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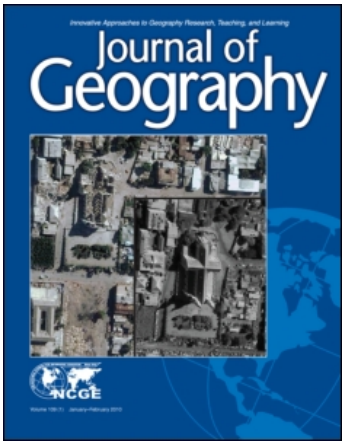

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Michael N. DeMers[a]
[a] Department of Geography, New Mexico State University in Las Cruces, New Mexico, USA

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Michael N. DeMers

ABSTRACT

Coyote teaching emphasizes learning community, long term mentoring, a need for learning, ownership of learning, heightened sensory awareness, storytelling, purposefully designed tricks, and the Socratic method to promote lifelong learning and a new generation of coyote teachers. Many of these methods are found in other educational philosophies but seem to be fully integrated in the coyote teaching method. Because geography is integrative, it seems a logical discipline in which to apply this method. Each of the characteristics of coyote teaching has its unique place in geography education. This article demonstrates how each of these components of coyote teaching can be readily employed, enhanced, and, more importantly, integrated into geographic education and inculcated into multiple generations of geography educators.

Key Words: *coyote teaching, mentoring, methodology, cooperative learning environment, geographic education*

Michael N. DeMers is an associate professor in the Department of Geography at New Mexico State University in Las Cruces, New Mexico, USA. His research interests include GIS education, GIS design and applications, and Landscape Ecology.

INTRODUCTION

In the 1960s a method of instruction historically employed in many native cultures around the world was formalized by the writings and teachings of Tom Brown Jr. Called coyote teaching, partly because of the Native American mythology of coyotes, its original application was for facilitating the learning of outdoor survival skills (Ball 2003). It was later adapted to other forms of survival, for example, survival in urban areas (Young and Haas 1997). A student of Tom Brown's, Jon Young, combined the skills, techniques, and philosophy of coyote teaching with the traditional western educational methods he was experiencing as a graduate student to demonstrate its adaptability to all subject matter, and educational settings. He demonstrates that integration every day through his Wilderness Awareness School.

The term coyote teaching might, to some, connote shamanism and mysticism, but its true substance is far less ethereal than that. In fact, its many parts are often employed piecemeal in a wide variety of educational settings and philosophies. Its integrative nature is among its strengths and this makes it very adaptable to the equally integrative discipline of geography. This article describes the roots, underlying techniques, and overall philosophy of coyote teaching. It then describes situations in which its individual aspects can be readily adapted to geographic education at any level.

WHAT IS COYOTE TEACHING?

Coyote teaching is not so much a philosophy as a convergence of learning technologies that support the ideas of learning community (Young and Haas 1997). The term technologies is loosely defined here in that it employs methods, materials, and approaches all designed to support learning and long-term mentoring. Perhaps more importantly, it focuses on the idea that all of us share a learning community and that community of learning is both long-term and a shared responsibility. In short the technologies are the many aspects of teaching and mentoring that are collectively applied to create a unified learning environment that is somewhat more robust than traditional western approaches to learning. The components and potential methods of application are each explained in the following paragraphs, together with concrete examples of their application within the geography educational environment. The examples are only suggestions and are meant to encourage the development of individualized, content-specific implementations of your own coyote teaching.

COMPONENTS OF COYOTE TEACHING

Learning Community

The concept of a learning community is not new. Its fundamental premise is that the student takes a more active role in learning (von Glasersfeld 1989) and demonstrates a motivation to learn often based on firsthand experience and success at problem solving (Prawat and Floden 1994). By contrast, the role of the instructor becomes more of facilitator rather than teacher (Bauersfeld 1995). Under this method of pedagogy the teacher asks rather than tells—the learner actively pursues knowledge and understanding under the guidance of the facilitator.

Geographers have often employed this approach to learning. It is seen in group projects, and team-based learning, and especially in discovery-based learning environments (Brown and Campione 1994). Field trips typically

employ teams whose interactions are truly supportive, although small-scale, learning communities. Moreover they provide an experiential approach that is typically more meaningful than what can be obtained through books or lecture. Laboratory exercises such as those taught in physical or resource geography classes provide hands-on discovery approaches to learning where the instructor supplies guidance. Geographers often use project-based learning as a means of providing both relevance—a need to learn—as well as collaboration in the focused solution of a large-scale problem. All of these are commonplace in the formation of learning communities within geographic education.

In native cultures, however, the idea of learning community is more universal and far reaching than is typical of traditional western educational systems. It is considered everyone's responsibility to nurture the learning of everyone in the community. Such a concept stands as a fundamental precept that educators and learners from around the community share information, lessons, exercises, and ideas within an often informal learning environment. This Native American idea of learning community recognizes no classrooms and no formal settings. Instead it is integrated into the society itself and thus promotes learning as a valued commodity.

So how do we do this in a culture where we do not live in closely knit communities where we all know each other and see each other all the time? I think we often forget that there are many learning communities with which we are familiar in western culture. These are part of going to school with the same students each year as we grow up. This is less true today than in the past when there were far fewer people moving to new parts of the country and new parts of the world. It is still present today. In fact the rapid advances in distance education technologies, particularly those related to online learning have the important consequence of enhancing the interactions of learners and educators that are geographically separate. Learning cohorts can now interact instantaneously with one another in ways that could not have been imagined before the Internet existed.

Such a cohort builds relationships that allow recognition of interests and needs, strengths and weaknesses, both in a cultural and in an educational context. What we have often forgotten to do is to replace the teacher as the primary source of knowledge with the fellow students. Obviously this is going to be different at selected learning levels.

Long-Term Mentoring

One important aspect of coyote teaching is that the instructors act not just as temporary guides but are actually considered part of the family. In native cultures everyone is considered a brother or a sister and all are involved, to some degree or another, in the training and nurturing of all members of the community (Young and Haas 1997). The overriding concept here is that mentoring does not involve reforming but enhancing the wants and desires of the learner and encouraging them to become better at what they are and what they do. Such mentoring requires that the goals, strengths, weaknesses, as well as the situations and circumstances that might affect the learner must be understood fully. This cannot be done through the typical three times a week lecture setting where that is as much interaction as is allowed.

It is impractical to expect that classes, whether K–12 or university, are going to resemble a native community, but a learning community can be developed. The concept of learning community is becoming more commonplace in the educational environment (Palloff and Pratt 2005; von Glasersfeld 1989); in fact, it is integral to the constructivist model of education (Willis 2000). We use learning community and mentoring when we have students work on problems together, when we use discussions (face-to-face or online) for learning, or when we form study groups. We also employ the mentoring model when we have informal meetings with students, when we contact them after they graduate, and when we advise students about their overall educational needs. The key is to "know" each student as well as we can in the time allowed. Beginning classes by asking students to tell each other about themselves, or providing an opportunity to share their biographies in an online environment also provides opportunities for both building community and creating a mentoring environment.

Currently, I am working to provide a long-term mentoring program by encouraging students in my GIS (geographic information system) courses to become part of ongoing social networks such as typical Facebook, Myspace, Twitter, and LinkedIn types of learning communities where former students are asked to stay in touch with my new students. Also, I have experimented with more exotic forms of social networking such as multi-user virtual environments (MUVE) and Second Life where the students and former students interact using digital representations of themselves as "avatars." Moreover, I am developing a network of GIS professionals who also are members of these MUVEs, some of whom have volunteered to occasionally visit with my students inside the virtual world to discuss the real world of the GIS professional. While these methods are still in the early stages and their success so far is untested, the use of cyberspace in all its many forms seems a reasonable way to both shorten the vast distances of students and graduates and to form a long-term mentor-based learning community.

Need for Learning

Because coyote teaching as it is formally defined has its roots in survival schools and outdoor education, the need for learning is based on the most basic need possible—survival. If you are in the wild and have no knowledge of how to find food or water, the result is catastrophic and final. This creates an immediate and urgent need (you could easily replace this word with relevance or

incentive) to learn these skills. In classrooms and even outdoor field trip environments, the idea that the student must learn skills or attain knowledge or die is not likely to be accepted by either school administrators or parents. Yet teachers have established a number of techniques that impose a need to learn. We call these quizzes, exams, homework, assignments, term projects, portfolios, and so on, all incorporating some form of grading or evaluation of the outcomes. While these forms of motivation have been around for many decades, their effectiveness is not always what we would like. There are, however, some clever techniques that instructors employ to heighten the urgency to learn without increasing the punitive nature.

One method is to have collaborative groups compete with one another to get the highest score or the most points on an exercise (Michaelsen, Knight, and Fink 2004). A competition approach, often employed in team-based learning, both encourages learning community and mentoring, but produces an environment of competition that heightens the interest in learning. While this approach works for learners who have a competitive nature, it has two unfortunate consequences. First, the less competitive learner is also often the type that most needs support and is not likely to benefit from this approach. Additionally, the competitive spirit may form teams but may also result in a less cohesive total learning community

An alternative method is the use of project-based learning, especially where there is both a real-world scenario and where the results must be presented in public. The real-world nature of the project increases the perceived need to learn because it focuses the students' energies on topics they may face in their real work environment. Project-based learning has the added advantage of requiring both analytical and integrative thinking, not to mention requiring the application of value systems and use of true collaboration. One project used in one of my geographic information systems modeling classes was to provide students with a single square mile (section) of land and required them to place one square mile of proposed land uses within that section based on soil limitations and socioeconomic criteria. The land uses were divided into two general competing classes: public (including sanitary sewer and parkland uses) and private (in this case, different types of housing). To add some spice to the problem students were divided into two groups, each responsible for their own land uses. One group was a land development company and the other group was the city. The high degree to which the students identified with their respective roles and were engaged in the problem was exemplified by their having created letterhead, elected a CEO and a mayor, and begun initiating letter writing campaigns and face-to-face meetings with each other to resolve their conflicts. The heightened urgency promoted the necessity for learning, and the need for compromise enhanced the learning community.

A similar reason for increased urgency is encountered when students are asked to create portfolios of their work. While the portfolio is typically graded, one method to increase the student's interest is to evaluate student performance as an employer rather than an instructor. This is a method used in my techniques classes; students also have been engaged in reviewing portfolios as a means of selecting their own team members. Additionally, having the students present their work to their classmates or share their portfolios often produces a higher level of urgency. Such presentations allow for improved discussions and broadening of ideas. One assignment given to small groups in a GIS modeling class resulted in three completely different answers to a single question because of differences in scale, problem identification, and methodology. In the presentations the students actually discovered more about the nature and solution of the problem than they had anticipated.

Ownership of Learning

The teacher-led class so typical of the modern western educational system places the burden of learning on the instructor rather than where it should be—on the student. While it is the responsibility of the teacher to teach, it is the responsibility of the student to learn (Rainer and Matthews 2002). Coyote teaching is designed to engage the student and, because it creates scenarios in which the student is forced to learn something to receive some form of reward structure, puts the ownership of the educational process on the students' shoulders. One way of envisioning this is that the student is not a customer who receives an education, but a client who interacts with the teacher to acquire an education (Bailey 2000; Lee 1996).

There are several ways in which ownership of the learning can be deflected from the instructor to the learner. For the land-use exercise where students belonged to either the development company or the city group, within a very short time, and without any direction on my part, the two groups began creating letterhead, business cards, and a set of guidelines for their particular interest in the land. The groups began writing formal letters to each other using their mock letterhead and set up meetings in the evenings, on weekends, and in the chat rooms provided online. The project added a sense of need, community, and ownership of the learning. Because the students needed to know the effect of land use decisions on their organization they began to pursue learning without guidance. My role as instructor immediately changed from one of "source of information" to one of expediting and directing the learning processes.

Open-book exams are a powerful method to encourage students to explore possibilities beyond rote learning. For example, an open-book exam given in my landscape ecology course proposing the use of a local nature park for our community offered students the opportunity and initiative—without requiring or even suggesting—to visit and measure the study area. Some students spoke with officials responsible for the land, while other students set up meetings with those planning on creating the nature park. Eventually, because of the interaction with park officials, one student was employed by the nature park.

Games and puzzles are used as supplements to courses. Typically, students receive some minimal extra credit for performing these tasks. Examples include the use of crossword puzzles to help the students with terminology and subtle meanings, and the use of cryptograms of famous quotes from geographers, cartographers, and others that relate to the subject matter. These cryptograms are selected not only for their puzzle but also for the meaningfulness of the message the solution provides. To help my students with spatial cognition I often use well-known spatial puzzles such as those found on this site: *http://www.expandyourmind.com/logicproblems/logic_puzzles.shtml*. Another technique for encouraging student interest is to provide jokes and cartoons based on geographic topics and to ask students to provide a simple, one-line description of the geographic principle underlying the reason the joke is funny.

All of these techniques provide opportunities for the student to interact with the material in nontraditional ways but also to link the interactions to their learning. Moreover, given the direct positive relationship between time on task and the amount of learning, these techniques also encourage students to spend more time on the material. Emphasizing time-on-task is one of the primary principles for good practice in undergraduate education (Chickering and Gamson 1987).

Heightened Awareness

Another hallmark of coyote teaching is that it increases a student's awareness. The more familiar we become with our environment—whether that environment is natural like a forest or a meadow or an anthropogenic environment such as a city or a farm—the more we notice. This is the premise behind Kolb's Experiential Learning Theory (Kolb 1984) and has become a mainstay in geographic education (Healy and Jenkins 2000). A typical geographic example of this experiential nature of awareness is found in a first encounter with a new city where an individual's mental map or conceptual view is more ribbon-like than area-like. We memorize road patterns that will eventually be proven to be longer than necessary. The longer we live in a place the more we begin to develop a more comprehensive awareness of the spatial relationships of the places we visit. We find shortcuts, recognize faster roads, detect temporal changes in traffic patterns, and discover efficiencies that we did not recognize at first (Muehrcke 2005). Our mission as coyote teachers is to provide situations in which this can be achieved quickly and with as little difficulty as possible.

Among the more interesting approaches that Tom Brown and Jon Young employ to heighten awareness is a question and answer technique that encourages a closer look at situations and surroundings. Perhaps the most famous story involves a survival skills class in which Tom Brown brought the students into the wilderness without food. As lunch approached and students found themselves far from a kitchen or a restaurant, they asked how they were going to get food. Tom Brown asked if they knew how to find food; the students' responded "no" to which Brown replied (and this is paraphrased), "Ask the vole." While this might sound rather cryptic, what he was suggesting is that a small field mouse was able to find food. He was further asking the students to observe the actions of the field mouse as it went about finding seeds and berries. The students were instructed to get down at the mouse's perspective and to observe closely (Henry 2000; Kremer 2004). The students were being challenged to heighten their awareness.

Another example of how those who use the coyote teaching approach (called coyote teachers) employ it is based on the tracker metaphor. Imagine, for example, being asked to track a predator like a fox or a bobcat. Beyond the visual animal tracks, one is also forced to look for nonfootprint evidence: feces, broken branches, disturbed soil, and even the calls of birds. These things are there all the time but we seldom take the time to notice them. To be a good tracker one must begin to become more aware of these pieces of evidence. To be a good geographer one needs to become more sensitive to spatial patterns that occur in the natural and anthropogenic environments we encounter.

As educators we encourage heightened awareness, but we seldom focus on the act itself. For example, in palynology courses students are provided with hundreds of examples of different types of pollen and are often asked to illustrate pollen samples while observing them through the microscope. This forces the right side of the brain to begin visualizing these otherwise rather similar looking objects. Geomorphologists take students into the field to observe landforms, often requiring students to sit for hours writing observations so that they begin to recognize sizes, shapes, settings, and orientations that comprise different landforms. Remote sensing classes require students to view and enhance satellite images and answer questions about the relationships between different band reflectances and visual characteristics, and the features they are observing. Meteorology students collect atmospheric data on a regular basis and view sequences of weather maps so they can begin to understand the relationships among the various attributes and the resulting patterns. Each of these situations, and many more, require that students view objects and situations from a different perspective, and often with a larger purpose in mind to direct their attention.

One suggestion of Young and Haas (1997) is to learn to get away from distractions and to focus. Modern society is filled with demands and with distractions. The distractions are often designed to deflect our attention. Advertising, traffic signs, music, construction noise, all of these and many more fill our lives. These sounds, however, also contain information about what is going on in our world. Following

Young's advice, we need to focus on what is important and filter out what is not context specific. The good geographer is a trained observer. For field trips, I provide aerial photos or ask my students to interpret maps. I also ask the students to spend a few minutes just looking and/or listening and to consider the context in which they are immersed: the setting, situation, time, scale, and all the other factors that might give clues to what they are examining. It is a simple but very successful technique.

Strategies for Coyote Learning

Storytelling

Many cultures have long standing histories of storytelling and folklore. These range from tall tales like Paul Bunyan and Babe-the-Blue Ox as a descriptive metaphor of the formation of the lakes of Minnesota, to the leprechauns of Ireland teaching the lessons of greed, and the boogeyman myth used to frighten children into behaving. The Native Americans and other aboriginal groups also have such folklore. These tales are memorable and are often highly exaggerated to provide imagery that remains in one's memory for a long period of time. Many western cultures have robust faerie tales and stories that evoke strong reactions and many families share stories of siblings whose misadventures are nearly always blown quite out of proportion.

The use of such tales suggests two thoughts. First, the imagery helps us learn by creating graphic pictures so exotic and so outrageous that forgetting is nearly impossible. This trick is commonly applied in the Dale Carnegie training (Dale Carnegie Training 2001) where enhancing memory is important. Second, the linkage to these tales allows a feeling of community because it draws on material with which, as a group, we are familiar and of which we have a common vocabulary. This commonality of experience enhances the sense of community and provides a similar intellectual filter through which learning can flow readily. Several educators have said that story-based learning is among the most effective methods of imparting knowledge to any age group (*http://www.knowledgeplatform.com/Content/Pdfs/canning_workplace_stories.pdf*). An example of how storytelling might be used in geography classes illustrates this practice (Appendix).

The story in the appendix, like so many other stories, parables, fables, and myths, is based on truth. It is a fable describing the development of the first fully operational geographic information system in the world, the Canada Geographic Information System. These stories provide both a metaphor for learning and colorful imagery that the student can rely on for memory. This imagery is particularly important for visual learners, but can be delivered orally, visually, or through text depending on the audience. The more outrageous the imagery, the more likely the student is to remember both the story and the message it is meant to convey.

Purposefully Designed Tricks

Coyote teaching is based on the mythology of the coyote which, through many centuries and in many cultures, has personified the trickster (Heredia and Francis 1997; Tafoya 1979). In the wild, the real coyote performs tricks to mesmerize and confuse its prey prior to attack. In coyote teaching this technique is applied by the instructor to distract and to trick students into meaningful learning situations, often without realizing it (DeMers 2005). The students often are provided with situations or problems that purposely lead them astray. The intent is not to confuse, but to force students to experience mistakes and perhaps even to repeat them a time or two until they change their approach to avoid the same mistake. In concept, it is quite simple. If you walk around a dark corner and someone screams, you jump. If you do it again and the same thing happens, you begin to see a pattern and you might avoid dark corners. The result of this action, reaction, and repeated response is that you have been tricked into learning.

One example I often employ in hands-on GIS laboratory classes is to have the students overlay two maps. The datum for the first map is clearly stated, but I neglect to mention the datum for the second map. The result is that the maps do not coincide. I often do this more than once, and without announcing it. The intent is that, after repeating the mistake several times, the students will eventually begin to check for the datum before they overlay maps. Another approach that I have used is to create situations where the obvious solution is not only wrong, but totally impossible. In one case a student eventually overlaid two raster maps using a multiplication procedure. The maps were land use (nominal) and elevation (ratio). The student was rather embarrassed when he discovered that his map categories included things like "urban feet." Such embarrassments are best encountered in the classroom among friends rather than in public among colleagues you mean to impress. More to the point, because the product of his/her work genuinely surprised the student, he/she learned an important lesson through making the mistake. At this point I remind the student of the lecture and text-based material that relates to their mistake, which also helps to reinforce the learning process. This approach favors the behaviorist philosophy of education and demonstrates that coyote teaching is not a single philosophy but an integration of philosophies and technologies, all designed to enhance learning.

Socratic Method

For some time, it has been accepted by many educators that lecture returns a very low percentage of knowledge retained by the student (Dale 1969). One method of instruction that has become a mainstay in law schools and traces its origins to the Greek philosopher, Socrates, is a technique appropriately named the Socrates method. This method is a question and answer technique that emphasizes active

engagement in the subject and promotes critical thinking skills (Yang, Newby, and Bill 2005). Coyote teachers, in Tom Brown's words, "... never answer a question directly" (Young and Haas 1997). Instead coyote teachers provide probing and leading questions that challenge the students to discover the answer for themselves. Examples might include: "So you want to learn how to track the fox?" "Track the mouse." The idea is to force the student to think deeper about a topic than they are accustomed to and thus develop their ability to ask and answer their own questions. Coyote teachers force the student to make intellectual connections, to think in terms of consequences, circumstances, setting, conditions, and many more concepts that are often part of their initial question but about which they do not typically think.

The use of the Socrates method is commonplace in western law classrooms, some professional schools, and even many traditional classrooms, but it is becoming a bit of a lost art. The Socratic method requires a thorough, in-depth knowledge of the topic being taught, an ability to think on one's feet, and a deep understanding of the thought processes of the disciplinary novice. The students rely on this knowledge not as a repository but because having that knowledge allows the instructor to know what questions to ask next to lead the student to the right answer. For example, suppose your topic is to explain a pattern of vegetation on a steep slope. The first question might be something like: "Why is there lots of vegetation on one side of that hill and little on the other?" One could easily say "... well that's because the sun is more intense on the southern slope in the Northern Hemisphere than it is on the northern slope." The problem is that this factual explanation does not engage the student in the learning process. It is passive. Instead one could say: "Which side of the mountain seems to have the most vegetation?" If students reply that the north side has more vegetation, then you might ask next: "What else is different from the north to the south side?"

There are many methods of applying the Socratic method beyond the verbal give and take, including the application of case studies, allowing students to formulate and test hypotheses, and forcing students to recognize misconceptions (Collins and Stevens 1981). Some faculty use research projects, often based on their own work, to incorporate all of these techniques (Shore, Pinker, and Bates 2004). I applied this technique in my introductory GIS class where I provided students with a data set that I had used, together with other researchers, to examine changes in land use through time. The results of the studies had been published but I kept this information from the students until they finished their project. Their results compared to the published studies results became the basis for discussion. This approach was two-fold:

1. It employed a case study of land use change in central Ohio and allowed the students to formulate hypotheses about what they expected the land use change factors might be and how they could be recognized.
2. It asked students to discuss the limitations of study area selection, issues of temporal and spatial scale, and the problems associated with measuring polygon shapes when the study area boundaries produce artificial straight line segments.

Creating New Coyotes

Among the most important outcomes of coyote teaching is that it not only engenders learning among the students but also, because of the strong learning community it creates, the students become a new generation of mentors and teachers. As Tom Brown says, "If you are raised by coyotes you become a coyote" (Young and Haas 1997). Because the learning becomes so much a part of the learner's being and so important to their everyday life, they wish to share this with others as well.

As with the native peoples from whom Tom Brown learned these techniques, much of this future education will not be found in formal settings or even in classes. Instead, education will be more informal and will often occur at unlikely moments. One experience that immediately comes to mind is when I was driving into the mountains in Arizona with a car that had a built-in outdoor thermometer. My passenger noted that the temperature was dropping as we were going up the mountain. Soon a discussion of the adiabatic lapse rate ensued and eventually led to questions regarding molecular physics and atmospheric interactions. We even began to discuss the blue haze of the valley below.

In the United States system of education we often still rely on formal methods of preparing educators that do not benefit from a larger community of mentors to the degree it could. Hardwick (2005) suggests the use of a geography faculty development alliance to assist new college and university geography educators to adapt to their roles. A formal example of mentoring and the development of new geography educators at the elementary and secondary school level comes from the mentoring programs developed by the National Geographic Society's Geographic Alliance network. Bednarz, Bockenhauer, and Walk (2005) suggest extending the network by creating teacher consultants who act as mentors to assist novice educators. One extension of this idea that I have employed involves bringing in former students whose careers have relied on their geographic education as guest speakers. In some cases these same former students are also potential recruiters and often begin conversations with existing students that eventually blossom into mentoring relationships.

One former student also informed me, years after a geomorphology class, that not only did she "stop for landforms" as she was driving but she often broke into discussions with her passenger(s) about the origin of the landforms. Although quite informal, the student was acting

in the role of educational facilitator in a larger learning community. She, too, is now an educator.

Closing Remarks

This article introduced you to the concepts and techniques of coyote teaching and provided some simple examples from my educational experiences. Its purpose was to demonstrate, through simple examples, the utility of integrated learning technologies within geographic education. More importantly, it was meant to open a dialogue for those who already use some of the techniques found in the coyote teaching method so that we will all become more adept at their application.

While geographers are known to employ selected techniques found in this method, I encourage educators to consider the integration of all of the methods available within coyote teaching. By employing as many of these techniques as possible and by fully integrating them into one's teaching philosophy the students will gain the most from the method. Still, some of the coyote teaching methods are less often applied in our western style of teaching and bear examination. Of particular importance are the ideas of long-term mentoring and heightened awareness. These two principles stand out as the cornerstones of the approach. All the other techniques are integral to these key principles. By using the emerging technologies provided by the ever expanding Worldwide Web and its social networking tools we have the potential to provide opportunities to develop long-term mentoring even though the physical distances are often extreme. Moreover, the ability to use the Net to provide hands-on experiences and allow students to see more than could be provided by traditional methods may offer an increased awareness of peoples, cultures, landscapes, and environments that could never have been imagined before.

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Appendix: An Example of a Story Illustrating Metaphor of the Development of the CGIS

There once was a vast land in a kingdom far to the north in a land of snow and ice. This land was rich in minerals and forests and many wonderful things. The land, however, was so large that nobody knew how much there was or where they would be found. The king, being a wise and caring ruler, asked his wisest advisors to come to his chambers so he could ask what should be done to take an accounting of these resources so that his people could enjoy the fruits of these lands for many generations. When the advisors arrived he asked them, one by one, "How shall we make an accounting of all that is of value in our kingdom?"

The first said, "We must send out surveyors throughout the land so that they can locate these things and report back to us." The other advisors nodded their heads in agreement.

The second advisor then said, "They must have supplies and tools to sample and collect what they have found." Again the others agreed.

A third said, "We must have our accountants prepare ledgers and tables of all that is found from their journey." And once again the others thought that a good idea.

The last advisor said to the king, "We must put our map makers to work preparing maps of these lands and resources as well." All the others agreed, smiling at one another.

When they had all had their say, the king stroked his beard and asked them, "How long will it be for our surveyors, and sample takers, and accountants, and map makers to put all this together so that our people can benefit from this knowledge?" "After all," he said, "we have one of the largest kingdoms in the land, and so few people." Here all the advisors began to mumble among themselves and to scratch their heads. It was obvious they had no answer for their king.

Suddenly the doors to the king's chambers came crashing open as the great magician Tomlinson rushed into the room. "Forgive me my lord," he said as he looked at the bewildered advisors, "I have been observing your discussions in my magic panel." "Your advisors have all given you sage advice," he said bowing, "They will need my magic and that of my fellow wizards to bring this together in time." "It is more than one magic, but many forms of magic." We will need magic to see the land from above quickly, magic to record what we observe in a magic box so it can be retrieved later, magic to link the locations of the objects we note to descriptions of what they are and how good it is." "This will be a system of magic I will call 'geographic information systems,' " he smiled at the thought of this, ". . . and you will be the first to possess its power."

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