# TACIT KNOWLEDGE AND PEDAGOGICAL EFFICACY USING THE SITES M2

*Ronald E. Anderson*
University of Minnesota, USA

## Abstract

Starting with premises about the role of tacit knowledge, communities of practice, and ICT mindtools in efficacious learning and teaching, we make some predictions about the interrelationship of these processes. These relationships are explored with secondary analysis of SITES M2 data. Specifically, cases selected as "stellar" by NRCs in 21 countries are re-analyzed. Findings confirm that to the extent that tacit knowledge is needed either for student work or for effective teaching, the student or teacher will seek out communities of practice (or knowledgeable others) and ICT mindtools in order to address the requirement at hand. If such knowledgeable resources are found and utilized, a positive learning outcome, which we call pedagogical efficacy, will be likely.

## INTRODUCTION

Recent thinking about knowledge, communities of practice (cf. Brown and Duguid, 2000; McDermott and Snyder, 2002; Seeley, 2000) and the role of tacit knowledge (Polanyi, 1966), suggest some ideas regarding the nature of learning that deserve to be explored theoretically as well as empirically. One purpose of this paper is to illustrate how that might be done. Another is to take advantage of the qualitative case studies of the IEA SITES project by conducting secondary analysis on some of the cases.

The conceptualization offered here has implications for conceptions of the role of technology in innovation and educational change. The concepts of both innovation and change implicitly promote change for the sake of change or novelty rather than improvement. By emphasizing efficacy in dealing with learning and the outcomes of innovation, we incorporate the notion of effectiveness with learning, emphasizing that innovation and change in education have little utility unless they result directly in improved learning.

# THE CONCEPT OF KNOWLEDGE

While common educational discourse generally presumes that knowledge refers to facts, objective information, and low-level understanding, the rapidly emerging field of knowledge management takes a broader, more inclusive view of knowledge, including subjective information, experience, tacit understanding, and even values, and socio-emotional states. A major textbook (Tiwana, 2002) in the field defines knowledge as "a fluid mix of framed experience, values, contextual information, expert insight and grounded intuition that provides an environment and framework for evaluating and incorporating new experiences and information."

## The Tacit Dimension of Knowledge

Treatises and textbooks on knowledge management distinguish two major types of knowledge: explicit and tacit (cf. Polanyi, 1996; Rumizen, 2002). While explicit knowledge encompasses that knowledge which can be stated and is in that sense objective, tacit knowledge can not necessarily be explicitly stated or written down and tends to be subjective. Tacit knowledge includes judgment, experience, insights, rules of thumb, intuition and its retrieval depends upon motivation, attitudes, values, and the social context. Professionals and other experts generally perform their practice primarily with tacit knowledge. Thoughtful writing depends heavily on tacit knowledge. Group work on complex problems depends largely on tacit knowledge. ICT troubleshooting and interaction with complex ICT applications utilizes considerable tacit knowledge. Thus, tacit knowledge plays a major role in learning and teaching, when they involve complex problem solving is involved.

For any given problem there are implied demands. That is, solutions to the problem require the use of different kinds of resources, and one such resource is tacit knowledge. Another might be ICT resources including applications embedded within software. "Tacit knowledge demand" (TKD) would be the amount of tacit knowledge needed for an optimal solution to the problem.

## ICT and Knowledge

The field of knowledge management (KM) developed from attempts to utilize ICT to organize and exchange knowledge, however KM deals primarily with explicit knowledge. Furthermore, ICT applications in education tend to work primarily with explicit knowledge. An important exception to this are a class of applications called Mindtools by Jonassen (1996). Mindtools are computer-based applications that function as intellectual partners in order to engage and facilitate critical thinking (Jonassen, 1996;). These include, but are not limited to, concept mapping, modeling tools, microworlds, and text analysis systems. Mindtools thus tend to help people with processing their tacit knowledge.

# THE SOCIAL DIMENSION OF KNOWLEDGE AND COMMUNITIES OF PRACTICE (COPS)

Allee (1997) and others argue that knowledge is communal and that the social aspect is critical in knowledge creation. Brown and Duguid (2000) note that knowledge is different from information primarily in that knowledge tends to be associated with a particular person or persons, and that it is difficult to "detach" knowledge from these people. Furthermore, they claim that knowledge implies the knower has understanding and some degree of commitment, and that focusing upon knowledge rather than information "returns attention to people, what they know, how they come to know it, and how they differ." (p. 121)

Given this social dimension of knowledge, it is more understandable that there should be a close relationship between knowledge and communities of practice (COPs). COPs are groups, usually a subset of a network of workers, that informally exchange ideas and share knowledge pertaining to a common practice. Organizational theorists (McDermott and Snyder, 2002; Wenger, E. and Snyder, 2000) have discovered how effective COPs can be in facilitating the sharing of information and thus improving the bottom line in businesses. They have given much attention to methods for formally organizing these informal structures.

## Problem Solving and Pedagogical Practices

All types of knowledge, but especially tacit knowledge (e.g., insights, smart hunches, values, attitudes, and intuitions), are needed to solve complex problems and make critical decisions. Complex problem solving and high-level decision-making rests at the foundation of the goals of most recent advocates of instructional change, especially those using the rhetoric of "21st century skills." Advocates for constructivism and student-centered learning, and the majority of the intellectual leaders of the educational technology movement also tend to promote instructional strategies that aid in learning high level thinking and problem solving.

Teachers have complex problems to solve too: pedagogical challenges of all types. Teachers are learners constantly facing decisions calling for pedagogical strategies or practices. Teachers have a professional responsibility to continually try to improve these pedagogical decisions. In a sense the job of the teacher is not best practices but better and better practices.

The model for both students and teachers that emerges from this analysis can be simplified as in Figure 1. In the model a problem to solve is the input to pedagogical practices, which results in a performance or learning outcome. If we add the tacit knowledge dimension to this model, we can identify appropriate pedagogical practices for different levels of tacit knowledge demand inherent in the problem to be solved.

As noted earlier, tacit knowledge demand (TKD) is the amount of tacit knowledge needed for an optimal solution to a problem. For present purposes we will operationalize this concept as a percent or proportion that tacit knowledge is of the total knowledge required for the problem solution. A high TKD would mean that most of the knowledge required for solving the problem would be tacit knowledge.

*Figure 1: Diagram to Illustrate the Relationship between Problems and Pedagogy*

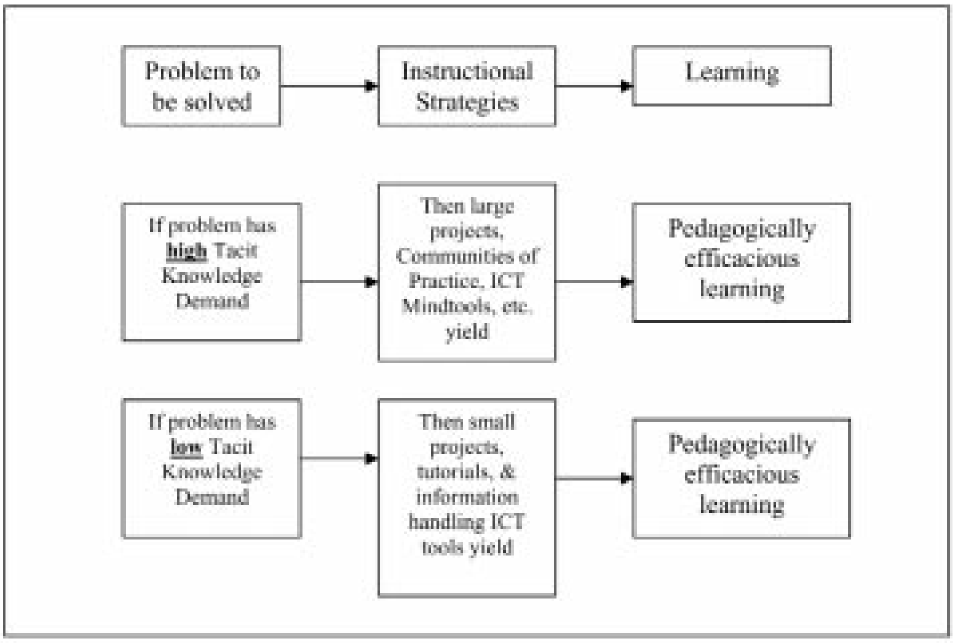



Figure 1 shows that problems with a high TKD will best be resolved with pedagogical practices such as COGs (communities of practice), large projects, and the use of ICT Mindtools, which if applied with pedagogical skills, will result in pedagogically efficacious learning. Problems with low TKD tend to be associated with small projects and lower level information handling tools, which may yield pedagogical efficacy as well.

## Pedagogical Efficacy - Effective Learning

Learning is the acquisition of knowledge of all types and we consider it to be the primary output or outcome of pedagogy. The conjunction of pedagogy and efficacy yields a dynamic construct encompassing the entire range of content, skills, and performances that may be deemed desirable. (Note that we are not treating efficacy as self-efficacy, which is how it is commonly used in psychology, but it is considered here as an attribute of groups and schools as well as teachers and students.) Given that knowledge in its very broad sense is essential to the desired student outcomes of complex problem solving and decision making, then we can say that the generally desired, transformative direction for education is pedagogical efficacy.

## Innovative Pedagogical Practices

Knowledge concepts and problem solving can help us to think about educational innovation particularly in the area of pedagogical reform related to technology. In the practice of teaching, selecting the best practices or the most appropriate instructional strategies, constitutes complex problem solving. In such situations teachers develop tacit knowledge to address the challenges.

Whereas "innovative teaching practices" implies any kind of creative departure from the traditional, whether good or bad, the concept of "pedagogically efficacious teaching practices" suggests teaching practices that are productive with beneficial outcomes. These practices are pedagogically efficacious from the perspective of both teachers and learners. Pedagogical efficaciousness for a teacher means having the knowledge critical to deal with a teachable moment, effectively applying it in the process of designing and implementing instruction. Pedagogical efficaciousness for a student means having the knowledge critical to deal with a learning activity and being able to apply it to solving problems, creating products, and communicating the outcomes to relevant others. Pedagogical efficacy is a dynamic concept in that as the base of relevant knowledge grows, the teacher and student need to incorporate this knowledge into their teaching and learning processes/activities.

### Relationships between Knowledge Demands, Pedagogical Practice, and Efficacy

The basic theoretical assumption underlying these concepts and their application to education is that there is a tendency toward alignment of knowledge demands, especially the tacitness of the knowledge needed, and the type or level of pedagogy required. Thus high tacit knowledge demand combined with instructional strategies that support such knowledge, will result in pedagogical efficacy. Likewise those problems requiring little tacit knowledge when combined with low level instructional strategies and tools, will result in pedagogical efficacy as well. This assumes a standard learning situation such as a receptive learner with the capacity to learn, and a teacher or instructional designer with the ability to introduce the strategies at appropriate times.

Furthermore, from these assumptions we would predict that the higher the tacit knowledge demand of the learning problems addresses, the greater the likelihood of the use of ICT Mindtools and communities of practice as generally emerge in large projects. The underlying rationale for the hypotheses are that associated with each increment in tacit knowledge demand is a reasonable (in the sense of best practices) selection of pedagogies and ICT solutions.

## METHOD AND DATA

The Second Information Technology in Education Study (SITES) Module 2 was a qualitative study of innovative pedagogical practices using technology, which produced 174 case studies from 28 participating countries. Each National Research Coordinator (NRC) was invited to select one case that he or she considered to be in some sense the most outstanding national case. However, no criteria were specified for what constituted an outstanding or stellar case. NRCs from 21 countries provided a "stellar case" selection. Table 7-1 gives a list of the countries that submitted stellar case selections, along with brief titles of the cases.

*Table 1: Countries, Case Numbers, and Case Titles of SITES M2 Cases Selected as "Stellar" by SITES M2 National Research Coordinators.*

| *Country* | *Case No.* | *Brief Case Title* |
|---|---|---|
| Australia | AU004 | Constructivist Teaching with ICT |
| Canada | CA002 | Creating a Learning Community |
| Chile | CL010 | Working Recreationally with Math |
| China Hong Kong | CN003 | Cyber Art Project |
| Czech Republic | CZ003 | School Library as Multimedia Center |
| Germany | DE009 | Luring into Reading via the Internet |
| Spain, Catalonia | ES005 | Roots: To Share among Schools Using ICT |
| Finland | FI005 | Netlibris Literature Circles |
| France | FR005 | A Trip to Rome |
| Israel | IL013 | The Salt Flat Project |
| Italy | IT001 | Smoke Signals |
| Lithuania | LT004 | Information Skills Through Project Based Learning |
| Latvia | LV001 | ICT in Foreign Language |
| Netherlands | NL017 | Code Name Future |
| Norway | NO006 | Crossing the Antarctic |
| Philippines | PH006 | Filipino Literature in Motion |
| Portugal | PT001 | Image in Movement |
| Singapore | SG001 | Digital Art |
| Slovakia | SK011 | Let's Sing Together CD-ROM |
| Thailand | TH002 | Learning to Compose Poems with ICT |
| England | UK010 | Challenge 2000 |
| U.S. | US014 | Future High School |

These special cases, which are called the "stellar cases" within SITES, offer a relatively small, manageable set of cases for secondary analysis. These cases were initially given a cursory analysis and described in a chapter of the M2 report (Kozma, 2003). Secondary analysis of these cases is warranted because there are many unanswered research questions suggested by the primary analysis (Anderson, 2003).

## Measurement

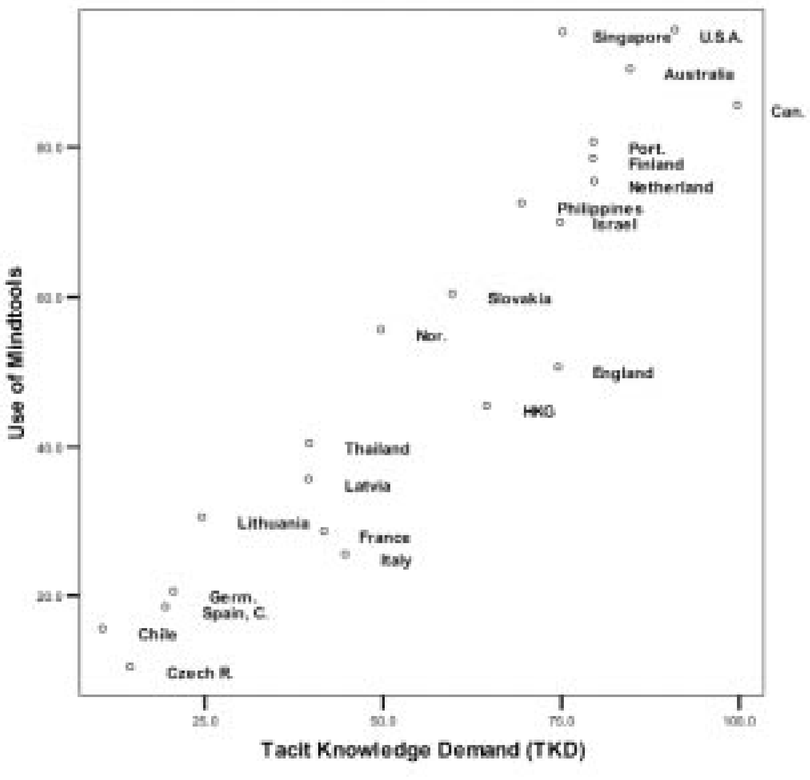
In order to code the cases for their degree of tacit knowledge demand, degree of Mindtool use, and involvement of communities of practice, the author read each case and made a judgment regarding the extent to which the feature was present or might have been present. Of course, the case descriptions were not written with these dimensions in mind, so for many cases it was necessary to guess what had actually happened. The reader is cautioned that the coding strategy has not been validated and should not be viewed as definitive. This is an exploratory study and intended to be suggestive regarding what might be worthy of further work.

Another word of caution is necessary here because the points on the scatterplots are labeled with country names. The codes for each country's case in no way represent the educational system as a whole. Nor do they represent what is seen as ideal or desirable in that country. The country names, rather than the case names, are given only because it suggests the kind of analysis that might be possible from a larger, more focused study in the future.

## FINDINGS

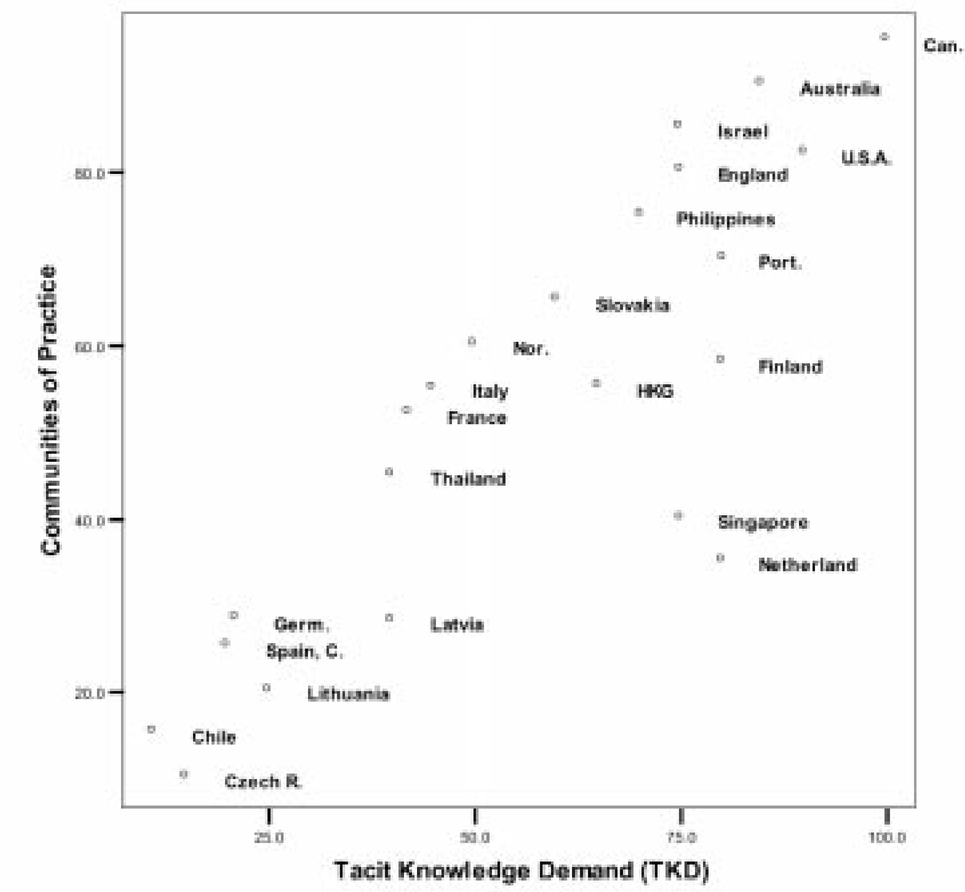
First we examine the relationship between the tacitness or non-explicitness of the knowledge needed for a student task or project and the extent to which ICT Mindtools were incorporated in the innovative pedagogy for that task. Figure 2 gives a plot of the relationship between tacit knowledge demand and the degree to which Mindtools or their equivalent were used in the innovative pedagogical program. As predicted, there is an observable relationship between these two dimensions. This indicates that the extent of Mindtool use was in part a result of the degree of tacit knowledge demand.

*Figure 2: Mindtool Use as a Function of TKD*




The relationship between the tacitness of the knowledge needed for a student task or project and the extent to which communities of practice were incorporated into the case are shown in Figure 3. As predicted, there is a strong relationship between these two dimensions. This indicates that the utilization of communities of practice was in part a result of the degree of tacit knowledge demand.

*Figure 3: Communities of Practice as a Function of TKD*




## CONCLUSION

While knowledge has been an element of the thinking that has influenced the development of ICT tools for instruction and innovative pedagogical reforms, tacit knowledge has been largely neglected. While tacit knowledge may seem elusive, it is a major ingredient in problem solving and should be accommodated more extensively in instructional design as well as in the development of ICT applications in education.

The findings of this study are very tentative and preliminary because of the limitations in measurement. There is a need for working on the measurement of concepts used in this study concurrently with the design of the collection of additional data. At some point it may be possible to conduct a study that would also have measures of pedagogical efficacy. Meanwhile it would be advisable to give further consideration to using the concept of efficacy in studies of pedagogical innovations.

## References


Allee, V. (1997) *The Knowledge Evolution: Expanding Organizational Intelligence.* Boston, MA: Butterworth-Heinemann.

Anderson, R. E. (2003) "Stellar Cases of Technology-Supported Pedagogical Innovations." Pp 195-216 in Kozma, R. B. Editor (2003). *Technology, Innovation, and Educational Change: A Global Perspective.* Eugene, OR: ISTE.

Brown, J. S. and Duguid, P. (2000) The Social Life of Information. Boston, MA: Harvard Business School Press.

Jonassen, D. H. (1996) *Computers as Mindtools for Schools, Second Edition.* Upper Saddle River, NJ: Merrill.

Kozma, R. B. Editor (2003). *Technology, Innovation, and Educational Change: A Global Perspective.* Eugene, OR: ISTE.

Law, N. (2003). Innovative Classroom Practices and the Teacher of the Future. In C. Dowling & K. W. Lai (Eds.), *Post conference book for the IFIP "ICT and the Teacher of the Future" Conference 2002*: Kluwer Academic Publishers.

McDermott, R. and Snyder, W. (2002) *Cultivating Communities of Practice.* Cambridge, MA: Harvard Business School Press.

Mioduser, D., Nachimias, R., Tubin, D., & Forkosh-Baruch, A. (2003). Analysis Schema for the Study of Domains and Levels of Pedagogical Innovation in Schools Using ICT. *Education and Information Technologies*, *8*(1), 23-36.

Polanyi, M. (1996) *The Tacit Dimension.* Garden City, NY: Doubleday.

Rumizen, M. C. (2002) *The Complete Idiot's Guide to Knowledge Management*, Indianapolis, IN: Alpha Books.

Seeley, C. P. "Change Management: A Base for Sharing." *Knowledge Management Review 3, 4* (Sep-Oct, 2000), 24-29.

Tiwana, A. (2002) The Knowledge Management Toolkit, Second Edition, Upper Saddle River, NJ: Prentice Hall PTR.

Tubin, D., Mioduser, D., Nachimias, R., & Forkosh-Baruch, A. (2003). Domains and Levels of Pedagogical Innovation in Schools Using ICT: Ten Innovative Schools in Israel. *Education and Information Technologies, 8*(2), 127-145.

Wenger, E. and Snyder, W. *Communities of Practice: The New Organizational Frontier*, Harvard Business Review 78, 1 (Jan-Feb, 2000), 139-145.