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Roles

In a Makerspace, with students following their own passions and designing dozens of different kinds of projects, the old way of running a classroom just doesn't work anymore. In this chapter, we describe the new roles we see emerging in Makerspaces: what to expect of the teacher, students, and possibly others.

Nobody who uses the space needs to be an expert, not even the teacher. The most important thing is to have a passion for and a curiosity about making in many different forms. Once you establish safety and basic competency, members can teach themselves what they need to know.

We find that projects that a member is passionate about are one of the best motivators for learning. Students and mentors can tap online resources, or access the expertise and know-how of the local community and other members to fulfill that passion. Skills can be brought, taught, or bought.

A New Kind of Teacher

With 5–40 students in a Makerspace at the same time all doing different things, it's time to throw out a number of the rules-of-thumb you may have learned as you trained to be a teacher. Hang onto all your good habits, get rid of the bad, and introduce some new ways of running this new kind of classroom. Time for a different brand of leadership! You may want to use these metaphors as you adopt your new persona:

- ***The Project Manager***. We borrow the project manager metaphor from the design industry. It's usually used for large-scale projects where a large team works together to attain a shared goal. The project manager oversees the team and a project's plans, risks, schedules, budget, and conflicts. A project manager knows how to create objectives that are clear and reachable. They define requirements and make judgment calls about budget, timeline, project scope, and desired outcomes. They also give feedback on quality of work done by their team.
- ***The Principal Investigator*** (or PI) While college lectures are often passive, university labs and research are usually richly active. Think of a Makerspace teacher in the role of a PI, the head of a research lab. Graduate students collaborate with one another and with their advisors while pursuing research that is usually based on their own interests and expertise, towards what they want to learn. Professors check in regularly with their students to give them advice and feedback. Similarly, in Makerspaces the students are learning from and consulting with the teacher and with one another while pursuing projects that are generally of their own design.
- ***The Coach***. Good coaching can be as hard to come by as good teaching. It requires a certain economy of talk and limited praise with a lot of thought going into how to convey lot of information with minimal interaction, i.e., giving feedback without riding the players too much. The best coaches learn what works well with their players and improve their "curriculum" and technique from season to season. (Read more about coaching in Gallimore R. & Tharp R. "What a Coach Can Teach a Teacher, 1975-2004: Reflections and Reanalysis of John Wooden's Teaching Practices" *The Sport Psychologist*, 2004, 18, 119-137 Human Kinetics Publishers.)
- ***The Research Librarian***. One teacher described his viewpoint of teaching in a Makerspace, "I don't lead them, I aim them." This resembles the role of a librarian. A librarian listens to a patron's needs, desires, and interests, and then helps connect the

reader with the resources that might satisfy their hunger for knowledge. They bring the library visitors over to the right shelves, pull a few books a little farther off the shelf, suggest some other books or resources that may be of interest, and then go back to their desk to work with another patron. They provide strategies for finding the right materials, and help unlock the powerful search tools that readers can use to find what they want now and in the future.

No matter what metaphor works best for you to help you work effectively in a roomful of divergent projects, there are a few tasks that are chiefly your responsibility as the teacher.

- Recruit students.
- Recruit adults to mentor and/or manage the Makerspace (paid or volunteer).
- Delegate some of your responsibilities to advanced students and adult volunteers.
- Assign or help match mentors to project teams.
- Schedule meetings and group build sessions.
- Engage with other Makerspace teachers to ask and answer questions.
- Stay in touch with the Makerspace core team and participate in surveys and other data collection to help improve the whole community.
- Share documentation collected from students.

Students

Students in a Makerspace are passionate about do-it-yourself, hands-on projects in a variety of domains. In a Makerspace, their primary job is pretty clear: to make stuff! Getting from nothing to something, though, is where the students gain valuable skills, not just of the mechanics of how to make the thing they want to make, but also in defining and managing their responsibilities.

There are some other more subtle things that all your students must commit to do, and you may want to ask them to agree to these goals as a precondition to using the Makerspace.

- Engage in their own learning and exploration.
- Define a project and work with other students and mentors to exhibit their completed project (or evidence of what they've accomplished to that point) by a preset deadline. be in the areas of technology, art, craft, engineering, music, science, green design, or other Maker themes.
- Use the facilities, tools, and materials in a safe way.
- Alert fellow students, mentors, and/or program leaders when facilities, tools, and materials are being used in a way that could cause harm to themselves or others.
- Come to meetings.
- Apply good time-management and project-planning skills (optional, but very helpful!)
- Give others working on other projects feedback and help make their projects the best they can be, in a positive, creative, dynamic spirit.
- Improve or "plus" projects—only if such feedback is welcomed—with helpful suggestions, tips, and assistance when they see a way other students' projects could benefit from what they have to offer, while respecting their projects.
- Tell program leaders changes they'd make to the Makerspace to improve it for future users.
- Work one-on-one with an expert and/or in groups to design and produce their project. Meet regularly with a team and/or a mentor for design and build time. The amount of time needed varies considerably depending on the project vision.
- Document their projects as they create it.
- Commit to work as a team and to be a part of the Makerspace community.
  Hint: If use of the Makerspace begins anew each year or semester, or if all users begin at about the same time, kick off your time together by asking them to try generating the rules for using the Makerspace—they might spontaneously come up with many of these on their own.

You may opt to have students "apply" through a non-competitive application process as part of their application or initiation to your Makerspace. They could to write a short paragraph about why they want to use the space, what kinds of things they have made in the past, or what they'd like to make. Sometimes this helps you sniff out which kids have been signed up for the program involuntarily, such as by a parent, rather than on their own initiative.

If for some reason you're short on students and need to recruit more, these are the kinds of organizations in which other Makerspaces have started, or which we recognize as sharing in our mission.

- Nationally organized groups with local chapters (e.g. 4-H, FIRST Robotics, Girl Scouts, Boy Scouts, Boys & Girls Club, YMCA and YWCA, Intel Computer Clubhouse)
- Schools: public, private, charter, or homeschooling collectives— consider from pre-K to college, especially certain tracks or departments in engineering, art, science, crafts
- Community art centers and art collectives
- Libraries, museums, and science centers
- Master gardening programs, beekeeping clubs, urban greening groups
- LEGO user groups
- Hacker meetups and hackerspaces

For more about working with young people, see our *Maker Club Playbook*, created for the Young Makers program.

Shop Host / Chief / Coordinator

You have a great space with great equipment, but that's all for nothing if no one knows how to use it and nobody has the job of maintaining equipment and supplies. Every Makerspace needs a manager, which could be the same person as the teacher, or another volunteer or staff person helping coordinate the space and the program. Sometimes, one person serves several roles, so this could be the teacher. But it's a lot of work to do both. At Georgia Tech, the Makerspace is jointly operated by the college students who use it.

The shop host controls access to shop facilities and knows about the usage and safety of tools in the shop. This person should have the same skills outlined for Mentors, as their interactions with the students will likely have a profound effect on the kids' confidence as Makers and continued interest in making.

A school could have a non-certified role of a manager who works with teachers, knows the equipment, does purchasing, etc. This role might be especially critical in a school where the Makerspace is a resource center used by different classes and in different contexts. That is, multiple teachers and multiple classes could use the space: a physics class might use the space for a unit, an afterschool program on robotics might build there. It's not necessary that it be dedicated to just one particular class on making.

Besides managing the space and the fabrication tools, shop hosts should be willing to:

- Work with project groups to help them achieve their project visions.
- Run safety training for all who use the Makerspace; monitor that safety is practiced at all times.
- Help project teams to acquire skills with tools, tool safety, and other aspects of hands-on fabrication.
- Track use of consumable materials, re-order as needed.

Mentors

A project team might consist of a single student who wants to work alone, or a group of students who have decided to benefit from one another's complementary talents. We feel that either model works best when every project team has a mentor clearly assigned to them.

Mentors are adults who are interested in working with youth and who may be experienced in one or more forms of making. Mentors answer technical questions, address supply issues, pass on their knowledge of tool usage and safety, and help manage realistic project-build schedules. Along the way, mentors might exploit "teachable moments" to explain underlying math, science, and engineering concepts.

You will probably want to find different kinds of mentors. There are those whose curiosity, sense of adventure, project management skills, and positive attitude can help carry young people through the difficulties of a project toward a successful completion (or at least a valiant effort!) Then there are those who have extensive skills in lots of kinds of making, or a deep expertise in one kind of making. Sometimes you can find both modes of mentoring in the same person. You probably need the first kind of mentor as you start the Makerspace, and you'll probably need to match the Makerspace with the expert-at-making mentors as they progress in their projects.

As soon as the students have chosen their projects, they'll probably have questions—how to get started, how to finish before the deadline (that is, how to write a project plan), how to resolve a technical issue. Often Makerspaces tap into their network of the parents and friends of families to serve as mentors for this kind of problem-solving. We find that at this stage especially, the best mentors are curious, patient, and flexible, and they have the skills to find out how to do something.

The role of a mentor is to help one or more project teams find a *project vision* if they don't already have one, and then to help them realize that vision for *exhibition* at Maker Faire. Along the way, we encourage mentors to exploit the *teachable moments* that naturally occur during making to expose the underlying math, science, and engineering principles involved. But they aren't teachers so much as guides. We also expect mentors to pass on their knowledge of proper *tool usage and safety*. Finally, an important role for mentors is to demonstrate to Makerspace the importance of *failure as a means to success*. That is, to expect and embrace failure as a normal part of the making process.

It is difficult to be a good mentor. No matter what our age, we appreciate mentors whose facilitation is welcoming and intended to spark interest, provide focus for our attention as needed, strengthen our individual understanding and clarify our intentions through reflective conversation. We like how the **Exploratorium's Tinkering Studio** describes facilitation and activities in its design principles:

Facilitation: Principles that inform the interaction between staff and museum visitors

- *The facilitation is welcoming and intended to spark interest.*
- *Facilitators try to focus visitor attention, based on individual paths of understanding.*
- *Facilitation should strengthen understanding by helping learners clarify their intentions through reflective conversation.*

Activity Design: Thoughtful approaches to interacting

with materials, tools, and technologies.

- *Activities and investigations build on visitors' prior interests and knowledge.*
- *Materials & phenomena are evocative and invite inquiry.*
- *STEM education is a means, not an end in itself.*
- *Multiple pathways are readily available.*
- *Activities and investigations encourage learners to complexify their thinking over time.*

The Intel Computer Clubhouse has invited mentors to support the creative projects of young people since 1995. They define the role as a "balancing act [of] being aware of the complexity of your role as both a knowledgeable guide and a friendly partner.... Although mentors wear many different hats, the primary goal of a mentor is to guide and support—rather than direct or teach." In Clubhouses, much like in a Makerspace, a mentor could be an observer, guide, resource, role model, active participant, catalyst, or friend. For more of the Clubhouse's Tips for Mentors, see Resources at the end of this playbook.

While there is no simple recipe for how to mentor, mentors will be most effective if they think like Makers: staying curious, interested, respectful. Mentors should always focus on the students' interests, not their own, but they can share what they love to do so that the students can see that mentors are passionate about Making too. Mentors should try not to lecture, but instead ask questions and model habits of mind that will help your students discover answers on their own (even if, in the end, this takes longer than just answering their questions or doing the work for them!) Good mentors encourage students to support one another and help each other with the problems they face to build community within your Makerspace. They are ready to learn from the kids.

Mentors should be willing to:

- Work one-on-one with students or in groups of up to 4 members, or with one or more project groups to develop projects to meet their milestones and final deadline.
- Give project feedback and help make projects the best they can be, in a positive, creative, dynamic spirit.
- Exploit the "teachable moments" that naturally occur during making to expose underlying math, science, and engineering concepts in an inspiring and engaging manner.
- Attend meetings as scheduled.
- Identify students who might need extra support or encouragement.
- Provide general help to students.
- Offer encouragement to students.
- Offer specific guidance or workshops in areas of expertise, if applicable, in technology, art, craft, engineering, music, science, green design, and other Maker themes, or demonstrate the curiosity and commitment necessary to develop such skills
- Help organize logistics for projects.
- Bring any serious concerns/issues to the attention of the teacher.
- Engage in their own learning and exploration.
- Provide some technical support of project documentation (video, photos, sketchbook, lab notebook, blog) if needed.
- Establish contacts to obtain in-kind donations, sustain member projects, and to give members and mentors possible tips and resources.
- Model and pass along good time-management and project-planning skills (these are very helpful!)
- Experience meeting new people and sharing ideas (i.e. they may not be a good fit if they consider themselves "shy")
- Commit to work as a team and to be a part of Makerspace community
- Desire to support the Makerspace philosophy
- Help young people build skills and confidence

Recruiting Mentors

If you're an experienced Maker and have lots of Maker friends, you already have a source of mentors. Other places to look for mentors are neighbors who are handy with tools. Don't forget to think about retirees (older men and women too) who might be looking for ways to give back to the community. They often have significant hands-on experience. If you're having trouble finding mentors, let us know. We may be able to help.

Once you get past those initial questions, however, even with the best mentors you may need to find some specialized expertise. Mentors don't need to possess all the skills and knowledge that might be needed to complete a project — they just need to be willing to try to find those who do, or to learn alongside the student. Or this can mean active outreach to identify and draw in talent from the community. That piece is a little bit like community organizing.

Tip: At the end of the chapter on Projects we list community resources that may be a source for mentor recruitment.

By the way, parents provide invaluable help! Parents should be encouraged to participate, as mentors, managers, or shop hosts, or as general volunteers willing to support the Makerspace in whatever ways are necessary.