PROJECT-BASED LEARNING KICKSTART TIPS:
Hackathon Pedagogies as Educational Technology

John Duhring

COGSWELL POLYTECHNICAL COLLEGE

"The greatest glory in living lies not in never falling,
but in rising every time we fall."—Nelson Mandela

ABSTRACT

Many of the technologies making their way into mainstream education are digital, and much of the focus in schools has been to help people learn to use them. Alongside "high tech" are new face-to-face technologies that are proving to enhance learning in a variety of settings. Connective technologies that enable participants to organize themselves into hackathons, meetups, and "un-conferences" deserve careful review. Until now, their structure and the pedagogies they enable for academic purposes have not been studied. This paper illustrates hackathons at a structural level and suggests some academic contexts in which they can be used. Furthermore, this paper will discuss their impact on course design, the roles of teacher and student, and the outcomes afforded by their use with an eye toward encouraging experimentation on a more widespread basis. The underlying thesis is that in general, students are capable of far more than they reveal in schools today.

Introduction

By choosing to examine face-to-face educational technologies from the perspective of the participating students, this paper is not suggesting that traditional classroom interactions are obsolete. Rather, this paper argues that traditional classes can be augmented and made more effective by embracing the proliferation of personal communication tools now available to students. Hackathons exist on the premise that participants will self-organize and develop meaningful projects through structured communications. Examples of personal transformation and learning abound with such consistency that these mechanisms deserve consideration and implementation within mainstream academic environments. Studying how hackathons work promises to validate their use in schools; their implementation will integrate student engagement more deeply than typically practiced using traditional classroom activities alone.

The root of the word "education" comes from the verb "educe"[1] (the Latin verb "educere" means to draw forth or bring out) and the origin of "teach"[2] derives from the English word "techen" and the German word "zeigen" (to show, point out or demonstrate); these roots provide guideposts for exploring the use of new technologies. Since "pedagogy" is defined as the science of teaching, this paper attempts to find indications of replicable educing and teaching in hackathons. As a starting point, reflect on how the practice of "show and tell" has been used

1 Definition of "educe": http://www.merriam-webster.com/dictionary/educe.

2 Definition of "teach": http://www.merriam-webster.com/dictionary/teach.

in the classroom until now. Typically a part of early childhood education, "show and tell" periods are popular with students but often become unwieldy as more structured curricula are introduced. When college students are asked to give demonstrations or participate in projects, they must brush up or hone the skills needed to take advantage of collaborative opportunities and to showcase their unique talents. Might hackathons prove useful as manifestations of "show and tell" going forward? What skills and learning objectives are addressed? How might they be measured?

Last summer, a recent graduate from a major university, armed with her Master's degree in anthropology, joined the ranks of many recent grads as she embarked on a job search. Unlike many, she looked into high technology jobs even though she was not a programmer or computer scientist. Her path led her to attend one of the many hackathons that have sprung up in San Francisco. From there, her learning journey propelled her to the realization of a new kind of anthropology, in which the users of connected online resources take the internet with them, wearing it almost like shoes. She attributes her adaptation to a mix of the hackathon experience and regular meetups. Her story of personal transformation could only have been possible with the face-to-face technology that is permeating high tech centers as deeply as smartphones: structured interactions devoted to project-based learning. While her learning outcome has yet to result in a position, her career is fully in motion and the kind of positions she is preparing for advertise six-figure salary ranges with significant growth potential.

This paper is meant to describe hackathons from the participant's perspective and provide some anecdotal evidence of their educational effectiveness. It is intended to animate the vocabulary and mechanisms involved in the hackathon experience for lay audiences. It is not prescribing how to evaluate or run them. It assumes that each student is communication-

Image from Facebook.com/hackathon feed (https://www.facebook.com/hackathon), showing participants in a Mexico City event. Note how participants mix freely, whether using technology or not.

Hackathon Structure and Observable Dynamics

The basic hackathon structure can be adapted for use in both meetups and un-conferences. A well-run hackathon involves a series of easily replicated steps, yet each one is a unique experience based on the contributions of participants. The essential elements include:

- A purpose
- Pre-event preparations
- Project pitch phase
- Mixing and recruiting phase
- Project development phase
- Project presentations
- Judging, recognition event, and closing statements

Hackathons can be presented as competitions, celebrations, tributes, or any number of other mechanisms that focus participation for some desired purpose. Setting the purpose appropriately requires thought, in that the sponsor of the hackathon is harnessing "free labor." People don't volunteer for a hackathon on a weekly basis--it is something to build slowly toward. When their campus was in Palo Alto, the famous Facebook hackathons would involve participants pitching tents. For an academic setting, this means that hackathons require careful planning. While a three-day

event might prove too taxing for students, a one-day hackfest can inspire them to set their focus in a way that can last an entire term.

Hackathons identify participant interests on a number of levels, and might serve well as a great way to kick off a course. If a course involves a final project, the hackathon mechanism could serve to generate project ideas, compare alternative approaches, and to "scale down" projects to increase the value of overall class performance. A kickoff event that promises to yield early feedback on course expectations and outcomes might resonate with students entering a challenging course. Students will get to know their classmates in an atmosphere similar to going on a class campout.

Beyond the organizers, judges, and facilitators not examined in this paper, participants in hackathons typically fall into two camps. A small subset of participants plan in advance to initiate a project for the event, while others hope to become involved with something interesting. Both camps will develop ideas and set expectations for what they wish to accomplish. It's not unusual for friends to approach an event together, compare notes, and determine their approach prior to the event itself. Experienced event organizers treat the planning phase as part of the event itself. Facebook's worldwide hackathons have become so large that they have pre-event meetups in locations around the world to help participants understand what judges will be looking for and how they can best display their skills.

Such high levels of intensity and focus at large pre-events might not be easily replicable in academic settings. However, those who are prepared will stand as participants for their classmates to emulate. A reward for "best pitch" or "most prepared" participants might encourage greater pre-event involvement.

Typical One-Day Event Schedule[3]

8:30 a.m.	Open doors, mingle and eat
9:00 a.m.	Kickoff and introduction of rules and structure
9:30 a.m.	Participant pitches and team formation
10:00 a.m.	Project teams start work
12:00 noon	Lunch
2:00 p.m.	Team registration closes
4:00 p.m.	30-minute warning before start of project presentations
4:30 p.m.	Project presentations and demonstrations
5:00 p.m.	Judges confer in private, participants mingle
5:15 p.m.	Winners are announced, prizes awarded
5:30 p.m.	Event close

Each hackathon begins with an introductory period where ground rules are described, along with criteria for evaluation. The main event starts off with participants being asked to identify themselves if they wish to pitch a project to attendees. For anyone who has read the Harry Potter books, the sorting function at the beginning of a school career carries implications that last a lifetime. On a smaller scale, the actions of participants in an academic hackathon carry significance. The project pitches serve to bring the sorting function to the event in an organic and genuine way. At the very least, the variety of approaches suggested by the pitches

3 Tips for running a hackathon: http://www.socrata.com/open-data-field-guide/how-to-run-a-hackathon/.

might illuminate new approaches to students who might not have a clear idea of what a given course might involve. Less motivated students are given the benefit of the examples presented, while more motivated students are challenged to "up their game" as they match themselves with project teams. It is beyond the scope of this paper to attempt to identify or measure the implications of a hackathon on course performance, but we hope that such studies will begin soon.

The anthropology grad mentioned in the introduction of this paper attended her first hackathon without any thought to what she might accomplish there. However, she was greeted with acceptable ground rules and pitch-giving guidelines. She took a flyer and contributed her story of managing a shared space and seeing the need for a smartphone app to help others in similar situations. As she described her thoughts, the needs, the elements involved, and the possibilities for what she thought could be achieved, she felt a certain distinction even in being able to speak without judgment or grades. There was no downside for her to communicate as best she could.

Typically, those giving "pitches" hear every other pitch and develop a sense of accomplishment as well as foreboding. They have no idea how their story might resonate or compare to others. When all the pitches have finished, the event organizer has each presenter stand alone in a designated area and then informs the rest of the participants to approach the presenter with whom they wish to collaborate on a project team.

Imagine the young anthropologist's surprise when she was deluged with intense interest from her audience. Suddenly, she was a hiring manager and had to consider the resources being put at her disposal. The sorting function goes into full swing as each of the project teams deals with the new reality of their project suddenly materializing before their eyes. Or not.

Some pitches generate no interest at all. Typically, if some presenters wish to abandon their project or have not attracted a team by a certain time limit, the event organizer agrees to free them up to "go it alone" or join another team. A wide range of emotions can surface, which have not been documented well yet should be monitored closely in academic settings--this sorting process holds vast potential for further research. Great teams sometimes form out of nowhere, while other great ideas wither from lack of support. In an academic setting, event organizers must come to terms with the organized chaos that ensues during the team formation phase. In many cases, no rules are the best rules; students come face-to-face with their own skills and shortcomings early on. Even so, experimentation in managing the process might serve to develop norms that benefit all students, from the most engaged and passionate to those who typically step aside.

Offsetting the potential drawbacks mentioned above, the sorting process creates dramatic learning outcomes when applied in education. In particular, each student is given the choice to choose who to listen to. They are free to approach teams based on a pitch and must determine if being a part of that team will be worthwhile. They are not weighing purchases as a consumer, but evaluating future involvement as a stakeholder. They size up others on a team to see how they might contribute, what they might learn, and how they might change. Veterans of hackathons develop a "team-worthiness" from this practice. They learn to commit themselves and adapt for the good of the project.

The short-term nature of a hackathon provides ample opportunity to change course or teams without serious consequences. Not everyone digs in for the duration, but those who do are recognized by their peers and benefit from their efforts. Once formed, teams must develop a strategy of what they think they can accomplish and

then set about completing their project within the time allotted. Skilled participants hone their management chops by mixing with newbies, and vice versa. Those teams that fall apart or muddle through are offered the example of other teams that jell and stick with their tasks. While mingling with other teams is not uncommon, the outstanding trait of a successful team is the intensity and cohesiveness they develop as they work together toward their goal and final presentation.

It is not a stretch to imagine this process for every college student. The personal transformation from private life to professional requires challenges on a personal and team level. The uninitiated will be incompetent and unaware. Their more experienced teammates must serve as mentors, or the team will not achieve their goals. A well-designed strategy would involve the strong players advising the weak so they develop a new skill, or at least become aware of their weakness in order to focus their efforts on achieving competence in the future.

In almost any project, there comes a point where a change of course is required. Experienced hackathon organizers make sure they have experts available to teams for consultation and advice. The advanced skill of re-framing questions, critically evaluating potential outcomes, and redesigning projects within a limited time window tax the most experienced participants and make hackathons an educational method worthy of serious research. For shorter events, teachers can help their student teams develop their class project ideas in a compressed time frame.

Each hackathon must end, which might be their greatest blessing. Participating students must be reminded of the hard stop, when it is approaching, and what is expected thereafter. The project wrap-up phase amps up motivation and emotions, while at the same time turns the focus toward presenting a finished project to the other attendees and judges. Students whose skills were marginally useful at the front end of the project might find they can make significant contributions during the presentation development phase: scripting presentations, organizing slides, or gathering artwork become valuable contributions when handled with aplomb at this critical time.[4] Additionally, "newbie" participants can articulate their experience with the project alongside more deeply technical teammates. What they have learned, if only from the vocabulary level, serves to help explain the project to outsiders. As archivists mix with technical experts, they can experience a multi-disciplinary appreciation for each other and for their project that is far beyond what is experienced in most classrooms.

After a break to freshen up, it's time for "show and tell." In a college setting, this is not anything like the early school variety mentioned earlier in the paper. This is a team presentation to a critical audience and panel of judges. Each team takes a few minutes to describe the problem they have addressed, their plan of action, and the results of their project. Again, there has to be a time limit. Teams that present well can outshine those who take on a challenging project, which makes judging a highly subjective process.

Once each team has made their short presentation (typically 3-5 minutes), the judges typically confer in private in order to sort out their top picks. Event when the criteria for judging is made clear upfront, participants appreciate additional recognitions, such as "largest team," "most challenging goal," "best display of teamwork," or "most awesome demo." A festive atmosphere can bring all remaining attendees a sense of creating the event and being a part

4 The science behind stage fright: http://thenextweb.com/entrepreneur/2013/12/08/cure-stage-fright-science-behind-public-speaking/.

of the winning entries, if only as admirers or observers.

Closing statements at hackathons typically include personal observations from judges, which serve to validate the experience for all involved. Judges' observations carry meaning beyond the awards. Students get caught up in team activities and can be surprised by how their work is admired by others. Event organizers can underscore how the projects that the students have chosen provide evidence of their learning that will only continue as the course itself unfolds.

Most surprising to the anthropology grad was how closely-knit her team had become as they gave their presentation and were ultimately awarded the grand prize for their efforts. She and another team member decided to share office space and collaborate on testing the feasibility of the idea as an entrepreneurial project. Encouraged by her teammates and others at the hackathon, she enrolled in a rigorous 12-week immersion program for UX design and attended meetups around the city after work. She saw how her training in anthropology could be applied to what high tech companies need in their organizations: to flesh out use cases and identify user roles, to design experiments that yield actionable data, and to rapidly prototype user interfaces for consideration by engineering teams. Prior to her first-ever hackathon, she had no idea what these terms meant, much less that they applied to her future!

Questions for Course Design

When students use the Internet like they wear their shoes, self-organizing activities such as hackathons become possible. Just as shoes make it possible to embark on pathways through challenging physical environments, continual access to the Internet through mobile devices enables students to explore new educational pathways as they appear. Participants bring their laptops and mobile devices with them to a hackathon and this turns the gathering into an arena for learning. While the use of mobile devices for social media at conferences is relatively well understood, the possibilities when they are used in collaborative projects have not been widely evaluated. Even a cursory examination of hackathons brings up questions that might impact mainstream education.

Can hackathons improve course design? Picking course topics within a school term puts teachers in the uncomfortable position of establishing context without student input. When participants perform at hackathons, observant teachers are given a "heat map" of their interests. By their actions, they are providing input on what is meaningful to them. This does not mean students need to be explicitly involved in course design. Rather, they exhibit their interests and capacity during the hackathon framework in ways that might help fine-tune discussions, assignments, and topics worthy of inclusion in the course as it unfolds.

Can courses involve students as experiment designers, data gatherers, team leaders, mentors, and other roles that they might exhibit during hackathons? Hackathons surface the actions of students through their adoption of roles within teams. Observing these teams in action reveals a variety of roles that might be called forth again within classroom activities. The dynamics of each class differ so widely that incorporating the special talents of students challenges even the most creative teacher. During a hackathon, observers can identify talents that might otherwise remain hidden well into the class term.

Could a selected hackathon project be extended and expanded so that the entire class completes it over the course of the full term? Taken this way, the teacher can inject a level of rigor to the project that might have been lacking during the hackathon. While this might sound like a good idea, this paper

cannot describe any known cases where a hackathon project took life as a class project. For assessment of student performance, can hackathons help teachers identify personal learning objectives for each student? The opportunity to benchmark students based on their hackathon participation might prove valuable when measuring improvements during the rest of the course term.

What value can be placed on the capacity displayed by the participants in a hackathon? If a teacher uses a hackathon to calibrate the capacity of their class up front before issuing any assignments, they have the benefit of their observations for the remainder of the term. An observer can determine that while a student may lack certain skills, they have a handle on that student's capacity to accept challenges and make changes. While some teachers assume some entry level of competence for their class, many colleges find that students who are strong in one area need to "shore up" their skills in others.

Teacher as Observer

Of the many innovations that surround hackathons and how people use them, the role of "the teacher" does not exist in the same way as in the traditional classroom. While it is beyond the scope of this paper to do more than point out distinguishing characteristics, it becomes clear that hackathons provide teachers with a powerful platform with which to observe their students in action. Unlike traditional assignments, a hackathon is all about students bringing their ideas, their questions, and their curiosity, energy, and hard work together with others in order to produce something together within an artificially compressed time period.

This does not mean that teachers or organizers sit idly by. The reality is quite the contrary. Organizers and teachers are often in motion monitoring, responding to emergencies, and offering guidance when asked. And, more often than not, they are actively observing. Like an athletic coach, they are in position to calibrate students and teams in response to the evidence they are provided during the hackathon. They deal with personal issues as they come up, which may very well surface again later in the school term. When approached for assistance, they can identify the competence of the student teams at a fundamental level. The hackathon structure provides a strong scaffold with which to push responsibility for performance out to the participants. As an informed observer during this process, the teacher might very well benefit the most of any participant. Further examinations should be encouraged to bring forward how teacher observations can translate in terms of classroom activities and result in a more engaged and proficient learning experience.

Time Compression/Expansion

For those interested in bringing hackathons to an academic environment, three methods of adaptation lend themselves to most directly to a school calendar. Each of these has been put to use at Cogswell Polytechnical College, with positive results. The benefits of increased student engagement/creativity, more fluid team coordination, and improved scoping/scaling of projects seem to surface regardless of which method is used.

- One-day hackfests: The time restrictions of many courses dictate a short window in which to execute a hack event. Early observations of short events reveal student willingness to explore creative approaches to a subject. While the projects cannot be fully developed in that day, they can continue to evolve over a semester.

Weekend-long hackathons: Events such as the Global Game Jam[5] have sprung up and provide a compelling vision of distributed,

5 The Global Game Jam (GGJ) is the world's largest game jam event (game creation) taking place around the world at physical locations: http://globalgamejam.org/about.

coordinated hackathons. While these activities fall outside class-specific work, student teams gain valuable experience by stepping up to participate with a worldwide community as part of their course experience.

- Semester (and longer) projects: What does a course look like when it is managed as an expanded hackathon? Early results indicate an emergence of student leaders along with a sense of ownership and professional experience. As mentioned by leaders from the "Tangram Jam" educational video game project: "This is beyond the scope of a student project…it is industry experience."[6]

Conclusion

While they have not been rigorously documented for learning outcomes, hackathons expose students to new directions of study and opportunity. In addition, the skills practiced during hackathons can be mastered through repeated experience. Finding projects or experiments worthy of team formation, developing an understanding of what makes teams work well, identifying the skill-sets of team members, focusing and re-framing projects to meet a deadline, and developing persuasive project presentations are skills worthy not only of a classroom but will also be useful throughout students' post-academic careers.

By using a hackathon to kick-start a class, teachers can benefit from the opportunities for observation. They can identify competencies, as well as early warning signs, so that appropriate actions can draw out students for the full class term. The potential for students and teacher alike to come into some alignment at the beginning of a class might prove to be the biggest immediate benefit.

Once this kind of alignment is achieved, more traditional classroom activities just might take on new meaning for students. Students who have discovered an interest or competency through a hackathon seem willing to "deep dive." It may well be that the artificial pressure of a hackathon causes participants to test their limits and challenges them to increase their capacity. If this is indeed the case, then everyone benefits. The effects of hackathons on student performance and learning deserve to be studied more deeply.

It is not to far-fetched to envision a smooth transition from elementary school "show and tell" periods through college-level hackathons and beyond. The skills that surface improve with practice over time. It's logical to assume the quality of projects will improve as students mature in the application of their skills. Evaluating these activities as two points on a continuum might enable adoption across the grade levels.

> "A leader . . . is like a shepherd. He stays behind the flock, letting the most nimble go out ahead, whereupon the others follow, not realizing that all along they are being directed from behind."
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> *—Long Walk to Freedom: The Autobiography of Nelson Mandela*

6 Student leaders describe a two-semester long class project resulting in an action puzzle game for mobile devices: http://www.youtube.com/watch?v=N4la2V6MbBA.