Technology, Teamwork, and Teaching

Meet in the Classroom

A laptop policy prompts development of a new model to help faculty migrate to a new teaching paradigm

By **Sandra Poindexter, Choton Basu,** and **Steve Kurncz**

Interactive teaching paradigms, collaborative classrooms using teams, and instructional technology have long existed as individual movements, with some blending in recent years. A factor emerging nationwide, and the impetus for our model, was the adoption of a laptop policy at Northern Michigan University (NMU) in late 2000.

A regional institution with approximately 8,000 students, NMU began a mandatory laptop initiative, standardizing a set of technology tools (laptop, software, and Internet access) for all full-time students and faculty.[1] Infrastructure changes over the past five years provided network ports in lounges, study rooms, labs, campus residence hall rooms, and faculty offices. All classrooms have a network port for an instructor workstation, and 30 classrooms accommodate electrical and network outlets at each student seat.

Given that this mandatory laptop initiative costs students $385 per semester, students and other university stakeholders will demand accountability. For students to perceive these initiatives as academically valuable, enough faculty must make an effort to successfully integrate the laptop into their course content and/or course delivery. This setting is ripe for significant paradigm changes in learning, but faculty need new models, techniques, and strategies that can help them migrate to this new paradigm of teaching.

Through our study (see the sidebar), we successfully reversed the traditional lecture-based classroom (80 percent lecture and 20 percent interactive) to one of collaborative learning and interaction (20 percent lecture and 80 percent interactive). Various types of technology, including the laptop and Internet, are intensively integrated both in and out of the classroom to facilitate the learning

process we call the 20/80 model,[2] shown in Figure 1.

This article offers practical guideposts for integration strategies, theory, and outcomes assessment. We address the three "T" components of this model — technology, teamwork, and teaching style — as well as some lessons learned during implementation. We also present a roadmap for others wanting to apply the model at their institutions.

Teamwork's Contribution

"A lot of my instructors say they want me to work in teams to do projects because it's important, but no one ever teaches me how to work together in teams, and it usually ends up being a frustrating and unproductive experience." This student opinion captures a legitimate complaint. Placing students in teams for group work is certainly not new to academe, yet teams often work together on a paper or project outside of class time and merely hope for the best.

To address this problem, we believe team members must make a constant and conscious effort to work with peers as an effective and integral part of their learning, thereby forming effective work teams. The instructor serves more as a coach and facilitator than lecturer. In our study, 20 percent of the final grade depended on this type of classroom participation activity and team progress in reaching goals.

We formed teams based on five criteria:

- the Keirsey[3] version of the Myers-Briggs temperament sorting,
- Kolb[4] learning styles,
- an available meeting time (morning, afternoon, or evening),
- grade point average (GPA), and
- self-selection only in cases where all parties demonstrate prior effective teamwork.

Some may disagree with this grouping technique, but there were fewer team problems than previously experienced with student self-selection.

Certain tactics benefit a positive team experience:

- Team assessment. Once a team has been established, team members take inventory of their technical knowledge, then agree in writing to cross-train each other throughout the semester. As secondary outcomes of the classes, student self-confidence improved (they realized they had skills their peers didn't), and their technical skills increased as they shared tips.
- Competition and collaboration. Teams thrive when a little competition exists among teams or when teams receive recognition such as posting the best solution online. Conversely, requiring teams to exchange ideas or collaborate to reach a joint solution expands the peer-to-peer network. To remove the intimidating "sit quietly" mentality, students are encouraged to share snack food during class. This leads to a more casual atmosphere, fostering dialogue.
- Assessing team effort. Teams can deny assignment credit to a group member who misses classes or meetings without a valid excuse and reward themselves for jobs well done. These privileges allow teams to flourish and not be reduced to frustration when other members don't participate actively. After one month, a brief biweekly instructor team evaluation form can be used to rate how effectively teams work together and where their operations could improve. At the end of the semester, these are tallied for the team participation grade.

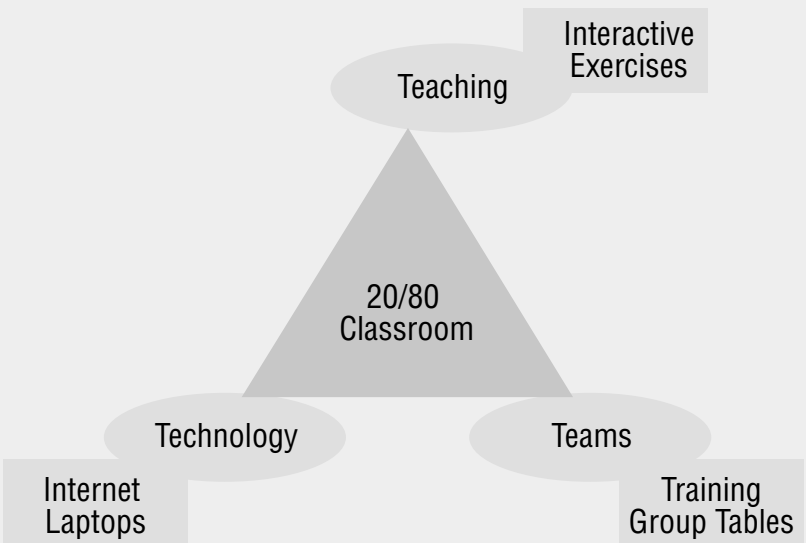
In our study, a substantial amount of class time was dedicated to the importance, functions, and dynamics of teamwork. Our training topics were

- goal setting,
- strategy planning,
- rules for conducting effective meetings,
- group decision making,
- conflict resolution, and
- understanding different personality and learning styles.

We used a series of videos on teams to help students create their own team operating rules.[5] While this training took precious class time, student feedback and our observations showed that these teams performed at a higher level than teams in traditional instruction classes, and their output was more professional and cohesive.

Figure 1

The 20/80 Model



Teaching's Contribution

In an interactive learning environment, course content objectives still have to be met, but lecturing takes a

backseat to team exercises and experimentation as the primary course delivery. Outside of class, students are expected to read, outline, or review textbook and reading materials. Only the most complex items, or items students question, are covered with an actual lecture. Class time is now free for graded group assignments, case studies, and projects that generate and share diverse solutions. This leads to some excellent critical thinking and problem solving. We've attempted to use some interactive exercise in every class period. Moving away from the textbook as a solitary source of information is a goal, not because textbooks are poorly written or don't contain useful exercises, but to model alternatives.

The first few meeting periods of the classes we studied were spent familiarizing students with the underlying philosophy of this teaching and learning approach. An exercise asked students to define an interactive classroom based on their perception and compare it to a traditional class. In groups, the students then debated the merits of this teaching approach over traditional teaching models, addressing anxieties that might exist. Using these introductory sessions to identify the goals, rules, and direction of the course helps many students realign their mental models to the one we use, and alleviates some doubts and anxieties.

Why is this 20-minute discussion critical to the success of the entire model? In elementary school, children spend a lot of time learning interactively. That approach recedes into lecture-based teaching during junior high and high school years, and students have to relearn how to interact. As one student worriedly said, "You've taken away everything I know about studying, and I'm not sure how to react." In part, student evaluations reflect some confusion as to purpose and exactly what is expected on projects; time spent explaining has a high payback.

Three examples of interactive class exercises illustrate this approach. They apply to most disciplines:

- Consensus decisions. A decision needs to be made as to the best alternative for a potential project. Pros and cons are discussed in the class, then among the teams. Each team downloads to their laptop a ranking spreadsheet prepared with weighting and tallying formulas, enters in their choices, and views the resulting tallies. These files are e-mailed to the instructor and merged at the instructor station into a consolidated tally, then all teams have a chance to explain their ratings. Teams may change their ratings, repeating the cycle until there is consensus. This is the Delphi method implemented with spreadsheet software on laptops, shared via e-mail attachments, and viewed with data projectors.
- Summarizing and presenting. Prior to class, students are assigned Web pages to read and questions to consider. In class, teams refer to the Web pages and consolidate their answers into one document sent to the instructor. Each team is then assigned one question and given 20 minutes to prepare presentation slides to depict their answer. These slides are merged at the instructor station, and a spokesperson from each team comes up to explain the team's answer. This reinforces productive Internet use, preparation, compromise, on-the-spot thinking, and effective presentation of facts and opinions with presentation software.
- Research. Students brainstorm a current topic in class, and a list of student-identified issues to investigate is typed at the instructor station. Students immediately download the list and begin in-class Internet research to locate needed information. The instructor helps groups determine validity of Internet sources.

In all these exercises, the instructor's role is to move through the room consulting with teams, providing suggestions, and occasionally bringing the class together for common issues. Whatever the exercise, there is an absolute expectation that outside readings and text materials have been read prior to class. Testing for knowledge can be conducted by checking for terminology at the outset of the class period or by opening with an in-class assignment based on the readings. Students are graded on their team's output for the class, their interaction in completing it, and their individual participation. They quickly recognize the importance of being prepared when the class begins with an assessment of their knowledge and preparation.

We provide lecture slides for the class prior to class time via the course Web site. The problems associated with a classroom full of passive, unprepared

Figure 2

Students Actively Engaged

students rarely occur after a few meeting periods.

Technology's Contribution

Too often technology is deployed without a clear purpose or consideration for appropriate use. Students quickly discern that paper and pencil may be a better tool and justifiably claim that technology is being used just for technology's sake. To avoid this, we ask ourselves, "What learning outcomes do we want for this course?" followed by "Can technology help us reach those goals more effectively or efficiently?"

Some specific and appropriate technology applications are

- Presentation software with or without multimedia to summarize text materials. Some lectures are voice-annotated presentation slides that students view before class, in essence getting the lecture outside of class and coming to class to do assignments.
- Posted minutes. Each class period, one person records class minutes using a template. The minutes are posted to the course Web site.
- Communication client software (e-mail, chat, bulletin boards) connects students to instructor and students to students. Rather than being impersonal and isolating students, as many technology opponents believe, out-of-class e-mail appears to open up an avenue for shy students and equalize their participation grade.
- Electronic assignments. Students do assignments in digital form and submit them as e-mail attachments or into electronic drop boxes. The sending team member copies all members on the e-mail. The assignment is graded electronically, by inserting comments directly into the document, and returned via e-mail. This procedure gives every person a copy of the team's submitted and graded documents, and frees up class time normally spent collecting and distributing papers. Insistence upon antivirus software can help prevent a class plague.
- Internet research and current materials. It's best not to assume students know how to effectively conduct research on the Internet. An in-class exercise requiring students to select a topic, locate relevant and valid information sources, and consolidate information into a summary statement is a useful way to supervise research.
- Server space allocated to teams for group work. Many documents become too long to e-mail as attachments, so one solution is to allocate team server space on a university server giving 24-hour access to group files.
- Laptops for interactive exercises, in-class research, decision-support modeling, documenting, and querying. Students download the needed files from the class Web site or visit Web sites to collect data, then work on the exercises during class in teams.
- Detailed course Web sites. These sites provide a clearinghouse for all outgoing materials, the historical archive, the current activities list, and minutes taken by students on a rotating basis.

The technology items on this list aren't particularly new or unique; many instructors use them often.[6] The differential factor for our study was how well these items became integrated into the course. Without technology tools, the 20/80 model isn't easily implemented. We didn't use what didn't fit our needs, but we used those that did extensively.

Some might presume that all students enter a computing course with high levels of computing competency and a willingness to use technology in any way. This isn't the case. Peers help each other learn new skills and overcome computer anxieties. The laptop became a centerpiece for the class periods, whether one laptop per team or per student. Having them available makes it easier to conduct some of the interactive exercises in class.

While interactive teaching can work in most classroom facilities, having a technology-friendly classroom helps significantly. Our room configuration includes an instructor workstation with data projection and Internet connection, and movable tables to form workgroups. It took three years to reach this point, starting with a grant to replace individual desks and long, narrow tables with sets of tables for teams of four. Seven new laptops were purchased prior to the NMU laptop initiative implementation, one per table, with electric outlets and network connections placed near each table. Finally, floor-to-ceiling posts were installed so that the tables could be arranged in conference style and students could connect their own laptops. We didn't consider a wireless network; at the time a wired network was more cost effective, gave faster communication speed, and was within our infrastructure to string external cable and lines to extend the existing system of instructor workstations.

Table 1 shows approximate costs for a 36-station group room.

Table 1

Costs for a Laptop-Ready Classroom

Item (includes labor)	Unit Cost	Extended Cost
36 network nodes	40	1,440
18 tables (for groups of 4)	325	5,850
9 network-ready laptops (1 per 4 students)	1,800	16,200
4 power/network poles (4 outlets each)	800	3,200
Total (presumes existence of instructor workstation and data projector)	$2,965	$26,690

The 20/80 Model: A Student's Perspective

One of the biggest considerations with any new educational setting or style of learning is, What do the students think? How do the students react? Table 2 summarizes key results of a 27-question exit survey given to 100 students. The survey results had very little deviation — students felt positively about the experience. Kurncz, a former student, speaks for his peers in writing this section.

Kurncz speaks:

After experiencing and growing from this style of learning over two semesters, I'm very comfortable discussing it. I personally feel that this method of teaching and learning is by far the most effective and positive that I have experienced throughout my education. (See the sidebar on page 38 for other students' comments.) I'll offer my thoughts on the areas of peer learning, interactive teaching, and technology integration.

Peer learning is a very positive component of this teaching style. Not only did I learn from the professor, during each class I also learned from my classmates. I admit that I felt apprehensive at first when introduced to my group. I thought, "This is never going to work." I was wrong — I walked away with one of the most positive team efforts I had ever experienced. Each day, instead of getting lost and bored with the never-ending lecture style, we interacted with one another. Not only did we learn from each other, we used each other's strengths to make the team even better. From the team training videos and from the professor we learned how to effectively set goals, confront each other when needed, and reach our goals. The personality test teamed me with students that I probably would not have chosen, but it put me with peers that I worked well with and gave the right student mix.

In this collaborative class environment your sense of responsibility goes beyond the professor to your teammates. You're keenly aware that they rely on you to come prepared to class so that the team can move forward. As the group bonded, questions came easier — especially questions that might not have been raised in a lecture setting. It's different when you're asking a question of a teammate than if you have to ask the professor in front of the class. One member of my team was shy and rarely spoke during the first weeks of class, but by the end of the semester she raised some of the best questions and comments of the group.

Textbook material was easier to understand when we tackled the issues

Table 2

Exit Survey Results

Question or Issue	Mean (5 high)
Most students will ask each other a question before they will ask the instructor a question in front of the entire class.	4.24
Students are responsible first for their own learning, but also for facilitating the learning of their team members and the learning of students in other teams.	4.03
In a team, it is better to have a mixture of student abilities (such as presentation, organization, writing skills, etc.) rather than grouping similar students together.	4.66
Learning how to learn new material and how to apply that knowledge can be better accomplished with an interactive approach (rather than straight lecture).	4.23
Assuming the reading material is clear and complete, college students can learn most (60–80%) of course content knowledge (terms, skills, steps, etc.) by diligently studying the text and assigned outside readings.	2.89
Learning from peers in interactive exercises legitimately raises the class average grade because knowledge and understanding are spread more effectively than with a lecture approach.	3.98
Using laptops in class to obtain materials, do exercises, and immediately post work is an effective use of the laptop technology that should be promoted in other NMU classes.	4.20
Class minutes, taken by class members, are a good way to summarize a class period's activities and provide reference and clarification for later review.	4.25
A dynamic (changing) course outline Web page encourages students to reference the outline more frequently than does a printed outline distributed on the first day of class.	4.20
Posting lecture notes on the Web site before class makes lecture periods more effective.	3.97
Posting lecture notes on the Web site before class discourages student preparation, e.g. "it's all in the notes anyway."	2.46
Submitting assignments as e-mail attachments is better than handing in paper copies at class.	4.28
Receiving electronically graded (comments in a different color font) assignments via e-mail is a good way to get and store graded materials.	4.21

as a team. If the team could not answer the question, then we took it to the professor or, interestingly, to another team. It wasn't as hard to ask a question when four people didn't know the answer. This created interaction among the different teams and the professor. I feel peer learning is one of the most important aspects of this style of teaching, since it creates an atmosphere for success.

Another aspect is the idea of interactive teaching, where the professor facilitates and oversees the groups instead of being treated as the one and only source of information. Students became more involved through participation and discussion. The professor recognized that students brought a lot of knowledge to the classroom and wasn't afraid to ask them to share it. In the field of technology, students often know about the latest advances, and this kept the class interesting when we got a chance to talk instead of just listen. The class got to know each other and the professor better, and we felt respected.

Many of the interactive exercises involved being given a topic that we researched on the spot and presented to the class in a short period of time. We learned to delegate tasks to one another and how to think fast in order to make the deadline. The posted class minutes kept us focused because we weren't left wondering what was covered during a class period or what announcements had been made.

The last component in this style of teaching is the technology integration. Laptops played a big role in peer learning and interactive teaching. By having the Web and laptops at our fingertips, we could produce effective and useful research and presentations. The online syllabus and outline were very effective; we could check the day's agenda and gather class materials even before class started. There is a perception that students won't go to class if they can get all the materials online, but in our case attendance wasn't a problem. Instead, early access to materials gave us the opportunity to read through lecture notes before class and made the discussions more productive and interactive. As students, it was our responsibility to check the course Web site for updates and questions to topics covered in prior classes.

Study Setting

Our study aimed to identify a style of teaching that shifted more responsibility for learning to the student, covered required course content, improved communication, and pulled away from the physical classroom learning environment without leaving it. The year-long project involved 7 sections of 3 on-campus information systems courses, more than 100 students, and 2 professors.

During class, students always sat facing each other at group tables seating four. Team exercises regularly used one or two laptops per table. The instructor facilitated the work by moving around the room as a consultant and urged teams to consult each other. The exercise results were e-mailed to the instructor during class, sometimes merged together at the instructor station and the solutions considered on the screen, and later posted to a Web site as solutions for downloading.

The interactive exercises varied in software used and focus of material, but the laptop and technology available were emphasized as resources as well as productivity tools. The interactive portion of the course consumed 80 percent of class time; lectures consisted of only 20 percent of class time. Technology, peer learning, and interactive teaching came together to meet our goal.

Lectures were usually delivered with presentation software for viewing at home or during class. Similarly, discussion groups and e-mails made team meetings more effective than the typical "meet you at the library" type of meeting because we e-mailed drafts of our work and expected each other to have reviewed it before meeting.

Electronic office hours were great, too. During certain hours you could always expect a prompt response. This also had a major impact on faculty-student communication. The feedback from our professor was that student-to-faculty communication soared. Obviously, this has a downside, since many students began to expect a one-hour turnaround and were often too quick to ask questions they should have answered themselves. In my opinion, establishing e-mail office hours during which replies could be expected offers a good compromise. Weekend hours were especially appreciated; many of us study on Sunday, and that's when we have questions.

Although this method of teaching has numerous positive attributes, it's only fair to give the negatives, too. The biggest danger is that a group doesn't work well together or includes several slackers. This situation offers a great opportunity for a student to step in as a leader and get the group working together, but not all students are ready to make this move; they may be better off alone instead of trying to carry a team.

I've experienced some teams in other classes that didn't always work well together, and it's hard to be positive when you feel the group is pulling you down. These problems were minimized by training in team confrontation and by doing a lot of teamwork in class where the professor could see our interaction. It didn't eliminate the problem, and I'm sure some people had negative experiences, but most were helped by the teamwork emphasis.

Another concern exists in properly defining roles. With so much emphasis on learning outside the boundaries of the classroom and ready e-mail contact, we weren't always sure when to turn to the professor for help outside of class. I experienced the situation where I spent

hours on a task and didn't think to ask the professor because we'd moved away from the teacher being the sole resource.

In conclusion, this method of teaching helped me tremendously. I took the topics and abilities that I learned from this class to my first job interview, where I explained that I was trying to earn a place on their team, not just a job. Others share my opinions — comments from my classmates (see the sidebar) capture the benefits of this teaching and learning model.

Students' Comments

"Every class in the CIS [computer information systems] field should be taught like this."

"This was my first experience with this style of teaching, and I enjoyed it much more than the 'typical class'."

"I really liked working with a team. The interactive learning experience makes it much easier to retain information than just plain lecture. Team members help me learn new skills and keep me motivated."

"I paid attention and learned much more from the interactive lecture than if we had had a more traditional one."

"The interactive class was great; never in a class have I [gotten] to know the instructor or classmates as well as I have in this class. The class interaction is what made this happen. Not only do you get to know the other people, but you learn from them."

Lessons Learned

Models are most valuable when they can be applied, sharing the lessons learned and hurdles to avoid in implementation. The roadmap in Figure 3 offers a visual path, while the following questions provide specifics.

Is this approach applicable in all types of courses?

It may sound presumptuous, but we can't imagine a discipline that couldn't apply this model to some degree. We have begun implementing it in three other courses: introductory computer literacy and two programming courses. Traditionally, the literacy course has a low attendance rate, but students consistently come to class with this model; the programming courses move at a faster pace with the peer teaching. The Internet provides the depth or currency lacking in textbooks, software simulates and consolidates, and e-mail communicates. We did find that the 20/80 model works better in some settings than others — three sections of the same course varied in class meeting time as a comparison. The more often a class meets, the more successful the adoption of technology, teamwork, and interactive learning.

Lesson 1: The 20/80 model is applicable in most courses, though variations such as 40/60 or 30/70 may be more appropriate based on topic complexity.

Will it work for all types of instructors, and will they use it?

To use this model, instructors have to give up some control, yet be ready to jump back in when teams go off track. Instructor self-confidence and comfort with student interaction are critical to the model's success. Training in team approaches, technology use, and converting materials to a new paradigm takes time. Realizing this, textbook publishers now provide links to online resources or CD-ROM supplements. As with any change there are early adopters and those who accept change only after the road is smooth. Realistically, not all faculty members want to make these shifts, and forcing the issue could undermine a stable teaching career. At NMU an instructional technology support center followed two guidelines: let faculty adopt at their own pace, and offer just-in-time training. Faculty attendance at training sessions was high for two years, followed by significant adoption rates. In the fall of 1999, 12 courses had incorporated WebCT in some manner; by winter 2001 the number surpassed 300. Training session attendance dropped as faculty reached a plateau, but is expected to increase again for the next level. "I don't need any more training right now.… I've been over trained for what I can effectively use," one faculty member stated, adding that he'd be back for more when he was ready. Recognizing this cycle of training, adoption, and saturation could help administrative planning for faculty training and resources.

Lesson 2: Level and timing of adoption varies across faculty who differ in willingness to change; initial efforts do pay off in the long run.

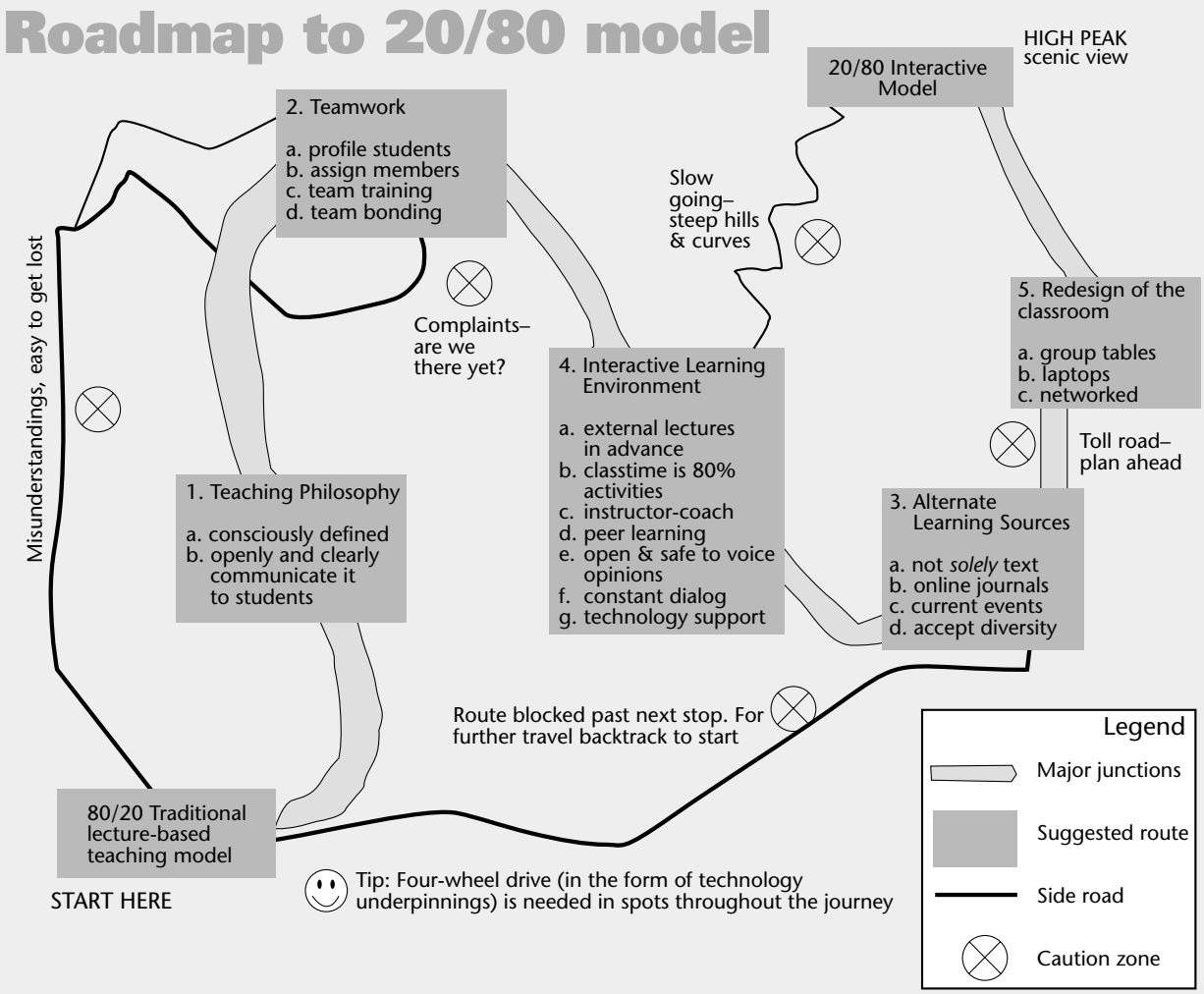
Can it be applied for all types of students, or are there risks?

A lot of effort went into shifting students to a new learning mindset. Lessons learned from earlier experiments proved the need for time spent explaining and retraining.[7] The belief that a computer-literate generation will automatically adopt and thrive in a technology-rich educational environment is, we believe, a myth. Just because more of today's students have computing experience doesn't mean they know how to use computers effectively in their education. Experimenting with the model in several courses yielded both anecdotal and quantitative evidence of higher average achievement with less standard deviation — the bell curve shifts left and narrows.

Lesson 3: A plausible conclusion is that peer learning removes the gap between the high and low scores. Top scorers have shared their knowledge with their peers during class, pulling everyone up slightly.

Figure 3

The 20/80 Roadmap



Is this model possible without the laptops and other technology aids?

A goal of 80% interactivity requires technology support, but it doesn't dictate a laptop for every student. In some cases, classes can use labs for certain periods. Floater laptops can be purchased and issued at each class period to a team of four, optimally two laptops per group. An instructor workstation or student laptop can be used to record brainstorming lists, discussion, or class minutes. Within 24 hours all class members can be e-mailed a copy. Clearly, having a laptop policy at NMU made technology more a focal point and permitted full integration. In some instances specific technology may not prove effective. When digitized pads were introduced for note taking, students in our study preferred to take notes directly on their laptop or paper. These tablets were a prime example of using technology without a firm educational goal; more thought should have gone to the course objectives before introducing the technology.

Lesson 4: Technology plays a vital role in the model's implementation. There isn't enough class contact time to cover material, expect teamwork, and conduct assessments without tools that enable effective learning outside the classroom.

How essential is the redesigned classroom facility?

Group tables aren't essential, but preferred. Poindexter has used this model in three settings: rows facing forward, group tables around the perimeter, and group tables spaced throughout the room. The group settings far excel in this 20/80 learning environment. By facing each other rather than the instructor, students were more active and more willing to risk an error with only a few peers listening. Tables also provide adequate workspace for groups to use laptops, spread out materials, and occasionally enjoy shared snacks. Learning around a table became more natural and casual — almost like a kitchen table. Keep in mind that laptop use requires electrical and network connections, which have safety considerations. Perimeter tables, accessible to

wall plugs, are preferred to rows of desks.

Lesson 5: A technology-ready classroom facility boosts the model's application. Immediate results appear in a group-friendly classroom.

Future of the 20/80 Model

Faculty must provide the instruction and direction for their courses, but student competencies are shifting. Applying the 20/80 model fosters team spirit, confidence, trust, and a consolidated knowledge building unparalleled in any traditional teaching style. Testimonials from our students indicate that this has been a very positive experience (see the sidebar "Students' Comments"). So what is our final conclusion on the long-term impacts of the model?

We believe that the answer lies in the goals and objectives for your students. We're convinced that students who enjoy this learning environment are apt to stay interested enough to pursue knowledge on their own. As future employees, these students will remain life-long independent learners willing to share their abilities with colleagues and celebrate their success together. We are confident that the 20/80 model works and that others will find tremendous benefits in implementing this model in their teaching environments. *e*

Endnotes

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