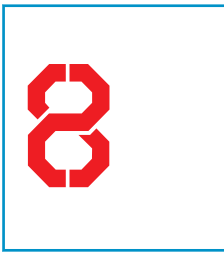
The Learning Community & Differentiated Learning



Tinkering is a social activity. Even loner geeks love the occasional group tinkering session. The communities of your students will overlap into the community you create around your students' tinkering. It's best to think this through a bit, informed by recent research, so that you can make your tinkering community a high-energy, high-interest, highly effective one. And there's one more thing you need to consider: your kids will all learn differently at different rates, but it's not difficult to support each of them just where they are.

The Learning Community

Tinkering often has a hard time fitting within the confines of the classroom learning tradition. That is to say, if you want to teach well with tinkering, it may be best *not* to start with all the assumptions and culture inherent to the school classroom. Instead, you could consider the following question as a guide: how can I create the best little community for my tinkering kids? You'll need to get as much insight as you can into the broader community or communities you're dealing with, and within that context choose the best way to invite the kids' participation.

The Community Science Workshops have formed deep roots in our communities, and each one has also formed a solid and well-grounded community of tinkerers who frequent our spaces. We want our work with the feeder communities to follow accepted cultural practices and to forward their own goals whenever possible. We pursue this by means of education through tinkering.

Barbara Rogoff, senior professor of psychology at University of California Santa Cruz (coincidentally just up the road from the Watsonville Environmental Science Workshop), has researched and written extensively on different traditions of education used in different cultures and locations. Among others, she describes two traditions that contrast quite vividly and I think illuminate important differences between standard classroom learning and learning by tinkering. One is called *intent community participation* and the other *assembly-line instruction*.

Intent community participation, outlined by the "concept prism" shown in Figure 8-1, is what happens in many traditional cultures when kids learn by hanging around, listening, and participating in some productive activity. Kids can jump into the activity at various levels, and adults support them. Adults and kids and the entire social group gain from the experience. An example is kids learning basketry or agriculture or childcare by first watching, then helping, then taking on more and more responsibility as they grow older. This also happens in industrial societies in areas such as learning about home computers and learning religious or cultural activities.

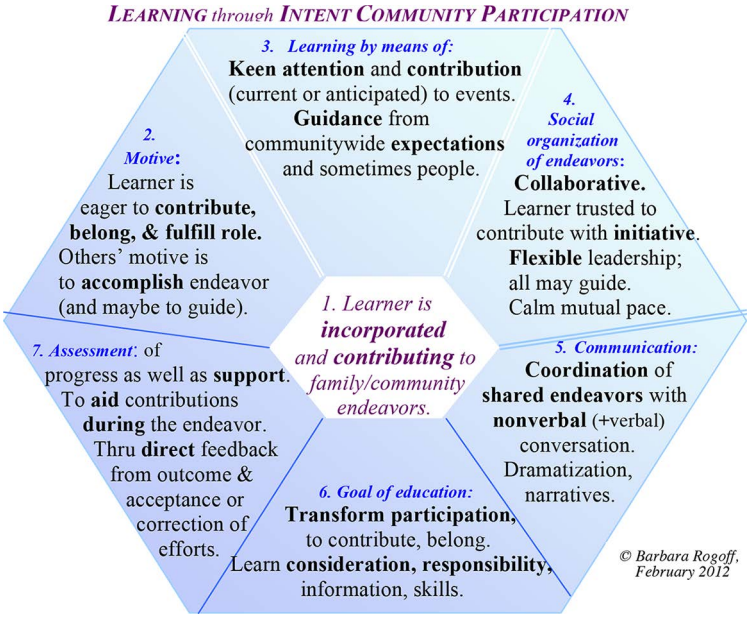


Figure 8-1. *Intent community participation concept prism*

Assembly-line instruction, outlined by the concept prism in Figure 8-2, is what happens in many schools. Learning is separated from productive activity. Kids are separated from families and most other adults and have little agency to decide how and when they'll plug into the learning process. The content is decided by experts far removed from the community. Kids may have no idea why they're learning this content, nor any idea how to apply it, but the broader society has deemed it important. Students are expected to ingest the content and later they are sorted according to how accurately they can parrot back this content on exams.

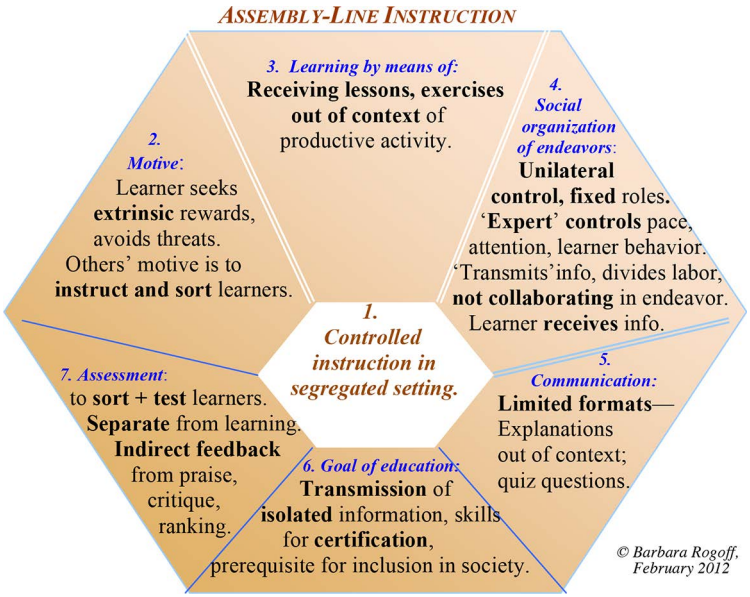


Figure 8-2. *Assembly-line instruction concept prism*

Rogoff points out that some schools have moved away from assembly-line instruction, with great results in terms of their own goals. Clearly, different traditions developed to meet different needs, and these needs change. Rogoff and her group go on to draw various conclusions about children's development and learning of cultural practices and the broader consequences of different learning traditions. Their research can make you realize the value of thinking about how you were taught and your own assumptions about how education should be done, especially in comparison with other traditions. The key point for educators or, in our case, tinkering facilitators, is to know that you have a choice, beyond the nuts-and-bolts formats and structures mentioned in Chapter 4, as to how you invite your kids to participate in the tinkering you'll be carrying out. You'll make that choice consciously or not, so it's best to be aware of how you choose so kids can get the most out of the experience.

Since it's hard to do good tinkering within the school setting, we have put some effort into forming our tinkering spaces at the Community Science Workshops more toward intent community participation. Some aspects are automatically in place. For example, there are usually many adults present in our tinkering space, some of them tinkering themselves. Kids of all ages are also present, and there is usually no time restraint, so the spectrum of watching/helping/doing often happens naturally. Newer learners want to contribute what they can, and more advanced tinkerers want to accomplish something. If assessment happens, it comes from direct feedback (Did the gizmo work or not?). Communication is about needed, practical issues having to do with the tinkering.

Other aspects are a bit harder to fit to the model. For example, productivity, per se, is not one of our top priorities. Sometimes we are productive, but it is most often the case that our tinkering goal is for fun, and that there are other, often easier ways to procure whatever it is we're making. Examples are constructing chairs, building toys, and sewing clothes. We also sometimes work together to offer something to the community, such as a parade entry or a haunted house. Here the goal is clear, everyone helps, and everyone benefits.

Rogoff says Intent Community Participation doesn't have to be oriented toward practical necessities or commodities, which is good, since I have concluded that the closest thing to an essential commodity we offer is an idea-rich, safe, educational space where kids can go and learn when they're out of school. That and the real learning that happens when kids are tinkering there. This learning happens nonstop amid all the fun, and I see that it mostly happens along the lines of Intent Community Participation.

Most kids raised in the dominant culture in California are weaned on the assembly-line, school-based tradition, and it is not so easy to just pop in and out of traditions. But it does happen. Rogoff and her colleagues talk in terms of "repertoires of cultural practices." By this they mean that most of us have a bit of experience in several of the possible learning traditions, and as we grow and mature, we learn how to enter a given situation to participate in a productive manner. For many of our immigrant kids, it is naturally easy to enter into the educational environment of our Workshops. Where they've come from, there was a good deal of Intent Community Participation happening.

Education traditions aside, thinkers on teaching and learning long ago ceased to view education primarily as knowledge transfer, but rather as participation in a social activity. Most learning happens within a "community of practice" or a "community of learners," and it is nearly always "situated" within a certain physical and cultural space. Your kids will not be stepping from or into a vacuum of culture when they enter your tinkering space. As Rogoff writes, learning often happens by means of "transformative participation in shared socio-cultural endeavors." That means you'll see kids change and grow as they participate in your little community of tinkerers. Linda Polin similarly maintains that your kids will learn "through a process of enculturation into a slowly but constantly evolving practice." Your tinkerers will learn stuff as they become familiar with the norms of your tinkering environment, which is also constantly updating, if you will, in response to them.

Jean Lave and Etienne Wenger, early pioneers with these ideas, described it as actual "identity transformation within a community." They hatched a somewhat daunting terminology to describe what they saw happening: "situated learning" and "legitimate peripheral participation." So when some kid wants to learn to fix her bike, the first step is often to help someone else who is fixing theirs: hold the bike steady, fetch the wrenches, pump the pump, etc. This assistant is learning (in the future, she may step up into the role of the primary fixer) and also helping—a legitimate participant in the operation—and the whole kit-n-caboodle is situated within the

warm, welcoming workshop environment, resplendent with tools, supplies, grease, interesting junk, and other people who know how to fix bikes.

These modern analyses from academia offer a whole new perspective for educators and open up a new set of guideposts that fit very well with tinkering. For instance, we go out of our way to support the community of kids in our Workshop to work together and see similarities in one another: We can all solder! We have all mastered the drill press! We all understand double-nut locking systems! We all know how to measure a quarter inch! We can all recite the safety rules of the Workshop! We're the Science Workshop Posse!

We also see our relationship with kids and their families to be of paramount importance. To understand their community and to help them acculturate into our little educational community is as important as any information we have to offer or how we offer it.

See Appendix B for selected references describing research done in this area over the last three decades. Check them out if you can, and don't get put off by the academic speak![1] The good news is that you needn't understand each nuance of these theories and frameworks. If you can just view your students as real actors in their own education, and view your program as a mini-community overlapping with the collective communities of your students, and see the participation and interaction of your kids as essential to the learning that happens, you'll be primed and ready for wondrous education to take place with your group of tinkerers.

Differentiated Learning

In school, certain students tend always to be ahead of the game, always done with their worksheets early, always getting 110% on tests or looking a bit bored in class since they "know it all" already. Once upon a time, when I was young and right up until around 10 years ago, schools would skim off these students, put them together in a special group, tell them they have fantastic potential due to the talents and gifts bestowed upon them, and call this the accelerated group. There are huge problems with this, not least of which is the seed of arrogance sown in those who make the cut. And then there is the issue of the students who don't get into the winner's circle. Are they to be labeled the decelerated group? Slow? Untalented? Ungifted? No potential?

Some schools may still do this, but in California, no more. Now it's up to the teacher (of course with plenty of free time on her hands—not!—to cram one more thing

1. Don't be surprised if you open up one of these references and find your eyes crossing at the site of what appears to be a completely separate language: "transformative enculturation through legitimate peripheral situated participation in a practice community…" It may inspire you to reject it all outright. But also don't forget the words of Kurt Lewin: "There's nothing more practical than a good theory!" And know that whatever happens in a given educational situation, it's following someone's theories and beliefs, conscious or not. Thus, it's better to think about it and make sure it makes sense. Then get back to the tinkering.

into the instructional period) to carry out differentiated instruction. This means basically that the teacher should be meeting each student's current needs in relation to the content being delivered, with just enough challenge and just enough handholding to ensure productive learning takes place every minute of the day. This, with some students who have just arrived in the country, some students whose parents have been reading to them since before birth, students with all manner of disposition and personality and learning style and nutritional intake, all in the same classroom, often 35 or more of them. Sound impossible? Of course it is!

Teaching without real stuff is an awful challenge. Presenting knowledge to a group of students by means of worksheets or a textbook page is like feeding the inmates in prison: "Here's the grub, bub, take it or leave it." When teachers are pressed to carry out differentiated instruction, they're often given matrices or rubrics[2] full of activities or further exercises for the students to choose from, which can be a bit like giving the inmates two or three different forks to choose from.

When I've listened to differentiated learning zealots speak, yet another eating analogy comes to mind: intravenous (IV) feeding at the hospital. The bright hope is that the teacher will be able to discern and offer precisely what each student wants and needs in precisely the right manner using a stack of papers and workbooks, with maybe a video or two and, in the wealthy schools, the World Wide Web. An information IV, so to speak, of which the teacher is in charge.

Tinkering offers a better alternative. If the goal is to have students learn at their own levels and by means of the methods that work for them, why not let the students lead the way? And what better way to discern where to plug them in than to let them fool around with real stuff in real context? I'm not for a minute suggesting that pencils, papers, and reference texts should not be close at hand. I'm saying that these are not enough. It's a wide, wonderful world out there, but classroom walls and official curricula often cut it off from the students. In doing so, they also cut off many valuable learning avenues, some of which are essential. Differentiated learning matrices will in no way substitute.

Differentiated learning happens easily and naturally when students are tinkering. Students approach the stuff from their own standpoint, using everything they've learned up to now about this stuff and its place in the world. They also use tools and materials according to what they've seen and tried in the past. They are ready to learn the next level of knowledge this tinkering topic has to offer, and there are *always* more levels. I have seen the old adage proven again and again over a pile of interesting junk: the more you know, the more you know you don't know.

The beginning circuits tinkering activity outlined in Chapter 7 is a case in point. Some kids will need to learn that the insulation must be stripped from the wire to

2. An irrelevant yet irresistible aside: there were no rubrics when I was young. I'm convinced the rapid rise of rubrics, with their carefully crafted columns and categories of characterization is in large part due to the strikingly splendid sound of the spoken syllables in the word itself. Say it three times quickly. Rubric, Rubric, Rubric. Fun, eh? Like kissing a trout…

make it connect, while at the next table, other kids have formed a combination series/parallel circuit that shows a motor can let electricity flow without itself turning. To do differentiated instruction, you simply approach students or groups *where they are* and help them move on. You can suggest a goal you think may be reachable and point the way forward.

In fact, doing tinkering without leaving it open to differentiated learning is darned-near impossible. I've seen it tried and it's painful and ugly: "Now pick up the hammer with your right hand. (Ana, put the glue down.) Now hold the nail with the left hand, three-quarters of an inch from the edge of the board. (Miguel, not that board.) Now give it a little tap to get it started. (Sofia, get back over here!)" And it gets worse from there. I guess that wouldn't actually be called tinkering, but perhaps "human robotics." Clearly the point has been missed: No one hammers the same. No one tinkers the same. No one thinks or learns the same. If we are to be facilitating our youth's learning, we've got to understand that and provide opportunities for them to do it in their own way. With real stuff, this is smooth and easy.

Beyond the actual act of tinkering itself, when it comes to observing and describing and trying to explain what's going on in the tinkering process, students also come at it from a plethora of different angles. The final discussion will bring this out, but you needn't wait. As they tinker away, your conversations with them can expose what they observe and what they do and don't understand. You are then well situated to offer them the support they need to get a conceptual grip and expand their understanding.

On a related note, *scaffolding* is another unfortunate term from the dictionary of edu-speak. Originally a scaffold was a structure on which the criminal stood to await his hanging. Hardly an appropriate goal for our schools. Scaffolding is just a funny word to describe individually supporting or helping a student to learn, and just like differentiated instruction, scaffolding becomes utterly obvious in the tinkering environment. When the stuff is spread out, and the general direction is determined, kids start tinkering, and the astute teacher watches what's happening. Ah, Jill has never used wire strippers, and her buddy is not helping, so she'll need help from the teacher. Oscar is screwing off instead of focusing, which means he probably missed the directions or is afraid of not being able to build it. Melissa just cut way too much wire, so she probably needs a review of how to measure. And so on.

You can be as structured with this as you want. For example, just before launching the tinkering session, you can say you'll have a five-minute session on wire stripping at the front table for those who want it. You can ask for a show of hands on who understands, and then give more instruction if the majority of them want it. You can even put one or more students on a corollary project that is preparing them for doing their chosen project better, such as cutting a bunch of curvy lines with the scroll saw on scrap wood before they cut into the wood of their project.

Kids who've got the project figured out are valuable here, too, as mentioned above. You can either wait until they're done and then put them on assistant duty, or put the kids who've never done it before right with them from the start. It doesn't always work, but often it does. I remember one rough, annoying kid—a highly unlikely

assistant that I ended up appointing to assistant on a snap decision (that is, I was about to snap)—telling me with a big smile at the end of the session, "You know, I think I like helping even more than building my own!" Score! I'd say he and the ones he helped were all well scaffolded and differentiated, so to speak.

(By the way, don't forget to learn from your students. It is a rare day when I do not learn something from my students, whether it be a new way to build something, a new idea on how to make something work, a new and plausible explanation for why something works, or a new mistake to make in the construction of an old project. When you give students the chance to tinker and ask them what they think is going on, you never know what you'll learn. Perhaps that could be called inverse differentiated instruction?)