The Kaleidoscope Scientific Vision for Research in Technology Enhanced Learning

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kaleidoscope

shaping the scientific evolution of Technology Enhanced Learning

the kaleidoscope scientific vision

for Research in Technology Enhanced Learning

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preface to the first edition

Researchers do not normally trouble themselves with 'vision statements'. A vision for a field of research is more likely to be an evanescent and emergent property of its intellectual clashes, than something that can be represented as a joint communiqué. There was some debate within the Kaleidoscope Network over the wisdom of developing an agreed statement on where we believe our research is heading. There is too wide a range of ambitions, too many uncertainties about the intellectual foundations of the field, too little agreement about the most fruitful pathways to pursue.

Against that reluctance stood the sense that, nonetheless, there is something shared by the researchers in this field. Technology enhanced learning is expanding throughout the developed economies, and global education will extend this to the developing economies as well. Researchers believe that innovation in a system will be more effective if it is informed by a scientific approach to understanding that system, in this case: technology enhanced learning. If educational leaders and policy-makers are to envisage a future role for technology in education, then the research community should have something coherent to offer that helps to shape that vision.

The Kaleidoscope Network therefore embarked on the difficult process of agreeing a vision for our research. It was a highly collaborative and iterative process, conducted through face-to-face meetings and an online collaborative document development environment. The result is published here as our first expression of the ambitions of the research and the issues it raises.

For researchers, sharing a common understanding of similarities and differences is an ongoing process. In Kaleidoscope we have now have reached the point where our vision statement is likely to be stable at a general level but within that researchers will continue to argue about what precisely ought to be done, with what priorities and how. Although the statement has aimed for stability in its broad outlines, it will evolve to its next versions by elaborating the detail that will contribute to the realization of our broad vision.

1 introduction

Kaleidoscope is the European Research Network shaping the scientific evolution of technology enhanced learning (TEL). It integrates the leading research teams in the field, who work collaboratively across educational, computer and social sciences to transform the quality and reach of the learning experience. Kaleidoscope fosters innovation and creativity through the development of new technologies, methodologies and concepts, defining the challenges and solutions for interdisciplinary research.

Kaleidoscope's goal is to inform knowledge transfer between education, industry, and the wider society. Through its scientific programme, Kaleidoscope is helping to build a dynamic knowledge-based economy for Europe, engaging with social, economic and political stakeholders at all levels. As a Europe-wide research Network our research is unusually broad-based and multicultural, a genuinely *European* vision for the role of technology in shaping our education policy, embracing the different perspectives of the member states.

At national level, across the EU, and within the Commission itself, there are common ambitions for education – education for all, an improvement in the quality and reach of education at all levels, personalized learning, improved high-level skills for the 21st century workforce – TEL can serve all these aims.

We see TEL in terms of what it can do for both formal and informal learning, serving the most ambitious aims for education. If 'education for all' is an objective, then we want to show how TEL can be a means to that end. If the aim is to improve the quality and reach of education, we can show where TEL has done that, and what more it could potentially do.

TEL research goes beyond the formal education sector to investigate fundamental questions of human learning and development. There is a productive interdependence between instrumental and fundamental research. Our understanding of learning and development informs the design of better learning tools and environments. Conversely, the deployment of these tools creates new contexts for learning, and raise further fundamental questions.

There has always been a gap between research and practice in education. Part of our mission is to use technology to bridge that gap by creating online communities of practice. The teaching community provides a natural test-bed for the resources, tools and environments being produced by the research community. The great advantage of the digital world is that we can share with each other the prototypes, the trial-runs, the data collected – the teaching community can become a dynamic part of the research community (see Annex 2: ART 3D on page 12).

Within Kaleidoscope, technology and pedagogy are considered together, as it is pointless, from a pedagogical point of view, to make ICT-based tools available if the educational strategies, and the activities the learners engage in, are not rethought. Technology can influence learning by fundamentally changing both the way in which it can be taught and learnt, and the nature of the discipline content itself.

"kaleidoscope's goal is to inform knowledge transfer between education, industry, and the wider society."

2 the changing world

We locate learning at the centre of our concerns - both the 'what' and the 'how' of learning, both content and process, both knowledge and skills.

In a changing world it is organisations' and individuals' capability to learn, rather than simply their access to information, that determines socio-economic development.

Information no longer has the proverbial strong link to power because technology provides such wide access now. It is more important to be able to filter, judge and connect information. The competitive edge comes from organizing information into knowledge, which enables more successful action, and from deploying knowledge wisely to benefit society. We are only just starting to understand the design of technology for wise learning, yet this is a priority in a world facing the grand challenges of global poverty and climate change. This continual production, dissemination, and use of knowledge, by individuals and organizations adapting it to their own context, requires us all to keep learning, continually.

Over the last 20 years, the nature of knowledge required in workplaces has been influenced by three significant changes:

- a dramatic increase in the deployment of information technologies as a pervasive, mediating presence within workplace practices - replacing human work, and also informing human work by making information more accessible and usable;
- a change of focus from mass production to prioritising customer requirements on a more individual basis – 'personalization';
- a shift in expectations regarding employees' actions, from the ability to execute specific commands towards a greater ability to conduct personal judgments and take personal initiatives.

The knowledge now required in modern workplaces is therefore changing. As one example, there is more quantitative or symbolic data, processed by information technology, being used in the interactions between employees and customers. The current expectations for personal initiative and creativity are far greater than they used to be. The young generation coming into the workplace is equipped with highly creative and participatory skills through their familiarity with technology. With all the information now available, the distinction between those who can merely "process" it in traditional forms, and those who can glimpse opportunities and create new methods to sort out problems on the spot has widened.

The knowledge society, progressively shifting jobs from manual labour to knowledge skills, across the world, has generated an accelerating demand for education and higher education. Within the educational system, we have to reflect the social phenomena resulting from the new capabilities for networking.

Personal access to technology means that every citizen requires, and is often acquiring for themselves, the technology skills also needed in the workplace. The digital divide is not just between individuals: it is also between home and school, or workplace and university. The education system in every country has to renew itself with respect to the expectations and capabilities of its learners.

Educational contexts are complex and highly varied across age groups, disciplines, communities, cultures – we cannot assume that any particular technology resource or tool will work in the same way wherever it is used. Technologies for learning must be designed for culturally-mediated settings, which themselves are not fixed. They are continually evolving through the interactions between people and technology. The teachers and learners in those settings, whether in schools, colleges, training organizations, or universities, must be able to make the technology their own. They should be able to customise the digital tools, resources and systems we build. Our research therefore emphasises the importance of the *co-design of technology and pedagogy* for effective learning.

3 trends within kaleidoscope

The Kaleidoscope Network of Excellence in TEL embraces a wide variety of labs, and research traditions, but there are clear commonalities in our approach. There are also distinct research trends within the Network, and in this section we indicate both the commonalities and the diversities.

We see 'knowledge' in two different ways. It may be seen as something fairly stable – the expert view, the common knowledge, received wisdom – which is to be passed on, enabling us to learn from others. It may also be seen as something quite unstable – the product of our experience, practitioner knowledge, local wisdom. There is a continuous interplay between the two - we rely on stable representations and treat knowledge as independent of context, and at the same time have to engage in 'work' to make sense of them in a particular setting – then creating new stable representations and so forth. The two types of knowledge are complementary.

Traditionally, formal education has focused more on the transmission of stable knowledge established by scholars and scientists. But education is now recognizing the importance of equipping individuals with the capability to produce their own knowledge – to continue to learn from their own experience and interactions with others. The skills of enquiry, analysis, synthesis, collaboration, knowledge negotiation, evaluation, communication, are the high-level cognitive skills that we all need as citizens and as a workforce.

Technology supports both expert and practitioner knowledge. It can support the teaching of stable knowledge, as in tutoring systems, or in computer-supported inquiry-based learning. And complementing this, a key theme in Kaleidoscope is research that focuses on supporting the development of 'practitioner knowledge' through interactive and collaborative online environments in which users can create and negotiate new ideas or representations of their practice. This work continues the research tradition created a decade ago by the EC, to "take a human-centred approach to the exploration of new, visionary interactive systems for people in their everyday activities" (see, for example, Annex 2: Magic Forest, Dragon Pathways, MyArtSpace see page 12).

These projects reflect an ongoing interest in the educational potential of computer games and the ways games can facilitate learning either in formal or informal ways. The term 'game-based learning' has been introduced to describe the forms of learning 'accomplished' through the process of playing games. This research area within Kaleidoscope has now coalesced around the "Learning Patterns for the Design and Deployment of Mathematical Games" joint activity.

Kaleidoscope projects share a vision of technology as a unique way of enhancing learning, enabling us to learn in powerful ways. When you build a spreadsheet model of how a system works, you are learning a lot about its operation and features. Information technology is not just about the information we see presented in models and on web pages; it concerns also the ways we can represent our actions, perceptions and experiences in terms of information that a computer can interpret and use. Once that happens, the technology begins to mediate our thinking, taking it further than it might otherwise go. Similarly, communications mediated through technology become enhanced in ways that are not possible when they are purely face-to-face, auditory, or print-based. The technology can capture our fleeting discussions, for example, or invite us to address wider or narrower audiences, or structure our debates.

A strong research trend, especially in the Eastern European research labs, is the use of programming languages to encourage thinking skills. Programming languages allow learners to develop insights on their own thought processes, and express ideas in terms that must work when interpreted by a computer - wishful thinking is not enough, and a working program provides a rigorous test of ideas. Kaleidoscope projects study the use of computers to develop creativity and personal constructions of knowledge, including procedural knowledge and knowledge about complex systems, not just the analysis of well-behaved and known-in-advance data. For 40 years, research has

stemmed from Seymour Papert's ideas about the relevance of computer programming and related skills to achieve a better understanding of real-world processes, content, and our own thinking processes.

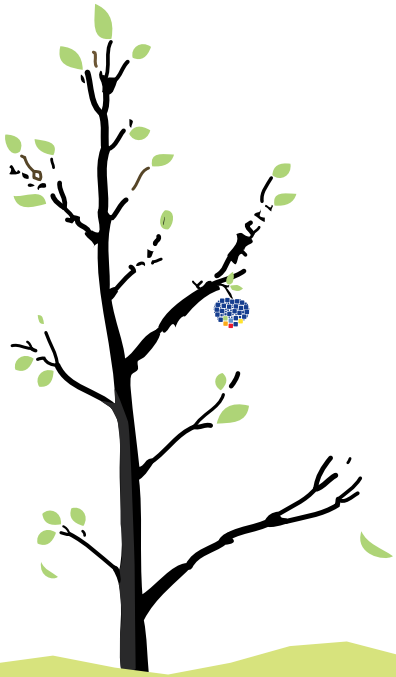
Although Papert's vision has suffered substantially over the last half-century, due to a widespread technocentric misinterpretation of his ideas, there has been a steady and cumulative research effort, particularly in the field of mathematics education. Recently, this work has resulted in radically new manifestations of the Logo idea (for example, NetLogo). Several of the research groups within Kaleidoscope are now working in this area, bringing to it a greater level of theoretical support and methodological know-how. A recent EU-funded example, involving many Kaleidoscope members, is the WebLabs project (see Annex 2).

New internet services and social software can facilitate productive learning in formal or informal ways. The term 'networked learning' has been introduced to describe the forms of learning taking place in groups or in communities to promote connections between learners, tutors and educators, and between a learning community and its learning resources. Research in this area within Kaleidoscope concerns both the conceptualization of networked learning practices through the exploration of new tools, and research on productive ways of organizing and designing for networked learning.

"Kaleidoscope projects share a vision of technology as a unique way of enhancing learning, enabling us to learn in powerful ways."

The affordances of mobile technology bring many advantages to learning, both formally and informally. Its ubiquitous nature puts the learner very much in control and supports collaboration with others, enabling learning to take place both inside and outside the classroom. Mobile learning supports many types of pedagogy, but is particularly suited to inquiry-based learning (IBL) and computer-supported collaborative learning (CSCL). The Kaleidoscope Network has now brought these three research areas together in a convergence initiative to explore the learning patterns, learning designs, task structures and learning activities they have in common that are most effective for learning.

There are contrasting but complementary research methodologies represented in the Network, embracing both the quantitative, experimental approach to educational research, and the qualitative, ethnographic approach. Both are needed to cover the different kinds of research questions found within the substantive topics outlined above.



4 changing the world of learning: challenges for research

As soon as we represent knowledge in some medium, such as a book or a diagram, that process reshapes it and the way it is learned.

One challenge for research, therefore, is to decide how to represent the content and process of learning in a digital medium. For example, it would be possible to represent some aspect of a national economy as an animated diagram of the changing relationships between various parameters. Or it could be represented as a simulation model, allowing learners to change the rate of inflation, say, to achieve the best effect on employment. Or they could compete to achieve the better effect. Or they could collaborate to find the best input. Or the data could be represented in a table and the learner given the task of designing the model that matches the data. These representations are experienced very differently by learners – but what is the pedagogic difference between them? What do they learn differently from working as an individual than in a group, from observing, experimenting, competing, collaborating, constructing? TEL supports all these different forms, so one challenge is to make them available as learning design tools for teachers to explore for themselves the different pedagogies they offer.

A second challenge is that we have to allow for the fact that learning is always context-dependent. The TEL product, and the context in which it is used, must each shape the other. The challenge for research is to design and build the TEL products that allow the varied local contexts to shape them. Educational software that cannot be adapted to its environment does not survive. This is the clear conclusion from several decades of development of specialized resources that have not been taken up by teachers, partly because they cannot take ownership of them as they can of a book (which can be selectively photocopied) or an interactive whiteboard (where they can create their own content).

Kaleidoscope is working towards establishing TEL as a proper interdisciplinary research field, finding a nexus for the many different orientations and approaches currently present.

Further challenges to the research community come from the ambitious aims of national and EU policies for education:

- Access to knowledge
- Empowerment of people and communities
- Massive participation, at all levels, i.e. learners should shape learning
- Acceleration

The role of TEL is to achieve the improvement in the quality and reach of education implied by our highest aims for education. *Improving quality* means using TEL to change the way learners encounter and engage with knowledge: it can rehearse them in the high-level cognitive skills of negotiating ideas, exploring systems, collaborating on projects, constructing their own representations of knowledge. *Improving reach* means exploiting the internet to bring wider access to knowledge and communities of practice: technology can bring far greater flexibility to the ways in which learning and education are conducted. TEL provides, potentially, the economies of scale and remote access that make possible the widest participation in education. The role of the Kaleidoscope Network is to demonstrate this potential. The role of the Commission is to realize this through the political and organizational change needed to exploit technology.

In recent EU Policy Frameworks education, training, human resources and employability are being integrated and increasingly related to reforms in national learning systems in Europe, in the frame of the lifelong learning perspective. In spite of the fact that all these policy strands recognize the priority of human resources development and citizens' empowerment, research on education and training in Europe has a number of critical weaknesses, which might jeopardize the ambition of Europe to grow and generate new employment.

A major problem for TEL is the knowledge gap on learning innovation. The problem derives from the lack of priority for comprehensive learning innovation within research programmes, the lack of accumulation and utilisation of current practice and the few available research results, and the lack of proper consolidation of the knowledge now available.

One important historical shift is presented by the ODL Liaison Committee, which proposes concrete initiatives and recommendations for actions by EU institutions, national governments and other stakeholders of education and training systems:

- to promote educational innovation research and its coordination by well-organized measures at EU and national level,
- to increase the relevance of educational research in Europe, and
- to evaluate and systematically utilize research results,
- thus maximizing the impact of research on innovation, and the effectiveness of education and training systems, and to better link policy, research and innovative practice (see ODL Policy Paper 2006). The paper proposes one recommendation that is particularly relevant to Networks of Excellence in the EU: to establish collaboration channels, common value commitments, and a vision for future Lifelong Learning in Europe.

"the challenge for research is to design and build the tel products that allow the varied local contexts to shape them. educational software that cannot be adapted to its environment does not survive."

5 mechanisms to make the change happen: research practice

Research in TEL is typically not supported in its own right. Researchers often target funding for either educational research or computer science research to gain funding for TEL research. This makes it difficult to foster interdisciplinary research that forges the collaboration between education and computer science that is needed to make real progress in TEL.

Research in TEL needs:

- multidisciplinary teams, where research is led by one discipline, and supported by others
- interdisciplinary teams, where two or more research disciplines join forces in order to solve a problem of mutual interest
- sub-communities of researchers who gradually accumulate and share research findings
- laboratories, where innovative technologies can be developed and transferred to learning environments for testing
- a diversity of methodologies, for coverage of the human, organizational, and technological challenges set by TEL.

The products of TEL research need a robust process to ensure they are adopted. Commercial products have the route to market that research products, usually only developed as prototypes, do not have. There are several reasons for this. First, there is a tension in social science between innovation and knowledge cumulation. In the academic culture, it is easier to stand out by offering a counter-position than by integrating existing work. Research builds on what has gone before in terms of theory and findings, not in terms of products and artefacts. The outputs of academic research are therefore rarely packaged in a form that would be reusable by others, because no research project has a budget for making its code reusable. In any case, researchers in education are experts in educational research, not software production. Hence, in many cases, even if they were to invest in productization, the result would not be up to industrial standards. For the outputs of our research to reach into classrooms and colleges, good collaboration with publishers and the digital industry would be one way of ensuring this.

The research community therefore needs to explore ways of collaborating with the digital industries to embed research in commercial products, and to bring commercial funding into research development. The experience of Kaleidoscope shows that commercial developers can be engaged with the research community when there is a flourishing user group model.

The TEL research community should also reach beyond researchers to the teaching community. We can use technology to support teachers and lecturers in collaborative 'open teaching' that turns them into players in a community of innovation and discovery, sharing and building on each others' outputs – dramatically changing the practice of teaching, of course, but also enabling teachers – those of us who have access to 'fieldwork' with students every day – to contribute to the research process. They represent a different kind of researcher – action researchers, perhaps – but they have a great deal to contribute.

It would be possible to create an open research community, which spawns from the members' own ideas and projects, using social software and social networking tools, similar to 'sourceforge.net'. A commitment to open research would operate on three levels:

- open outcomes: all the fruits of research should be freely available to all citizens of the world.
- open tools: any technology we use or develop to support our research, such as the platform we're using here, should be free and open source.
- open process: we should find ways to expose our work and invite collaboration from its early stages, while acknowledging the need to maintain a clear structure of academic credit and critique.

An example of an open research community from the experience in Kaleidoscope is given in Annex 2. We recognise that, more generally, the 'open education' movement is gathering pace. The UK Open University's OpenLearn initiative is a recent example, in addition to the others round the world already under way.

The experience of Kaleidoscope shows that online collaborative technologies support an open research community by allowing us to:

- develop a shared research laboratory for this field,
- support scholars in collaborating on a virtual doctoral school for European post-graduates,
- provide an open archive of research documents.

It has also shown us that these processes need to be moderated, and subject to agreed policies, if they are to work really effectively.

6 research programme

Collectively, from the work carried out over the last three years, Kaleidoscope researchers have identified 10 issues for the future of research on TEL, described in a paper about the future of Technology Enhanced Learning (see Balacheff, 2006):

1. An ambitious research programme combining collaborative learning, mobile learning and inquiry learning would be an excellent basis for questioning the concepts and theoretical framework underlying these sectors, and for developing a comprehensive approach.

2. Research is needed to address professional learning and training, based on highly realistic and interactive simulations, microworlds and role-play environments, allowing a deep immersion in virtual and/or augmented reality, providing access to the acquisition of embodied knowledge. There is a need to develop a more efficient and more relevant multimodal interface able to track and analyse learners' behaviours and to provide symbolic, graphic and haptic feedback.

3. A strategic research agenda should cover all cognitive and technological issues related to the design and compatibility of highly interactive learning objects, as well as their use. It means developing a new ecology of learning, which embraces not only the cognitive and technological issues, but also the socio-cultural, socio-organizational, and institutional issues.

4. The TEL research agenda should include the search for models accounting for learning as an emergent process in complex systems whose ecology is shaped by social, epistemic and technological factors. These models must be empirically valid when confronted with actual use, and computationally tractable to ensure cost effective and efficient transfer.

5. Blended learning, from a practical and theoretical perspective, needs concepts and models to support its development and ensure its efficiency. These concepts and models must address all the issues of compatibility, applicability, interoperability, and validity of the de-facto standards and specifications of the large variety of learning objects and environments likely to be involved in more and more complex learning situations.

6. It would be very productive to create a collection of domain specific evidence and research based recommendations, in order to inform practice and actual use of TEL. This would enable us to explore the differences and commonalities with respect to design principles and use of TEL environments, and to improve our understanding of the challenge of TEL from an epistemological perspective (computational transposition, new epistemological structures of communication and social interaction, fundamental questions of the philosophy of TEL, and the evolution of education and cognition).

7. The use of digital technology for the certification of knowledge and skills will be a driving force for the deployment of TEL. Research must contribute to the "decompartementalization" of learning practices and examinations and assessment either at school, or in the work-place, or to validate informal learning.

8. Support is needed for technology-enhanced innovative authoring and learning systems, tools and services, organised in a flexible software architecture, enabling the creation of a domain-specific platform that takes into account the context, and allows dynamic adaptation to different learners based on substantial advances in pedagogical theories and knowledge models.

9. It is critical to enhance the support of the experimental dimension of research in TEL by providing frameworks for the description of experimentation settings and processes, and frameworks for the description and annotation of experimental data. This would enhance the capability to share, manage and compare data, taking up the challenge of combining multiple disciplinary frameworks, tools and methods for gathering experimental data in a meaningful way. We need to provide the infrastructure for managing and sharing all this information and data, as well as supporting research collaboration.

10. The complex process of adoption of TEL in the different learning contexts is at the centre of where we should concentrate research efforts in the near future.

6 research programme (continued)

Our research programme will be built from the analysis in the preceding sections, and from thinking through these critical issues. Ultimately, the research questions we address will be directed at the practical educational advantages to be achieved through TEL. Currently the broad research questions include the following:

More specific questions include, for example:

- How do we optimise pedagogic and collaborative support within intelligent TEL environments to support the development of mathematical thinking – analysing, generalising, modelling?
- How do we support learners in the use of mobile communications environments for collaborative inquiry-based learning, and their teachers in collaborating on the design of such environments and tasks?
- Can TEL be made more effective for low literacy, linguistic, and numeracy skills, by building on both the findings from cognitive neuroscience relating to capacity issues for such learners, and on the best practice of special needs teaching community?
- How can the substance of learning be transformed by the design of adaptive systems that take account of the social and cultural embedding of learners?
- How might digital technologies afford a wider range of educational possibilities in epistemology (what might be learned and how) and equity (by whom can it be learned and when)?
- In what ways can digital technologies be deployed to foster more open and accessible routes for learners throughout the life course?
- How does technology support the process of 'negotiation of meaning' in the context of learning?
- Can we design methodologies for exploring the possibilities of more productive learning, i.e. learning which is more successful and efficient in achieving its intended outcomes?
- What are the social and cultural opportunities and constraints for the embedding of digital technologies in learning and teaching?
- How does TEL support the role of teaching, by the teacher, and by peers?
- How can technology be used to support every learner achieving their learning potential?

annex I:
the collaborative development process

1. The development of a document presenting the Network's vision for the future of TEL research was initiated in spring 2005 by Nicolas Balacheff and Richard Noss, two of the Network's founders. Following their first draft for Network members to review, a Task Force was formed in February 2006 to refine the document and engage the wider community of Network members. This Task Force included the original authors and four more senior researchers from across the Network.

2. The Task Force argued that as befits a Network of Excellence in TEL research, the development of a shared vision should be a collaborative learning task, supported by innovative and efficient technology. During the summer of 2006, the Task Force commissioned a technical team to design a process for developing the vision document and a set of on-line tools to support it. The challenge identified for this process was to capture as broad as possible an image of the intellectual capital of the Network, while maintaining a manageable, high-quality text (this is described in more detail in the Technical Report).

3. What emerged was an iterative consultation process that combined live synchronous events with on-going asynchronous discussions. The base assumptions were:
   - Network members are all experts in their fields, and knowledgeable in related fields.
   - Network members are motivated to contribute to the vision statement, yet at the same time limited in their time resources.

4. The result was a hyper-document built in concentrated bursts of activity, spread over a four months period.

5. Initially, the Task Force published a skeleton document, based on the first draft by Balcheff and Noss, outlining the major issues to be addressed in the Vision statement, and offering short propositions for members to react upon. The Network members were then asked to comment and discuss these propositions. Based on this discussion, the Task Force elaborated the document – expanding sections and adding new ones. After two asynchronous iterations, the emerging draft was presented at a live 'webinar' which included a Q&A session. After a further asynchronous iteration, the revised document was presented for discussion at a Network executive event.

6. We recognised that our vision would need to evolve over time, and wanted to embed this capability into our initial development of the Vision statement. To this end, the Vision Task Force established the online collaborative tools needed: the online asynchronous discussion environment, and a synchronous discussion environment ('webinar'). All members of the Network were informed of the schedule for contributions to the successive drafts, and were sent reminders of each deadline. The Task Force drafted sections for discussion, and incorporated the points made into each successive draft.

7. The collaborative tools have been integrated with the CCI portal system, and will be re-used for further development of the Vision statement. In this way, we intend to refresh and renew our Vision statement as our scientific understanding of the field develops.

8. The current version of the Kaleidoscope Scientific Vision statement will remain available on the Vision website: **http://vision.noe-kaleidoscope.org/**.

annex 2: project exemplars

art 3d

Cnotinfor is launching an innovation and development project – ART 3D (Aprendizagem enRiquecida pela Tecnologia 3D) strongly based on researchers, decision makers, designers, developers, content editors and end-users (teachers, students and parents) involvement in all phases.

The creative and iterative development cycle methodology fosters the active participation of all players in designing and building the learning tools, and in testing and using them. This is something Cnotinfor has always promoted, but within this project, involving several Universities and schools, we go further in adopting a systematic and research supported approach.

magic forest and dragon pathways

These microworlds are powerful environments for children to build narrative learning environments and games in an easy way (see Microworlds). Due to their object-oriented approach they enable the learner to focus on the properties of each element of a narrative or game and on how each of them interacts with each other. This interdependency appears as an emergent behaviour. The user does not need to build up the entire structure, nor to detail all the sequences of the narrative. They simply define rules for objects and then marvel a the predicted and unpredicted results that incite them further to create new narratives.

Magic Forest was the most successful outcome of the Playground Project (www.ioe.ac.uk/playground/), funded under the i3 initiative (intelligent information interfaces), created a decade ago by the EC, in order to "take a human-centred approach to the exploration of new, visionary interactive systems for people in their everyday activities". Playground set out to build child-programmable environments for 4-8 year-olds to play, design and create games.

Magic Forest and Dragon Pathways, using an iconic rules-based object-oriented programming language, make it easy to animate any situation, should it be a story, a game or a simulation.

myartspace

25. This environment enables learners to create and negotiate new ideas. The premise behind MAS is that teachers discuss an open question with the students. The students then visit a technology-equipped museum and with handheld technology they curate their own interpretation of the visit, using a combination of resources provided by the museum and their own perspectives captured through photos, notes and recordings. These form the basis for sharing, reflection and discussion back in the classroom.

weblabs

26. The WebReports system is a web-based collaboration platform developed by the WebLabs project (see WebLabs). It was conceived as a tool for teacher-led communication between remote groups. The unique feature we designed for was 'Objects to talk with', allowing users to embed artefacts they had constructed in the conversational medium. Through an iterative design methodology, it evolved into a comprehensive learning medium that combines individual and social epistemic forces by supporting construction, communication and collaboration. PhD students in the Kaleidoscope Network have used the programming language 'ToonTalk' in pre-schools.

an open research community

The joint activity "Learning Patterns for the Design and Deployment of Mathematical Games" used the webpage of the project (that was built upon the properties of an open source tool) to communicate and exchange ideas and data with other partners as well as present the work and share the outcomes of the project with other researchers. The methodology and the tool used in this work could be utilized as a model for open research as follows:

Open outcomes:
The outcomes of the project (deliverables, papers, workshop outcomes) are available to all users within or outside Kaleidoscope and are fully accessible and downloadable from anyone.

Open tools:
The platform consists of interactive tools that were developed during the project. These tools were connected and were updated if one of these was changed. The primary function of these tools was to allow us to efficiently manage the pattern language (that was one of the aims of the project), and make it easy to use by any interested reader. For example, one of the project aims was to produce patterns (see Learning Patterns, 2006. These patterns followed a structure (high patterns with subcategories). In order to be able to show both the structure of the patterns created and the content of each pattern, several tools were used and each of these was interactive, as the user of the platform could jump from one to another.

Open process:
In every stage of the work all the tools were available to users to enable them to post comments and participate by critiquing the work in progress.

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http://www.lkl.ac.uk/kscope/weblabs/

authors

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