comprise any other community of practice: a domain of knowledge, a community of people who cared about the issues raised within the given domain, and a shared practice developed so that effectiveness within the domain was increased (Wenger, McDermott, and Snyder 2002). The community, however, had a general feeling that it needed additional support to both design and implement inclusive and differentiated educational programmes that could successfully respond to the needs of a contemporary pre-school class. It invited the academic researchers (with a speciality in early years and special needs education) to join the team and help the museum improve on this aspect of their work.

The expanded community of practice that was born of the collaboration between the education team and the academic researchers focused on the following developmental objectives, which, at the same time, became the basic stages of the action research process:

- Through the critical reflection and analysis of its work, to bring its situated knowledge into question and redefine needs, objectives for development and methodology.
- To develop new programmes for the early years.
- To monitor the implementation of the newly designed programmes and make alterations and modifications.
- To liaise with other experts.
- To carry out a formative programme evaluation at the end of each phase of collaboration.

Each of the above objectives/stages is discussed in more detail below.

Bringing situated knowledge into question – defining needs, objectives and methodology

The collaboration between the academic researchers and the museum's community of educational practice started with a series of workshops. These were organised by the academic researchers in order to introduce the community's members to the basic corpus of knowledge that was deemed necessary for the development of programmes for young children. The workshops included an introduction to the three kinds of learning in science education – conceptual understanding, procedural knowledge and investigative expertise – as well as some basic educational theories such as the theory of collaborative learning. The community then used this set of propositional knowledge to question its own very specific (situated) knowledge and the experience it had gained from the design and implementation of educational programmes up to that point. The community came to realise that although it had already defined a wealthy domain of knowledge, this was mainly on the subject of natural history. There was lack of knowledge about educational theories, teaching strategies and issues of inclusion that affect children's learning.

This preliminary work was followed by a community assessment of the 'museum tour' programme that had been offered to young children before the synergy started. The assessment showed that the museum tours were largely focused on the presentation of facts and the so-called 'pure knowledge' (de Bò 1999) that promotes conceptual understanding (Hodson 1996), with no evidence that other forms of knowledge (such as procedural knowledge or investigative expertise) were being cultivated.

The community, then, came to consider two possibilities: to follow a 'donor-recipient approach' (Croty 1998, 155), in which academics could find solutions for the people to implement; or to work collaboratively and find solutions together with the people and the stakeholders of this common project (Heron and Reason 2001). Considering that only 'committed involvement' could lead to transformation and reform (Freire 1996, 51; see also Hargreaves et al. 2001) and a collaborative culture could support the risk-taking and the intellectual and emotional struggle inherent in an educational change (Blair 2000; Hargreaves et al. 2001), the team conjointly decided to embark on a participatory action research project. At the next stage, pedagogical interventions were planned and implemented to investigate the use of a variety of teaching principles (such as child-centredness, self-initiated learning, collaborative learning, and so forth). Thus, the relationship between theory and practice, between propositional and situated knowledge became a hermeneutical one. There was 'oscillation' between theory and practice as the community completed phases of pedagogical intervention, critical reflection and action (see O'Grady 2011).

Developing new programmes for the early years

For the development of new programmes, apart from the pedagogical and methodological context, the team also had to consider that the museum as an organisation had its own characteristics and restrictions that needed to be taken into account: the particular capabilities and needs of the museum educators, the subject of the exhibits, the availability of resources and the spatial features of the museum building were the main factors that affected the development of all educational programmes. For this reason the community decided to 'start slowly' and 'move in small steps', 'one step at a time'. At first (during Phase A), the community started

developing a brand new programme and through this process tried to apply, explore and consolidate new knowledge about children's learning and early years pedagogy. For this purpose it had to meet regularly, plan, discuss and negotiate until the new programme had been designed. Several pilot implementations of the initial design took place and the team assessed the results and made necessary changes and modifications.

The general scope of the newly designed programme, which we will call Version 1, was to develop children's investigative expertise. Thus it focused on investigative procedures that included searching for evidence, observation and the recording of results and findings. The activities were interdisciplinary and the whole programme had a coherent cross-thematic basis. It also made use of some special resources, which included animal bones and fossils, sand pits for digging and some special tools (goggles, spades, brushes) as well as pencils, clipboards and graph paper.

Monitoring the development of the programme: making alterations and modifications

After the launch of the new programme, regular meetings of the community continued in order to monitor its implementation. Through continuous collaboration with the academic researchers, the community members used a variety of tools and data collection methods, which included sound recordings, field notes and questionnaires. Several community meetings were devoted to developing these tools, examining the data collected, analysing and discussing the results in order for the participants to gain a full picture not only of the programme quality but also of the community's own developmental progress.

Monitoring also included participant observation of the programme's implementation by the head of the education team and the two academic researchers. Participant observation was preferred to non-participant observation because observers could support the implementation of the programme at the same time. They acted as critical friends (Day 1999; Golby and Appleby 1995) and learning assistants when the museum educator was leading a particular session. Thus, they were involved in the implementation process, either helping or prompting the museum educator to make decisions and choices that would lead to the successful completion of the activities. Within a friendly and non-threatening atmosphere they helped museum educators to understand the particular learning targets of the programme, to deal with problems arising during a session and to reflect on their own practice in order to develop any further skills necessary for the successful implementation of the programme. They also helped educators to implement differentiated activities that responded to a variety of learning needs and supported children with special educational needs and their carers during the activities. At this stage, action had priority, although oscillation between theory and practice increased as educators tried to apply theoretical principles in practice.

Liaising with other experts

Liaising with other experts occurred as a natural evolution of the community's work. The assessment of the programme by an external expert, a highly specialised professional who is an authority in the development of early childhood curricula,

marked the beginning of another cycle of critical reflection on the results of Version 1. It was also a response to the community's questions about certain issues that emerged from the analysis of data from the newly implemented programme. A specialist university professor was invited to assess Version 1 and make recommendations for improvement. The professor's submissions concentrated on the epistemology that formed the basis of the programme. Version 1 was based on constructivism and (although it did not mean to be this way) was finally developed as a largely adult-centred course of activities. The professor argued that new developments in early childhood education endorse the co-construction of knowledge through the development of dynamic learning interactions between children, peers, educators and members of the wider community. The approach of knowledge co-construction is considered to be a successful way to bring children's voices and perspectives into the curriculum (MacNaughton and Williams 2009; Hedges and Cullen 2005).

These new submissions made by the professor were validated and accepted as they were congruent with the notion of action research although they signalled a major shift for the community's ontological and epistemological assumptions, which will be discussed in more detail below. In practical terms, the endorsement of this aspect meant that the community entered a new hermeneutical cycle in order to modify or even redevelop the new programme, putting new teaching and learning principles into practice. Disagreements and conflicts occurred in this new effort because the community once again had to consider the practical issues of space, children's mobility and learning resources, and the decisions had to be in line with the museum's capacity to accommodate the new endeavour.

Version 2 of the same programme eventually came together. This version retained the learning targets of Version 1 (which focused on the development of children's investigative expertise) and some of its core activities. However, Version 2 also offered children the opportunity to ask their own questions about the topic (their own queries about the life of a large prehistoric animal and the job of palaeontologist) and carry out further investigation in order to find relevant information. Adult-child interaction increased as teachers, parents/carers and museum educators helped children not only to think about and phrase their queries accurately but also to search various sources of information, and collect and record data that would provide the answers they were looking for. Children could choose the issue that interested them the most and join the group of peers and adults that formed around each sub-topic. At the end of the session, children would gather together and present their findings to the rest of the class. Version 2 also developed step by step, after several trials and pilot implementations that explored the methodological details. It was demarcated by an improvement – that of providing some choice to the children and the opportunity to embark on simple research in collaboration with supporting adults. In a way, this first trial aimed at the development of an 'intermediate level' of co-construction, where educators prompted co-constructing through a process of shared play. The community felt again that it needed to move in small steps in order to understand the nature of interaction between learners and the structure of activities within a framework of co-construction. It could then move on to a larger project that was going to totally embrace this idea and develop an 'advanced level' of co-constructing – in which educators and children negotiate and collaboratively define learning targets and procedures according to an individual child's needs (Fthenakis, Wendell, Eitel et al. 2009, 22).

Carrying out a formative programme evaluation at the end of Phase A

At the end of Phase A the community carried out a formative programme evaluation to come to terms with the new developments, the impact of its strategic plans and progress in its actions and knowledge. A methodological triangulation of data (Cohen, Marion, and Morrison 2000) compared the nature of teaching and learning in three different instances of programme implementation: the museum tour that was initially offered to pre-school classes, Version 1 of the newly designed programme, and Version 2 (i.e. the same method of analysis was carried out on three different occasions/pools of data). By comparing these three examples the community sought to find evidence of improvement, detect points of development and define the next step in the action research process.

The major findings of this evaluation will be presented and discussed in more detail below. They provide evidence which shows that through critical reflection and systematic inquiry the community of practice did achieve a gradual improvement of educational practice and a gradual movement towards the target of knowledge co-construction. This is evident in terms of both quantity (more instances that involve children's active participation) and quality (new attributes appear to define educational activities).

Evaluating development

The method. For this evaluation, two representative sessions of each programme were chosen, making a total of six one-hour sessions. The sessions were chosen from a total of 61 that the community had recorded as part of the action research data collection. The criteria for these choices were that the sessions should: be delivered by different museum educators (so that different implementers, with different skills were included); have the normal programme length of one hour (some of the sessions had to be shortened due to late arrivals and others had to be extended due to discipline problems or other difficulties); and provide a fair representation of the school population (i.e. a population that included immigrant children and children with special educational needs). Each session was subjected to qualitative analysis through a coding procedure. This included six general categories of codes: learning targets, children's actions, children's response, the role of museum educator, the role of other adults (teachers and parents/carers), and the use of resources. These categories reflect the aspects of the programmes that changed over the course of the action research. Each category included a variety of sub-codes that were mainly derived from the data. Coded text could consist of words, a phrase or even several phrases and sentences that expressed the meaning of the code. The compartmentalisation of text was largely avoided, especially when meaning was conveyed by a variety of phrases which explained and clarified each other. In that case, a code could be affixed even to a whole piece of dialogue (see Miles and Huberman 1994; Moustakas 1994). Coding was checked twice by community members who did not participate in the initial procedure and who acted as critical friends by searching for any misapprehensions that may have hindered understanding (Altrichter, Posch, and Somekh 1993).

The results. Tables 1–6 show the results of the qualitative analysis that was carried out for the six programme sessions. There is one table for each main category of codes, and for the reader's convenience these tables use the sub-code descriptions

instead of the actual sub-codes. In Table 1, for example, 'learn a fact' is the description for the sub-code 'fact'. The tables present the average number of instances each sub-code appeared in the two sessions that were analysed for each programme.

As we can see in Table 1, the new programmes (Versions 1 and 2) moved away from the mere learning of facts to include targets that aimed to promote children's investigative expertise, which was the community's primary objective. During a museum tour, children were presented with an average of 55 pieces of information (facts about animals or different types of ecosystems). This was an unusually large amount of information, which caused speculation as to how much of it could actually be understood and remembered by young children. The number of facts presented to children dropped progressively in Version 1 and Version 2 and other learning targets appeared. Asking questions, collecting and recording data and drawing conclusions from them are all targets that aimed to teach children 'how to do' science. There was also a number of 'unfocused observations' that were carried out during the museum tour. These were observations during which children were told to look at a particular diorama for about five to 10 minutes without a clearly defined objective (other than thinking whether the environment presented by the particular diorama offered a bear or a seal a suitable 'home' to live in), and without any other attention to the process of observation. These 'unfocused observations' were replaced by an organised process (what we call 'persistent observations'), during which children were encouraged to consciously observe objects, think about what they were observing and record the outcome of their observation.

Table 2 indicates a change in children's activity. Despite their young age, in the museum tour, children were restricted to moving between dioramas and just looking at the exhibits. In Versions 1 and 2 a variety of other actions enriched the children's visit and increased opportunities for movement. The simple viewing of the museum dioramas was reduced and the handling of objects was introduced and then increased. Children were invited to look at a variety of resources and work together in groups. The psychomotor activity, which was a very brief feature of the museum tour (swimming like a seal or walking like a bear), was replaced in Version 1 and Version 2 by an activity in which children were encouraged to consciously explore the concepts of size and weight using their body.

Table 3 shows further improvement, this time in the ways that the children were invited to respond to the activities. In Versions 1 and 2, children were led towards more focused responses, interactions with peers and adults, and given the opportunity to pose their own questions. More specifically, we can see that letting children talk with their peers was not encouraged (it was rather an issue of discipline) in the museum tour and frequently even children's relevant comments were ignored. There were also incidents in which children would make comments irrelevant to the topic (misled by some kind of personal experience). In the newly designed programmes (Versions 1 and 2) this phenomenon gradually decreased and time was allowed for children to pose their own questions or even to make their own hypotheses. In Version 2, children were for the first time offered a choice as to which group they would work with and the particular sub-topic they wanted to explore.

Table 4, which presents the museum educators' role, reaffirms the above conclusion. There was an obvious effort to decrease the educator's talk in each new programme; in particular, the reduction of closed-ended questions (37 during the museum tour decreased to seven in Version 1 and six in Version 2) and the

Table 1. Type and average number of learning targets in the three educational programmes.

Learning targets, sub-code description	Average number of instances over two sessions		
	Museum tour	Version 1	Version 2
Children were required to:			
Learn a fact	55	10	6
Carry out 'unfocused' observations	7	0	0
Carry out 'persistent' observations	0	1	2
Record data	0	1	1
Draw conclusions after data collection	0	2	6
Use their body to explore concepts	0	1	1
Ask questions	0	0	1
Collect data to answer their questions	0	0	1

Table 2. Type and average number of children's activities in the three educational programmes.

Children's activities, sub-code description	Average number of instances over two sessions		
	Museum tour	Version 1	Version 2
Work collaboratively in groups	0	2	2
Look at dioramas	7	1	2
Look at books, photographs, videos, etc.	0	0	2
Handle objects	0	2	6
Draw and/or write	0	1	1
Walk between sections and dioramas in the museum	7	3	3
Move hands (pretend swimming)	1	0	0
Move with heavy steps	1	1	1
Move on all fours	0	1	1
Dig	0	1	1

Table 3. Type and average number of children's responses in the three educational programmes.

Children's responses, sub-code description	Average number of instances over two sessions		
	Museum tour	Version 1	Version 2
Pose own questions:			
Ignored ^a	1	0	0
Taken into account ^b	4	1	19
Make comments relevant to the topic:			
Ignored ^a	19	3	0
Taken into account ^b	15	4	11
Make comments irrelevant to the topic:			
Ignored ^a	5	0	0
Taken into account ^b	3	1	0
Make comments that show misunderstanding:			
Ignored ^a	4	1	0
Taken into account ^b	8	1	1
Discuss with peers and adults	0	2	2
Make own hypotheses	0	0	1
Exercise a choice	0	0	1

Note: ^aIgnored by the museum educator. ^bTaken into account by the museum educator.

Table 4. Type and average number of behaviours displayed by museum educators in the three educational programmes.

Museum educator's role, sub-code description	Average number of instances over two sessions		
	Museum tour	Version 1	Version 2
Pose:			
Closed-ended questions	37	7	6
Open-ended questions asking children to provide:			
A short answer (up to five words)	39	41	35
A longer answer (a fuller sentence of more than five words)	0	0	10
An explanation	6	6	5
A description	1	9	5
A recall (of knowledge or information that had been discussed earlier)	5	6	8
Repeat what the educator said	2	3	0
Provide:			
Information relevant to the topic	17	10	6
Number of new concepts included	2	7	2
Information irrelevant to the topic	38	0	0
Number of new concepts included	17	0	0
Instruct children	1	20	24
Instruct teachers and/or parents/carers	0	4	4
Encourage/praise	12	14	25
Help children at work	0	6	4
Co-construct with children	0	0	1
Encourage children to ask questions	0	0	1
Scribe what children dictate	0	0	2

Table 5. Type and average number of behaviours displayed by other adults (teachers and parents/carers) in the three educational programmes.

Adults' role, sub-code description	Average number of instances over two sessions					
	Museum tour		Version 1		Version 2	
	Teachers	Parents/carers	Teachers	Parents/carers	Teachers	Parents/carers
Ask questions	3	0	3	2	3	2
Instruct children	1	0	4	2	3	2
Make comments	4	0	3	2	3	2
Ensure discipline	3	0	0	1	0	1
Co-construct with children	0	0	0	0	2	2

Table 6. Use of resources in the three educational programmes.

Use of resources, sub-code description	Average number of instances over two sessions		
	Museum tour	Version 1	Version 2
Dioramas	6	1	1
Special tools (spade, goggles, brush, clipboard, graph paper and pencil)	0	1	1
Sand pits	0	1	1
Books	0	0	1
Photographs	0	0	1
Videos	0	0	1

reduction of questions requiring a short answer (39 in the museum tour, 41 in Version 1, and 35 in Version 2). In parallel, there was an effort to increase children's talk via a variety of other activities such as: asking questions that demanded longer answers; asking the children to describe objects, situations and phenomena; recalling information previously given; encouraging the children to ask their own questions; scribing what the children dictated; and, finally, co-constructing with children (questions about the topic). There were also other roles that the educator undertook, such as instructing children on how to pursue the next activity, instructing teachers and/or carers and helping children in their group or with individual work.

There was also another significant improvement that needs to be emphasised: the amount of information irrelevant to the topic was reduced to zero, which brought about the elimination of children's irrelevant comments as seen in Table 3. The type of information that was coded and classified as irrelevant was additional information that bore little connection to the initial topic presented to the children at the beginning of the museum tour: if, for example, the children had to decide which was a good alternative environment for a bear to live in, information such as the names of other animals and details about their life was considered irrelevant. As we can see in Table 4, this was a phenomenon that frequently appeared during the museum tour and it appeared to confuse children, who were distracted by all the extra information.

Table 5 shows that the teacher's and the parents/carers' role also changed over the course of programme development. Parents/carers who had not been allowed to participate in the museum tour eventually became participants in the newly designed programmes. Teachers also did not need to deal with discipline and undertook other roles such as instructing children. Finally, both teachers and parents/carers were given the chance to engage in a process of co-construction with children since they were encouraged to help children to accurately phrase their questions and search for an answer using various sources of information.

Table 6 shows once again that the museum tours were based solely on the use of dioramas. The newly designed programmes introduced other resources that were used for a variety of activities.

On the whole, the above analysis showed the community that there had been remarkable changes regarding the six main aspects that defined the museum's educational programmes. These changes indicated a concerted effort to organise educational programmes that would encourage children's active learning and participation, with the use of a variety of resources and the active involvement of teachers or other supporting adults.

Discussion

The aim of the present study was to integrate the ideas of community of practice and participatory action research by referring to the case study of a synergy between museum educators and academic researchers. The study showed that the community of practice formed by the museum's educational team had benefited greatly from a participatory research project organised in collaboration with academic researchers. There were numerous benefits in this collaboration and the present study focuses mainly on those regarding methodological issues (how to set the objectives of research and monitor their implementation).

On the whole, the community's initial intention to interrogate its situated knowledge was achieved. Museum tours had been developed within the informal theoretical understanding on which the museum staff acted and which drew largely on the epistemology of positivism and behaviourist ideas about the role of children and educators (Bruce 1997; Croty 1998; MacNaughton 2003). The community managed to move beyond this informal theoretical understanding by means of questioning: the learning targets; the nature of children's actions; the way museum educators interacted with children; the nature of interaction between children and other supporting adults; and the nature of the resources used in each programme. Questioning these particular points and testing new knowledge (educational theories, strategies, perceptions, etc.) helped the community to formulate a 'knowledge strategy' that included strategic goals, learning targets, core competencies, teaching processes, and key activities built upon the epistemology of social constructionism (Wenger, McDermott, and Snyder 2002, 7; see also Croty 1998; MacNaughton 2003).

Collaboration in the context of participatory action research enabled the museum's community to monitor its works with scientific rigour. Researchers helped the team devise the most suitable tools, collect appropriate data, and analyse and turn the findings into practice again. The data analysis helped the community define not only the desired end product but also the steps towards its completion. The community for example realised that, since it adopted and made a general commitment to the philosophy and the principles of social constructionism, processes of interaction between adults and children for the co-construction of knowledge should increase in number and have a central place in educational programmes.

Action research enabled the community to relate the context of its work to broader traditions and debates, such as, for example, the debate concerning the context of educational programmes with a scientific focus. Through the participation of external specialists, the community avoided developing a self-referential and context-bound position which could have been highly likely due to the particular characteristics that the museum had as a living organisation (regarding the building, resources and personnel). At the same time the community interrogated the different propositional knowledge sets that were applied to the design and implementation of programmes, testing the educational theories in the specific conditions of the museum. This enabled the community to expand and enrich its domain of knowledge and experience in education.

Participatory action research enabled the community's progressive evolution. Wenger, McDermott, and Snyder (2002) consider that careful community design might involve fewer elements at the beginning of a project in order to allow the community to find its own pace, reflect and direct its own development over the course of time. 'Which community design elements are most appropriate depends on the community's stage of development, its environment, member cohesiveness, and the kinds of knowledge it shares' (Wenger, McDermott, and Snyder 2002, 54). In our case it was the community itself that defined the elements which were the most appropriate to be put in place first, developed during an initial phase in which several assessment and reflection processes guided the community on how to make the most appropriate choices.

Action research helped the museum community realise its value. At the beginning, all efforts were focused on the specific issues and problems related to the development of educational programmes. However, as the community developed,

members came to realise that as well as developing new educational programmes for children of pre-school age, they were also developing 'a systematic body of knowledge' at the same time, which could be shared with the local educational community (schools and families) and the international community through the publication of several research papers and paper presentations in educational conferences (Wenger, McDermott, and Snyder 2002, 59). Dealing with the schools, meeting a specialist professor and looking at different educational theories helped the community to start realising its value and the important role it was already playing in the wider educational community. It also prompted the community to investigate further the museum's potential for becoming a leading agent of educational change. In addition, it enabled the community to realise the importance that non-formal education has in the education of young children and to increase quality control of the educational services of the museum. Members concur that the quality of educational programmes offered to young children increased and that this increased the museum's credibility and the impact of the museum's community on local educational practice and culture.

Conclusions

The first conclusion we can draw from the present study is that a community of practice can not only interrogate and transform its situated knowledge but also move beyond such specifics and deal with the generalities of propositional knowledge. A quick browse of the latest literature shows that dealing with propositional knowledge is not a strange phenomenon in communities of practice, especially those that have been purposefully developed in the contemporary business world and develop into learning communities. Knowledge-based organisations initiate communities of practice for knowledge management and learning – that is, communities formed to share existing knowledge and/or apply and test the new with the optimal goal of improving performance (Snyder and Wenger [2004] 2010). Communities of practice become learning communities when they promote professional learning within a collaborative framework, which enables collective knowledge to emerge and a caring interpersonal spirit to permeate this function (see Morrissey 2000; Stoll and Seashore Louis 2007).

The type of knowledge generated under these circumstances can be both tacit and explicit, situated and propositional. Here there is again oscillation between theory and practice, and knowledge management ensures that there is a meta-analysis in abstract terms which aims at helping community members to realise what they know, how they know it and how they could increase what they know (Saint-Onge and Wallace 2003; see also Morrissey 2000). Fox (2000) and Hara (2009) support the above argument (although they use different terms to describe the notion of propositional knowledge). Fox (2000), for example, claims that 'codified' knowledge can well be a result of work within communities of practice as communities develop solutions useful to all (including professionals from outside the community). In the same line of thinking, Hara (2009) argues that 'subject-matter' knowledge may well continue to be an issue for a community of practice. Most professionals need to keep themselves updated with theoretical knowledge and then learn how to relate and apply it in their practice, a procedure that leads, according to Argyris and Schön (1974, 4), to the integration of thought and action and the emergence of 'theories of action' and 'professional practice' that 'determine all

deliberate [professional] behavior'. The above arguments present a position and stance in agreement with Hammett (2005), O'Grady (2011) and Goodson (2003) (who look into educational practice, namely that professional development could not be narrowed down to spontaneous, everyday learning and practice but involves the significant contribution of propositional knowledge. This is even more the case in social practices, such as teaching and education, which are defined by a dialectical relationship between theory and practice (Rosas C 1997). To a further extent, Goodson (2003) argues that, to avoid turning practitioners into technicians who uncritically implement forms of practice which are being generated elsewhere, a broadened focus of collaborative educational research should allow teachers (and, broadly speaking, educators) a greater degree of authority and control over their knowledge management (as it takes place into their research and, we would argue, practice). In this respect, McNiff (1993) argues for the development of a paradigm of research-based professionalism, a professionalism which will develop by and large upon the premises of research strategies that maximise the potential of the educator's involvement in research work.

Action research can facilitate such an endeavour, first and foremost because it is based on a 'radical epistemology' which integrates propositional knowledge with three other forms of knowledge (namely, the 'experiential', the 'presentational', and the 'practical'). Likewise, results will be valid and more useful if these four types of knowledge are congruent with each other and the detection of incongruities can be part of the action research process (as in our case) (Heron and Reason 2001, 183). Moreover, action research is considered to be a powerful instrument of professional development (Dana and Yendol-Hoppey 2008; Someth 2006). It could become part of the community's strategic plans and sustain the community's organic growth. Keeping up with knowledge development is the key need of every contemporary organisation (Wenger, McDermott, and Snyder 2002) and the advancement of practice is directly related to the individual members' personal and professional development which will challenge the community to keep moving forward (Saint-Onge and Wallace 2003). Communities therefore do not need to 'limit members' activity to apprenticeship for the learning of professional practices or the formation of professional identity and the induction of novices (Cuddapah and Clayton 2011; Lave and Wenger 1991; Wenger 1998). Sooner rather than later, communities need to come to terms with the need for a professional development that successfully meets all the challenges imposed by the contemporary world.

Meeting the challenges and making progress in professional practice – especially in the field of educational practice – might involve changes in understanding, values, and attitudes as well as the behaviour of both educators and pupils. Action research in general can help in advancing beliefs and perceptions and 'reconceptualising' educational practice so as to create new standards in pupils' progress (Sagor 2000; see also Hargreaves et al. 2001; Rosas C 1997). It provides a community of practice with the conditions within which reconceptualising can take place: it enables educators to distance themselves from their practice and critically reflect on it so that theory and practice (propositional and situated knowledge) 'nourish' each other, and to participate effectively in a collaborative process of reflecting and transforming all that educational practice contains (learning principles, targets, results, etc.) (Rosas C 1997, 222). Both communities of educational practice and participatory action research can help participants develop the

shared vision that is necessary for the development of a rigorous and better practice (Sagor 2000). In addition, a more general and valuable corpus of knowledge can be produced when action research is organised by academic researchers who are able to focus on and explore the issue of mediation between academic and practitioner knowledge; that is, mediation between propositional and situated knowledge (Mayer 1997).

References

- Altrichter, H., P. Posch, and B. Somekh. 1993. *Teachers Investigate Their Work: An Introduction to the Methods of Action Research*. London: Routledge.
- Argyris, C., and D. A. Schön. 1974. *Theory in Practice: Increasing Professional Effectiveness*. San Francisco, CA: Jossey-Bass.
- Bamberger, Y., and T. Tal. 2008. "Multiple Outcomes of Class Visits to Natural History Museums: The Students' View." *Journal of Science Education and Technology* 17 (3): 274–284. doi: 10.1007/s10956-008-9097-3.
- Barker, M. 2004. *Key Aims for Science Education in New Zealand Schools in the 21st Century: Messages from the International Literature*. Commissioned Research Report for the Ministry of Education, Wellington, New Zealand. http://www.kiwi.accurriculum/whats_happening/index_e.php
- Blair, L. A. 2000. *Strategies for Success: Implementing a Comprehensive School Reform Program*. Austin, TX: Southwest Educational Development Laboratory.
- Brace, T. 2004. *Early Childhood Education*, 2nd ed. London: Hodder & Stoughton.
- Christal, M., M. K. de Montano, P. Resta, and L. Roy. 2001. "Virtual Museums from Four Directions: An Emerging Model for School-Museum Collaboration." In *Proceedings of the 13th ED-MEDIA 2001 World Conference on Educational Multimedia, Hypermedia & Telecommunications*, June 25–30, in Tampere, Finland, 289–294. ERIC Document Reproduction Service ED46145.
- Clark, B., and C. Burton. 2011. "Sustainability Transdisciplinary Education Model: Interface of Arts, Science, and Community (STEM)." *International Journal of Sustainability in Higher Education* 12 (1): 41–54. doi: 10.1108/1467637111098294.
- Coffee, K. 2008. "Cultural Inclusion, Exclusion and the Formative Roles of Museums." *Museum Management and Curatorship* 23 (3): 261–279. doi: 10.1080/09647770802234078.
- Cohen, L., L. Manion, and K. Morrison. 2000. *Research Methods in Education*, 5th ed. London: RoutledgeFalmer.
- Crotty, M. 1998. *The Foundations of Social Research: Meaning and Perspective in the Research Process*. London: Sage.
- Cuddapah, J. L., and C. D. Clayton. 2011. "Using Wenger's Communities of Practice to Explore a New Teacher Cohort." *Journal of Teacher Education* 62 (1): 62–75.
- Dana, N. F., and D. Yendol-Hoppey. 2008. *The Reflective Educator's Guide to Professional Development: Coaching Inquiry-oriented Learning Communities*. Thousand Oaks, CA: Corwin Press.
- Day, C. 1999. *Developing Teachers: The Challenges of Lifelong Learning*. London: Falmer Press.
- de Boo, M. 1999. *Enquiring Children: Challenging Teaching*. Maidenhead: Open University Press.
- Department for Children, Schools and Families. 2008. *The Early Years Foundation Stage: Setting the Standards for Learning, Development and Care for Children from Birth to Five*. Nottingham: DCSF Publications.
- Department of Education and Skills and Qualifications and Curriculum Authority. 2004. *The National Curriculum for England – Science – Key Stages 1–4*. London: DfES and QCA.
- Fox, S. 2000. "Communities of Practice, Foucault and Actor-Network Theory." *Journal of Management Studies* 37 (6): 853–867.
- Freidus, H. 2007. "The Experience of Experience." *Journal of Early Childhood Teacher Education* 28 (3): 289–299. doi: 10.1080/10901020701555812.
- Freire, P. 1996. *Pedagogy of the Oppressed*. London: Penguin Books.

- Fthenakis, W. E., A. Eitel, D. Winterhalter-Salvatore, M. Daut, A. Schmitt, and A. Wendell. 2008. *Natur-Wissen schaffen. Band 1: Dokumentation des Forschungsking-Methodenwerts* [Natural Science: Volume 1: Documentation of the 'King of Research' Competition]. Bildungsv Verlag Eins: Troisdorf; Bildungsverlag Eins: Troisdorf.
- Fthenakis, W. E., A. Schmitt, M. Daut, A. Eitel, and A. Wendell. 2009. *Natur-Wissen schaffen. Band 2: Frühe mathematische Bildung* [Natural Science: Volume 2: Early Education in Mathematics]. Troisdorf: Bildungsverlag Eins.
- Fthenakis, W. E., A. Schmitt, A. Eitel, F. Gerlach, A. Wendell, and M. Daut. 2009. *Natur-Wissen schaffen. Band 5: Frühe Medienbildung* [Natural Science: Volume 5: Early Education using Mass-media Communications]. Troisdorf: Bildungsverlag Eins.
- Fthenakis, W. E., A. Wendell, M. Daut, A. Eitel, and A. Schmitt. 2009. *Natur-Wissen schaffen. Band 4: Frühe technische Bildung* [Natural Science: Volume 4: Early Education in Technology]. Troisdorf: Bildungsverlag Eins.
- Fthenakis, W. E., A. Wendell, A. Eitel, M. Daut, and A. Schmitt. 2009. *Natur-Wissen schaffen. Band 3: Frühe naturwissenschaftliche Bildung* [Natural Science: Volume 3: Early Education in Natural Science]. Troisdorf: Bildungsverlag Eins.
- Gajić, O., and J. Miliutinović. 2010. "Intercultural Dialogue in Education: Critical Reflection in the Museum Context." *Odgovori znanosti* 12 (1): 151–165.
- Golby, M., and R. Appleby. 1995. "Reflective Practice through Critical Friendship: Some Possibilities." *Cambridge Journal of Education* 25 (2): 149–160. doi: 10.1080/0305764950250203.
- Goodson, I. 2003. *Professional Knowledge: Professional Lives*. Maidenhead: Open University Press.
- Haikka, K., and M. Theodoridis. 2008. "The Challenge of Using the Multimodal Aspects of Informal Sources of Science Learning in the Context of Formal Education." In *Science Education Issues and Developments*, edited by C. L. Petroselli, 151–177. New York: Nova Science.
- Hall, B. L. 2001. "I Wish This were a Poem of Practices of Participatory Research." In *Handbook of Action Research: Participative Inquiry and Practice*, edited by P. Reason and H. Bradbury, 171–178. London: Sage.
- Hammerley, M. 2004. "Action Research: A Contradiction in Terms?" *Oxford Review of Education* 30 (2): 165–181. doi: 10.1080/0305498042000215502
- Hammerley, M. 2005. "What can the Literature on Communities of Practice Tell Us about Educational Research? Reflections on Some Recent Proposals." *International Journal of Research and Method in Education* 28 (1): 5–21. doi: 10.1080/01406720500036653.
- Hannon, K., and A. Randolph. 1999. *Collaborations between Museum Educators and Classroom Teachers: Partnerships, Curricula and Student Understanding*. Research Report. ERIC Document Reproduction Service ED448133.
- Hara, N. 2009. *Communities of Practice: Fostering Peer-to-peer Learning and Informal Knowledge Sharing in the Work Place*. Berlin: Verlag Springer.
- Hargreaves, A., L. Earl, S. Moore, and S. Manning. 2001. *Learning to Change: Teaching Beyond Subjects and Standards*. San Francisco, CA: Jossey-Bass.
- Hedges, H., and J. Cullen. 2005. "Subject Knowledge in Early Childhood Curriculum and Pedagogy: Beliefs and Practices." *Contemporary Issues in Early Childhood* 6 (1): 66–79.
- Herron, J., and P. Reason. 2001. "The Practice of Co-operative Inquiry: Research 'with' Rather than 'On' People." In *Handbook of Action Research: Participative Inquiry and Practice*, edited by P. Reason and H. Bradbury, 179–188. London: Sage.
- Hodson, D. 1996. "Laboratory Work as Scientific Method: Three Decades of Confusion and Distortion." *Journal of Curriculum Studies* 28 (2): 115–135.
- Hodson, D. 2003. *Teaching and Learning Science: Towards a Personalized Approach*. Buckingham: Open University Press.
- Høg Hansen, A., and T. Mousouri. 2004. "'Fuzzy' Boundaries: Communities of Practice and Exhibition Teams in European Natural History Museums." *Museum and Society* 2 (3): 161–174.
- Keller, D., and I. Drott. 1995. "Planning Non-formal Education Curricula: The Case of Israel." Paper presented at the annual meeting of the American Educational Research Association, San Francisco, CA, April 18–22. ERIC Document Reproduction Service ED384996.

- Kindon, S., R. Pain, and M. Kesby. 2007a. "Introduction: Connecting People, Participation and Place." In *Participatory Action Research Approaches and Methods: Connecting People, Participation and Place*, edited by S. Kindon, S. Pain, and M. Kesby, 1–5. London: Routledge.
- Kindon, S., R. Pain, and M. Kesby. 2007b. "Participatory Action Research: Origins, Approaches and Methods." In *Participatory Action Research Approaches and Methods: Connecting People, Participation and Place*, edited by S. Kindon, S. Pain, and M. Kesby, 9–18. London: Routledge.
- Lave, J., and E. Wenger. 1991. *Situated Learning: Legitimate Peripheral Participation. Learning by Doing*. Cambridge: Cambridge University Press.
- Lenellin, N. 2002. "Participatory Action Research in a Contemporary Art Museum: Findings from a Researcher/Practitioner Partnership." Paper presented at the annual meeting of the Americal Educational Research Association, New Orleans, LA, April 1–5. ERIC Document Reproduction Service ED465688.
- Lenellin, N., and L. Benzeze. 2004. "Reflection-on-action at a Science and Technology Museum: Findings from a University Museum partnership." *Canadian Journal of Science, Mathematics and Technology Education* 4 (4): 467–481.
- Lucas, A. M., P. McManus, and G. Thomas. 1986. "Investigating Learning from Informal Sources: Listening to Conversations and Observing Play in Science Museums." *International Journal of Science Education* 8 (4): 341–352. doi: 10.1080/0140528860080401.
- MacNaughton, G. 2003. *Shaping Early Childhood: Learners, Curriculum and Contexts*. Maidenhead: Open University Press.
- MacNaughton, G., and G. Williams. 2009. *Teaching Young Children: Choices in Theory and Practice*. 2nd ed. Maidenhead: Open University Press.
- Mayer, M. 1997. "Action Research and the Production of Knowledge: The Experience of an International Project on Environmental Education." In *International Action Research: A Casebook for Educational Reform*, edited by S. Hollingsworth, 109–119. London: Falmer Press.
- McNiff, J. 1993. *Teaching as Learning: An Action Research Approach*. London: Routledge.
- McNiff, J., and J. Whitehead. 2006. *All You Need to Know about Action Research: An Introduction*. London: Sage.
- Miles, M. B., and A. M. Huberman. 1994. *Qualitative Data Analysis: An Expanded Sourcebook*. 2nd ed. Thousand Oaks, CA: Sage.
- Ministry of Education. 2007. *Science and Technology: The Ontario Curriculum, Grades 1–8*. Ontario: The Ministry of Education. <http://www.edu.gov.on.ca>
- Ministry of Education and Religious Affairs. 2003. *Diathemathiko Enio Plesio Programmaton Spoudon* [Cross-thematic Curriculum Framework for Compulsory Education]. Ministerial Decree (C2/21072b, Government Gazette issue B, nr 304/13-3-2003). Athens: Ministry of Education and Religious Affairs.
- Morrissey, M. S. 2000. *Professional Learning Communities: An Ongoing Exploration*. Austin, TX: Southwest Educational Development Laboratory.
- Moustakas, C. 1994. *Phenomenological Research Methods*. Thousand Oaks, CA: Sage.
- Nakamura, K., V. Erickson, and V. Ford. 2002. "Creating Cross-cultural Exhibits in Schools." Paper presented at the 31st InSEA World Congress, New York, August 19–24. ERIC Document Reproduction Service ED474561.
- National Academy of Sciences. 1996. *National Science Education Standards*. Washington, DC: National Academy Press.
- National Curriculum Board. 2008. *National Science Curriculum: Framing Paper*. Carlton South: National Curriculum Board.
- National Research Council. 2011. *A Framework for K–12 Science Education: Practices, Cross-cutting Concepts, and Core Ideas*. Committee on a Conceptual Framework for New K–12 Science Education Standards. Board on Science Education, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.
- New Zealand Ministry of Education. 2007. "Science Curriculum Achievement Aims and Objectives." <http://www.nzcurriculum.iki.org.nz/Curriculum-documents/The-New-Zealand-Curriculum/Learning-areas/Science-curriculum-achievement-aims-and-objectives>

- O'Grady, K. 2011. "Is Action Research a Contradiction in Terms? Do Communities of Practice Mean the End of Educational Research as We Know It? Some Remarks Based on One Recent Example of Religious Education Research." *Educational Action Research* 19 (2): 189–199. doi: 10.80/09650792.2011.569205.
- Robin, B., S. Wilson McKay, B. Schneider, S. McNeil, and D. Odle Smith. 2002. "A Model for Creating an Art Museum–University Partnership to Develop Technology-based Educational Resources." In *Proceedings of 13th SITE 2002: Society for Information Technology & Teacher Education International Conference, March 18–23, in Nashville, TN*, 11–15. ERIC Document Reproduction Service ED472226.
- Ross C. L. O. 1997. "Using Participatory Action Research for the Reconceptualization of Educational Practice." In *International Action Research: A Casebook for Educational Reform*, edited by S. Hollingsworth, 219–224. London: Falmer Press.
- Sagor, R. 2000. *Guiding School Improvement with Action Research*. Alexandria, VA: Association for Supervision and Curriculum Development.
- Saint-Onge, H., and D. Wallace. 2003. *Leveraging Communities of Practice for Strategic Advantage*. Amsterdam: Butterworth Heinemann.
- Shepherd, H. 2009. "Inclusion and Museums: Developing Inclusive Practice." *British Journal of Special Education* 36 (3): 140–145.
- Snyder, W. M., and E. Wenger. 2010. "Our World as a Learning System: A Communities-of-Practice Approach [2004]." In *Social Learning Systems and Communities of Practice*, edited by E. Blackmore, 107–124. London: Springer.
- Somekh, B. 2006. *Action Research: A Methodology for Change and Development*. Maidenhead: Open University Press.
- Stanislas, C. 2005. "The Dialogic Museum and Ethnocultural Diversity." *Canadian Ethnic Studies* 37 (1): 127–135.
- Stoll, L., and K. Seashore Louis. 2007. "Professional Learning Communities: Elaborating New Approaches." In *Professional Learning Communities: Divergence, Depth and Dilemma*, edited by L. Stoll and K. Seashore Louis, 1–13. Maidenhead: Open University Press.
- Stringer, E. T. 2007. *Action Research*. 3rd ed. Los Angeles, CA: Sage.
- Wenger, E. 1998. *Communities of Practice: Learning, Meaning, and Identity*. Cambridge: Cambridge University Press.
- Wenger, E., R. McDermott, and W. M. Snyder. 2002. *Cultivating Communities of Practice, A Guide to Managing Knowledge*. Boston, MA: Harvard Business School Press.