Bridging disciplines: 
The natural resource management kaleidoscope for understanding ICTs

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Abstract

The potential of information and communication technologies (ICTs) as tools to enhance the development of rural and remote regions remains largely undetermined. The component technologies are designed as commercial tools for industrialized settings and the fact that they have potential for rural and remote community development worldwide is an add-on. The role and impact of the new technology is so vast that a multidisciplinary approach is needed to appreciate it. There are a growing number of tools and diagrams in the literature to capture the multiple dimensions of ICTs, and they all seem to fall short of capturing their very essence. In other words there is a need for a new epistemology to guide this process. This paper provides elements for that epistemology from the field of natural resource management (NRM). The fields of natural resource management and information and communication technology for rural development share several features: they involve multiple dimensions and technical disciplines, multiple stakeholders are involved, a seemingly endless number of variables and indicators need attention, and there is increasing unpredictability and complexity. Four pillars are proposed towards a new epistemology to understand ICTs as tools for rural and remote community development: acknowledging diversity in paradigms; embracing pluralism; embracing a systems approach; and emphasizing learning and participation. The paper describes ongoing action research with attention to stakeholder engagement in planning, tracking impact, and creating local capacities.

Keywords:
Interdisciplinary research, information and communication technologies (ICTs), natural resource management, learning, systems thinking, multiple perspectives, rural, remote, community development, uncertainty, epistemology

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1. Features of information and communication technologies as development tools

The potential of information and communication technologies (ICTs) as tools to enhance the development of rural and remote regions is difficult to grasp. A recent report suggests that observation and measurement in the field of ICT seems to be the most neglected area of policies and projects, particularly in rural areas (OECD, 2001). The initial hype about their potential was biased on a glorified technological promise but the early advocates were apparently unaware of the underlying social, regulatory, and economic barriers that continued to constrain rural and remote societies to a continued marginalization. No wonder some communities could run with the new opportunities and others not; the so-called digital divide had precedent ‘divides’ in all sectors, namely in health, education, jobs and economic opportunities. And yet, even the most cautious critics suggest that something is happening; that there may be benefits if the tools are appropriated carefully (Heeks, 2002). Questions arise such as: What exactly is happening? And through what lenses can it be appreciated? These questions can only be addressed through an inexact science, perhaps more of an art. This article attempts to contribute some building blocks into this art, as if one were providing mirrors to assemble a new kaleidoscope.

Information and Communication Technologies (ICTs) are often defined as technologies that facilitate communication and the processing and transmission of information by electronic means. This interpretation encompasses a full range of ICTs, from radio and television to telephones computers and the Internet. However, if we think more broadly about communication systems -whether they are electronic or not- they are part of the menu of media opportunities at hand: story telling, theatre, cassettes, illustrations, local newspapers, radio, video and music, etc. There is merit in combining electronic media with other media that people already like, use, and know how to control. For example community radio stations with a link to the Internet are becoming an important option.

The need to invent a new means for assessing the potential of ICTs stems from the fact that they are essentially misplaced tools. The component technologies tend to be designed as commercial tools for industrialized settings and the bulk of software development is meant for literate and English-speaking users. The fact that they have potential for rural and remote community development worldwide is an add-on. Those who are able to make them work in these settings are true visionaries. They are community-development workers who match-make –or mediate- among the needs of communities, the potential of the technology, their cost, and the public programmes available to subsidize their development. In many cases, they create organizations that provide computer literacy and stimulate demand for ICTs by offering public access sites where people can lose their fear of the technology, play with it, and realize its potential (Ramírez, 2001a).

ICTs rely on telecommunication networks that require major investments. Like with other infrastructures in the past, the intrinsic potential of the technology is often sufficient
Rationale to convince policy makers and regulators to invest vast amounts of capital for their expansion, even when the outcomes are difficult to predict, let alone quantify them (Sawhney, 2001). This leap of faith is also needed at the individual level; just think about the first time you used a computer (van Dijk, 2001). Ironically, as the technology becomes more sophisticated its potential becomes less predictable (Bar, et al., 2000). One reason for this is that it begins to affect multiple dimensions of every-day life of businesses, residences and public organizations; furthermore it creates new services that were unimagined before. The notion of a single best practice begins to appear as an elusive goal (Mansell, 1999). Instead, we are faced with multiple opportunities, each with the potential to be integrated into a specific context. This calls for efforts that are "... targeted at very clear activities, as simple and self-contained as possible, which are identified by stakeholders themselves as critical and representative of what can help them be better off". (Menou & Potvin, 2000). So, on the one hand their impact needs case-specificity, and on the other their potential affects so many dimensions that their impact requires flexible, participatory and evolving methodologies (Stoll, et al., 2002).

If what we are facing is indeed a collective journey into the unknown, then it is argued here that we need a new language to understand it. In particular, feminist writers and development communication analysts stress the needs for a new approach (Balit, 1999; Jansen, 1989). The kaleidoscope metaphor works well in that this tool is adjusted to each context; in addition, what we observe changes as we aim the tool to find the light that surrounds us.

2. Assembling an epistemology

The role and impact of the new technology is so vast that a multidisciplinary approach is needed to appreciate it. In the book ‘The Network Society’ Jan van Dijk dedicates a chapter each to the technology, the economy, politics and power, the law, the social structure, culture, and psychology, before venturing into conclusions and policy perspectives (van Dijk, 1999). There are a growing number of tools and diagrams in the literature to capture the multiple dimensions of ICTs (Melody, 1996), to track the myriad of indicators (Mansell & Wehn, 1998; Minges; Kirkman, et al., 2002), to describe the phases of the Internet (Bar, et al., 2000), to model the way people access technology (van Dijk, 2001), and to capture the impact across every component of the industry.

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2 Harmee Sawhney mentions an anonymous quote that conveys this notion rather well: "One does not build bridges by counting the number of people who swim across the river".

3 In the midst of this multi-dimensional complexity, some short-term evidence of positive, short-term impact in rural areas is beginning to appear. There is growing evidence that for rural people rural phones and email communication are more cost effective relative to having access to Internet-based information (Best & Maclay, 2002; Kenny, 2002). The positive consumer surplus (the savings incurred minus the cost of a phone call) can be significant enough to attract private investors to rural areas, as long as the regulatory environment is attractive (Richardson, et al., 2000).

4 Such metaphors are not new: Kai Lee refers to the compass and the gyroscope to describe the complex relationships between science and policy-making (Lee, 1993).

(Houghton, 1999). There is also community development literature where the impact of ICTs on enhancing communities has become a focus of research (Pigg, 2001). In the end, however, we have to wonder: what is the nature of the beast we are trying to describe? Do we have an epistemology to guide us through this process?

This paper provides elements for that epistemology from the field of natural resource management (NRM). In NRM, physical scientists and social scientists have already come to realize that their particular science is too narrow and that new insights are needed to capture a complex, ever-changing context with endless variables and indicators. To complicate matters, many other stakeholders are now in the picture and their perspectives are also different and cannot be ignored.

**Building block No.1: acknowledging a diversity in paradigms**

The overall perspective or paradigm that shapes the way we approach problem solving needs acknowledgement. The underlying appreciation of reality, the research approaches, the planning tools, and the different implementation mechanisms are not shared by all. Figure 1 shows how the modern and post-modern currents in development display significant differences (Maxwell, 1996).

Figure 1. Modern and post-modern currents in development (Maxwell, 1996: 161)

<table>
<thead>
<tr>
<th>Modern</th>
<th>Post-modern</th>
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</thead>
<tbody>
<tr>
<td><strong>Underlying reality</strong></td>
<td></td>
</tr>
<tr>
<td>Objectives</td>
<td></td>
</tr>
<tr>
<td>Simple, uniform</td>
<td>Complex, diverse</td>
</tr>
<tr>
<td>Preoccupation with macro</td>
<td>Development</td>
</tr>
<tr>
<td>Research approach</td>
<td></td>
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<tr>
<td>Measure</td>
<td>Preoccupation with micro</td>
</tr>
<tr>
<td>Survey</td>
<td>Listen</td>
</tr>
<tr>
<td>Reductionist</td>
<td>Participatory Rural Appraisal</td>
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<tr>
<td>Deduction</td>
<td>Holistic</td>
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<tr>
<td>Abstract models</td>
<td>Induction</td>
</tr>
<tr>
<td>Aggregate</td>
<td>Complex reality</td>
</tr>
<tr>
<td>Planning approach</td>
<td>Disaggregate</td>
</tr>
<tr>
<td>Plan</td>
<td>Enable</td>
</tr>
<tr>
<td>Model</td>
<td>Interact</td>
</tr>
<tr>
<td>Top-down</td>
<td>Bottom-up</td>
</tr>
<tr>
<td>Centralize</td>
<td>Decentralize</td>
</tr>
<tr>
<td>Implementation</td>
<td></td>
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<tr>
<td>Blue-print</td>
<td>Process</td>
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<tr>
<td>Role culture</td>
<td>Task culture</td>
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<tr>
<td>Standardization</td>
<td>Flexibility, innovation</td>
</tr>
</tbody>
</table>

A major challenge here is the fact that the technologies and policies behind ICTs ‘exist’ in the modern paradigm, and their advocates thrive within this perspective. However, when these tools are put to work in rural and remote settings, it is argued here that their performance and ‘impact’ are best appreciated in a post-modern paradigm. The settings they are embedded in are not the ones they were meant for – hence the need for the ‘mediators’ that was mentioned earlier. Moreover, the settings are varied and the appropriation of the technologies depends to a large extent on the amount of local control and adaptation that takes place. In other words, their role and impact can only partially be predicted; indeed, much of it will emerge from local interactions and creativity. Their relevance is in fact constructed locally to fit locally perceived priorities and needs. From
Building block No. 2: embracing pluralism

For the management of natural resources that include common property areas, conservation areas and watersheds, accommodating multiple interests is a necessity. Each stakeholder will defend his or her own interest and will appreciate opportunities differently. The relationship among the parties will shift from periods of collaboration to periods of conflict (Ramírez, 1999b). Understanding this complex context involves an appreciation of legal frameworks, natural sciences, social sciences, and participatory planning and learning process. Not a small feat, hence the need for an epistemology that embraces pluralism (Anderson, et al., 1998; Wollenberg, et al., 2001). In the field of NRM, a new epistemology has emerged to grasp these features and has now evolved into a range of action-research methodologies that include, among others: collaborative management (Borrini-Feyerabend, 1996), collaborative learning (Daniels & Walker, 2001), adaptive collaborative management (Buck, et al., 2001; Röling & Wagemakers, 1998), rapid appraisal of agricultural knowledge systems (Engel & Salomon, 1997), and linked local learning (Lightfoot, et al., 2001b; Lightfoot, et al., 2001a)5.

In contrast, the field ICTs for rural development is only now beginning to explore a new multi-disciplinary epistemology (Stoll, et al., 2002)6. The similarities between ICTs and NRM suggest that some of the lessons from NRM may be applied to ICTs research. Figure 2 describes some of the characteristics of NRM epistemology that can be brought into the field of ICT research. This bridging is based on action-research experience in Canada where multiple stakeholders were consulted in setting up a university research project on the role of ICTs in rural and remote community development7.

**Figure 2.** The characteristics of NRM and ICT contexts, (adapted from Ramírez, 2001a)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>NRM context</th>
<th>ICT context</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epistemology</td>
<td>Constructivism</td>
<td>Constructivism</td>
</tr>
<tr>
<td>Nature of truth</td>
<td>Multiple perspectives, diversity</td>
<td>Multiple perspectives, diversity</td>
</tr>
<tr>
<td>Goals</td>
<td>Multiple, often contradictory</td>
<td>Multiple, often contradictory or competitive</td>
</tr>
<tr>
<td>Systems perspective</td>
<td>Acknowledging that reality is best appreciated as a system with different hierarchies and emergent properties</td>
<td>Soft system: learning path to reach a situation in which collective action can be taken</td>
</tr>
<tr>
<td>Planning</td>
<td>Interactive process</td>
<td>Sometimes interactive, other times top-down</td>
</tr>
<tr>
<td>Policy process</td>
<td>Emerges from interaction among stakeholders at different levels</td>
<td>Emerges from interaction among stakeholders at different levels; or is</td>
</tr>
</tbody>
</table>

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5 For a review and analysis of the different methods to accommodate multiple interests, refer to (Ramírez, 2001b)
6 In the broader fields of network and information systems analysis, the difficulty in predicting long-term effects of ICTs is already clearly described (van Dijk, 1999; Bar, et al., 2000).
7 For further background refer to: Richardson & Ramírez, 1999; Ramírez, 2001a; Ramírez, 2000.
Building block No.3: embracing a systems approach

Systems theory is useful as an approach to understand the behaviour of natural resources and their complex interactions. In NRM it became evident long ago that ecosystems are complex and largely unpredictable, and systems theory embraced these features. Systems have multiple layers or hierarchies, they have feedback and communication features within them, and the have emergent properties that perplex even the best-informed forecasts (Lee, 1993). Ecologists, as much as organizational researchers, use systems thinking. The properties of systems are very much part of ecosystem analysis and about how humans interact within them (Gunderson, et al., 1995; Alsop & Farrington, 1998; Costanza & Folke, 1996; Holling & Sanderson, 1996). Moreover, systems thinking is holistic; it addresses overall patterns and relationships rather than reducing issues to smaller parts, which is the tendency of engineering approaches (Bennetts, et al., 2000).

Systems thinking is part of the stock of ideas by means of which we interpret the world around us (Checkland & Scholes, 1990). Systems thinking is useful as a tool for learning about complex situations and for interdisciplinary research (Ackoff, 1969). Since the late 1950s and early 1960s, systems thinking has also been applied to the analysis of organizations (Emery, 1969; Emery & Trist, 1969; Churchman, 1971). Erik Trist's work with the Tavistock Institute led to the notion of socio-technical systems (Trist, 1981). Socio-technical systems were understood at the time as a new field of inquiry where work conditions would be analyzed and improved through action research and a systems perspective. What is relevant is the view that social and technological issues cannot be addressed in parallel; rather they are to be analyzed jointly as a system and with the involvement of the stakeholders.

In a variation from systems thinking, Checkland and Scholes (1990) developed soft systems methodology, SSM. One key contribution from SSM is the notion that the principal stakeholders involved in a system are owners of the problem or issue. In other words, those who are directly affected, ‘own’ the problem and should be involved in understanding and addressing it. A first step in SSM is the visualization of the problem or topic, with all the richness of stakeholders, concerns, and linkages. In SSM, these diagrams are known as rich pictures in that they are ‘rich’ with information. In SSM, the ‘soft’ refers to the human and organizational realm of relationships and interactions (e.g. social capital and trust), which is seen as a component of equal importance to the ‘hard’ system (the material objects). It is noteworthy that the inventors of SSM were hard system engineers who realized they could not solve organizational problems with
attention only on the hard system. Instead, they realize they needed to address both and engage the stakeholders in the process.

The systems approach is beginning to appear in the literature on rural telecommunications and ICTs (Andrew & Petkov, 2000) and to a lesser extent this is also the case with SSM (Bryden, 1994; Bennetts, et al., 2000).

Building block No. 4: emphasizing learning and participation
As with NRM, when ICTs are put to work towards community development goals, multiple stakeholders are involved, each with different perspectives, goals and interests. It has been argued elsewhere that for ICTs to have an impact, the users need to become involved in defining what it is they want to achieve with the technology (Mansell & Wehn, 1998). They need to participate both in the design of the programmes and in defining what it is they will measure as evidence that they are achieving their goals. However, Heeks (1999) underlines that participation needs to be approached more critically and without the assumption that it will always and necessarily bring benefits. He recommends attention to: the political and cultural context, the motivation behind those who are introducing participation, and thirdly the willingness and ability to participate by those invited to contribute (Heeks, 1999). This critical reflection about participation is timely and echoes similar critiques in watershed projects (Rhoades, 1998), forestry projects (van Dam, 2000), and appraisal methodologies (Cornwall et al., 2001) to name a few.

Stoll et al. (2002) have begun to assemble a learning framework towards a participatory, transparent and continuous process about ICTs and development. The emphasis on learning, ongoing adjustment, and transparency -as a means of minimizing conflict among stakeholders- is also a hallmark of collaborative approaches in NRM. Indeed, learning is the best way to move forward in complex, unpredictable environments where multiple stakeholders interact (Lee, 1993; Woodhill & Röling, 1998; Röling & Wagemakers, 1998; Röling & Jiggins, 1998). Learning is an active process that engages all on an equal footing to explore a complex theme where no single person has the know-how to move forward. Instead, the group is expected to negotiate and agree on visions and the means to achieve them (Lightfoot, et al., 2001b; Lightfoot, et al., 2001a; Ramirez, 2001b; Ramirez, 1999a). Learning approaches also embrace the need to experiment, make mistakes, and learn from those mistakes. This is what Sawhney (2001) refers to as creative error.

Research into the accomplishments by Canadian community based networks that use ICTs to enhance community development, suggests that a number of common steps are taken to make the technology available and relevant:

1. Make access possible, through public places
2. Let community members experiment with the technology
3. Allow community members to dream up how to use the technology
4. Plan around those aspirations, aggregate demand, develop a business and developmental case for infrastructure upgrades
5. Organize to make the aspirations a reality in terms of infrastructure, applications, and skills (Ramírez, 2001a)

This process has more learning features than predictable outcomes. ICTs create new venues and spaces for innovation that were not there before. While some of the outcomes can be predicted, many emerge as people realize how they can harness the technology. From a soft systems perspective, these are emerging properties that can only happen when people interact with the technology.

Weaving it all together
We have now defined the pillars of a new epistemology to understand ICTs as tools for rural and remote community development:

✓ Acknowledging a diversity in paradigms
✓ Embracing pluralism
✓ Embracing a systems approach
✓ Emphasizing learning and participation

Beyond an epistemology, the four pillars begin to lay the foundation for an action-research approach to ICTs in rural development. The methodological achievements in natural resource management lend a hand here, especially with visual and participatory planning tools to engage different stakeholders in the negotiation (Pretty, et al., 1995; Guijt, 1998; Groot & Maarleveld, 2000).

3. Putting the epistemology to work

The first two pillars set a framework for multi-stakeholder engagement from the beginning. The cautionary pointers about participation presented by Heek (1999) are valid. They provide a checklist that reminds one to verify that the power relations allow for a legitimate process of engagement. This is not always possible, the conditions are never ideal, and mistakes will happen. The process of stakeholder engagement is not linear, nor entirely predictable (Ramírez, 2001b), however, as Sawhney suggests much can be learned from ‘creative error’. What is important is to initiate the process with an appreciation of the enabling conditions as well as the limitations8.

Action-research

The author has had experience with action research in rural and remote communities in Ontario, Canada that are harnessing ICTs for community development. The research documented three case studies by accomplished community based networks. The investigation led to the formulation of a model that describes how these organizations

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8 In the context of Industry Canada’s Smart Communities, some best practices for Community Engagement have now been prepared, visit: http://smartcommunities.ic.gc.ca/best/bp-engagement_e.asp
emerge as a result of a combination of factors including: community needs, governmental policies and incentive programmes, the technology and its costs. The research began with a consultation engaging over 30 stakeholders from different sectors involved in rural and remote telecommunications. Their involvement from the start created a network of trust and led to active involvement by the case study organizations in the research and in follow-up activities beyond it (Richardson & Ramírez, 1999; Ramírez, 2001a; Ramírez, 2000). In one setting the case study organization used the research as the basis for a presentation on its accomplishments at an international conference (Moore et al., 2001). In another, northern network, the research partnership led to an ongoing collaboration in planning and tracking the impact of ICTs in remote communities.

**Community engagement for collaborative planning**

The theoretical arguments made in this paper stem from on-the-ground action research work in East Africa and northern Canada. Experience with multiple-stakeholder workshops for improved agro-ecosystem management in East Africa provided the foundation for action-research work to harness ICTs for community development among aboriginal groups in northern Canada. Many of the facilitation and planning tools were the same: visioning desirable futures and specifying what was needed to accomplish the goals and who needed to become involved. The subject matter was different: in Kenya we talked about restoring farms and ecosystems, whereas in Canada we talked about improving health, education, local government and economic development using ICTs.

The main objectives of the community engagement workshops (CEWs) were: a) to help the communities in planning for the use of ICTs, b) to share information about the project and the progress done so far, c) to share the results of data gathered through surveys, d) to explore and identify how the communities would like to measure and verify the progress made in their respective communities in relation to health, education, local governance, and economic development, and e) to provide the local centre managers with tools to assess people's training needs and track how their knowledge and skills improve using the technology. As the result of the CEWs, each of the communities identified and explored the programmes that they would like to see implemented in their communities in relation to education, health, economic development, and local governance, and identified the indicators related to each program (TeleCommons Development Group, 2002).

**Tracking performance at three levels**

The systems perspective is a useful guide in addressing the levels of analysis where change becomes evident. We approach ICTs and community development at three levels: our current work with KNet, an aboriginal network in Northwestern Ontario, follows this approach:

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9 The methodological details from the African experiences are published elsewhere (Lightfoot, et al., 2001b), and the Canadian work is available on-line at [http://smart.knet.ca](http://smart.knet.ca)

1. **Community level access.** The access to ICT across a community is tracked with standard ITU and Statistics Canada indicators about access, equipment, and expenditures. This is done through an annual survey of residences and businesses in five fly-in communities. Some of them received their first phones after our first survey and have since acquired broadband telecommunication services: a ‘technological poll vault’ that other communities around the world will also experience.

2. **Sectors and organizations.** Capacity building and organizational strengthening for "harnessing" ICTs is assessed on the basis of the community visions in terms of better health, education and local government/economic development. The targets will be tracked on the basis of community goals, results and activities (a results-based management framework). During the engagement workshops, the community members provide the indicators of goals and results that matter to them.

3. **People’s skills and knowledge:** How ICTs improve individuals' knowledge and skill. People need to play with the technology first before they can dream of possible applications. Skill is not enough to translate the opportunity into a tangible benefit, but it is a necessary foundation. We have used qualitative tools to track relative changes in knowledge and skill among students involved in Community Access Programme (CAP) sites in rural Canada. Visualizing these otherwise-invisible gains is empowering to the learner (Ramírez et al., 2000).

*Creating local capacity*

A major challenge in both the Canadian and East African contexts is to create a critical mass of trained human resources that can keep the fire going. In Tanzania, a multi-stakeholder coalition has come together and has already established a track record in facilitating workshops to bring multiple stakeholders together to learn to improve natural resource management (Lightfoot & Groot, 2002). Their skills have now been put to work in workshops held in Uganda during 2001. In Kenya, two farmer groups have continued the facilitation work and have adjusted the approach to address conflicts and planning in the coffee sector, meat sector, education and health. In Northern Canada the work continues with community engagement efforts to ensure ICTs are put to work toward satisfying community priorities.

4. **Conclusions**

This paper builds a bridge between current theoretical and methodological perspectives in natural resource management (NRM) and information and communication technology for rural and remote community development (ICTs). The two fields of study share commons features: the reality they address is multi-dimensional, ever changing, unpredictable, and numerous stakeholders are involved. NRM enjoys a track record in terms of theoretical and methodological experiences in collaborative planning and

learning approaches that respond to the major features described above. In the field of ICTs and rural development, the theoretical and methodological approaches are at an earlier stage of evolution. However, in light of the parallel circumstances, several pillars from NRM can become the foundation for a new epistemology to address ICTs and rural development. The four pillars (acknowledging diversity in paradigms; embracing pluralism; embracing a systems approach; and emphasizing learning and participation) are likely not the only ones, but they do set the foundation for action-research work. The ongoing action-research work that underlies this paper points towards the relevance of this cross-disciplinary bridge.

The metaphor for the new epistemology is a kaleidoscope, a multiple-prism tool that provides a different view on a reality and one that changes depending on the users’ perspective. The evidence thus far regarding the potential of ICTs suggest that a kaleidoscopic approach may be the most appropriate way to capture the many dimensions where the technologies may have an impact.

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