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BORROWING FROM HACKATHONS: OVERNIGHT DESIGNATHONS AS A TEMPLATE FOR CREATIVE IDEA HUBS IN THE SPACE OF HANDS-ON LEARNING, DIGITAL LEARNING, AND SYSTEMS RE-THINKING

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Abstract

Overnight hackathons have risen in popularity as fast-paced environments for creative minds to convene and ideate. The Education Designathon brought together education thinkers from the MIT, Harvard, Brown, and Olin community and demonstrated project ideation, development, and implementation in under 39 hours. Sixteen projects were born out of the three topic categories: Hands-On Learning, Digital Learning, and Systems Re-Thinking. There were four key design parameters of the event— i) Three topic categories were framed: Hands-On Learning, Digital Learning, and Systems Re-Thinking, ii) Education Experts were brought in to pitch Challenge Presentations, lead workshops, and serve as ad hoc mentors, iii) A laboratory equipped with prototyping materials and a spending budget for each student enabled physical project developments, and iv) Award categories were not matched to the three topic categories but to sponsoring EdExperts. This paper reviews failures and successes of the Education Designathon and concludes with recommendations for future instances of hackathons seeking similar goals. The results of the Education Designathon previews the plethora of solutions born by simply introducing education as a transparent and "hackable" challenge.

Keywords: hackathon; designathon; education; system; problem identification; brainstorm

Resumen

Los " hackathons" han surgido en popularidad para servir como un ambiente funcional y rápido donde mentes creativas pueden convenirse e idear. El " Education Designathon" convocó a filósofos de la educación de universidades como MIT, Harvard, Brown y Olin y demostró ideación, desarrollo e implementación de proyectos en menos de 39 horas. Nacieron dieciséis proyectos de los siguientes tres temas: Aprendizaje Práctico, Enseñanza Digital y Re-diseño del Sistema Educacional. Hubo cuatro

parámetros claves del evento— i) Tres temas guiaron la discusión: Aprendizaje Práctico, Enseñanza Digital y Re-diseño del Sistema Educacional, ii) Expertos de la educación participaron como mentores, dieron retos relámpagos (" Challenge Presentations") y condujeron talleres de discusión, iii) Un laboratorio equipado con materiales para hacer prototipos y un presupuesto para cada estudiante asistieron al desarrollo de proyectos físicos y iv) Los premios fueron otorgados en base a los auspiciadores Expertos de la educación y no en base a los tres temas. Este trabajo revisa los fallos y sucesos del Education Designathon y concluye con recomendaciones para futuras instancias de hackathons que buscan metas similares. Los resultados del Education Designathon indican las muchas soluciones que nacen con simplemente introducir la educación como un reto transparente y" hackable."

Palabras clave*: hackathon; designathon; educación; sistema; identificación de problemas; lluvia de ideas; hackable*

1. Introduction to hackathons

The hacker culture has expanded across nations and disciplines. Originally used to describe someone who makes furniture with an axe, this makeshift nature reflected onto the first programming-oriented use of the word, one who makes "a quick job that produces what is needed, but not well" and then matured to include [one who makes] "an incredibly good, and perhaps very time-consuming, piece of work that produces exactly what is needed" (Raymond, 2003). Hackathons are gatherings of programmers to collaboratively code in an extreme manner over a short period of time on whatever he or she wants (Jansenn), and strive to embody the tone of "No Talk, All Action". US Deputy CTO for government innovation Chris Vein commends hackathons as exceptional "sensemaking" tools for government, encouraging agencies to use hackers' talents to solve in creative and imaginative ways that they would never have done themselves (Llewellyn, 2012).

Hackathons are catered to a challenge, or theme, and aim to maximize the talents of its audience: some boast a rigid structure for its participants while others embrace the open-ended nature of playful and exploratory interaction not directed towards any goal (Raymond, 2003). The Education Hack Day in Baltimore's high school brought together developers, designers, and educators for 36 hours to create usable applications. Project ideas were formed by using the Educator's Wish List in the developers' discussion and having children and teachers vote on them. The next morning the highest voted ideas were developed and 36 hours later functional demos were showcased and prized based on concept, execution, and application to the educator's problems (Beck, 2011).

After designing and structuring our own hybrid version of a hackathon, this paper identifies 14 ingredients in the recipe of hackathons: length of event, overnight stay, number of participants, application process, award incentives, mentorship provided, workshops offered, theme delineation, challenge presentation, team formation, project selection, medium of deliverable, end-user involvement, and amenities at the event. These ingredients can be seen as dials that are tweaked by organizers and sponsors of the event to achieve the environment most conducive to their goal. The question becomes, then, what is an appropriate goal for a hackathon in education, what elements should be capitalized and which should be minimized, and what goals remain unmet by hackathons?

2. Benefits of hackathons serving education

Making the big picture enticing again. Hackathons provide a getaway for coders and developers where they can focus ideation on the challenge before them without exterior distractions. As a hobby space for these ideas, the hackathon relieves the pressure that comes with similar processes, like in the job market where one's employment might depend on the success of the idea. With this liberation comes a dismissal of the fear to fail and an open, fun idea development environment is born where creativity is welcome and more likely to lead to useful engagements. The time constraint of having less than 48 hours to go from ideation to prototype pressures the hackers to work more efficiently, learn more efficiently, and work with clear direction for a chance to meet their deadline. Hackathons make their theme or challenge area "hackable" by granting access in ways that would otherwise not be open. Application programming interfaces, or API's, are developed by industry leaders to make data sets available. The more hackable the challenge, the more freedom there is to exercise creativity and the fewer boundaries delimit solutions.

Hack-driven solutions are promising. Results hint at the promise of making education a "hackable" — transparent, dynamic, and approachable— challenge to hackers that already have the problem-solving tools. Government agencies like the Department of Energy have jumped on board, creating the Energy Data Initiative to improve energy data and encourage innovation at hackathons. They continue to support API's and sponsor other hackathon events, such as the Clean Web Hackathon that offers two tracks differing in time and product maturity (Boston CleanWeb Hackathon, 2013).

3. MIT Education designathon & resulting projects

The event under study in this paper is the MIT Education Designathon, a 39-hour long hackathon with a twist (Artiles, 2013). The Education Designathon supplements the traditional hackathon by incorporating two new sub-topics— Hands-On Learning and Systems Re-thinking— to the more common topic, Digital Learning. To attract a new kind of audience to the two new sub-topics, the name was adapted from hackathon to "designathon." The event took place in an open space with machine shop access where hackers, or designers, could use power tools and materials to build. Teams were given a $50 budget per person to buy materials or outsource work. After opening remarks by Woodie Flowers, eleven Education Experts (EdExperts) representing all three subtopics gave 5 minute Challenge Presentations. These Challenge Presentations introduced the challenges and daily work of the EdExperts. After Challenge Presentations, participants were invited up to pitch their own ideas or projects to recruit team members. Twelve half-hour to hour-long workshops by EdExperts took place over the next 2 hours, with some overlap forcing participants to prioritize the topics most interesting to them. The twelfth workshop consisted of teachers, mentors, and faculty from around MIT poised to give feedback to the participants on their ideas and current projects. After lunch, lab safety trainings were offered to all participants who planned on using any machining tools.

Little structure followed thereafter. As groups entered the brainstorming phase, some hackers still uncommitted dabbled from project to project before settling in with a team or pursuing their own idea. Some groups wasted no time and directly went out to buy materials from their budgets, some continued strategizing, some enjoying feedback from EdExperts still lingering. Sixteen projects, or hacks, were demoed at the Final Presentations, ranging from a children's book to a rotating table to a Google Chrome browser extension (see Table 1).

HACKS	DESCRIPTION	TEAM MEMBERS	NEW IDEA	CONTINUATION
Plexx	Portable learning of skills catered to your interests as determined by your activity on social media.	3	No	Yes
TargetED	Student response system for real-time in-class feedback between students and professor	6	No	Yes
Terminus	Interactive game run on the terminal of a Linux computer to learn navigation through the operating s	2	No	Yes
Quantum Circuit Simulator	Interactive quantum circuit simulator for use on the edX platform	1	Yes	Yes
The Little Book of Circuits	Children's book that teaches through interactive circuit elements embedded in the pages	4	Yes	Yes
Dynamic Table for Creative Thinking	High-top rotating table that syncs to computer screen so that commands are controlled by walking left or right around the table	4	Yes	Yes
EduLinks	Dry-erase puzzle pieces assemble into curriculum maps and goals for educators and planners.	1	Yes	No
Arrow Pushing	Interactive software to teach most difficult chemistry theory through games, not assignments	4	Yes	No
Speak Up!	Program processes audio input to evaluate communication skills	4	Yes	No
Solar Gaming	Solar car interfaces with remote iLab (MIT) equipment	3	Yes	
CLEAN	Website for collaborative work where solutions are posted to posted projects	2	Yes	Yes
Global KidStory	Website for children to practice basic skills collecting traditional stories worldwide	3	No	Yes
Dictionary of Numbers	Google Chrome browser extension to translate big numbers into more relatable context based on geography	1	No	Yes
Flipper	Database that takes housekeeping, grading, and working enables more experiential learning inside the classroom when in person	1	Yes	Yes
Orange Narwhals	Build-It-Yourself kit materials that supplement online labs	1	No	Yes
DropBite	Playful electrolysis circuit demonstration	1	Yes	No
TOTAL		2.5[a]	11 of 16[b]	11 of 16[c]

Table 1 Characterization of projects developed at the Education Designathon

a. Average number of team members.
b. Hacks that were born at Designathon and not before.
c. Hacks that planned for continuation after Designathon, as of Questionnaire.

4.   Design parameters for future education hackathons

A wrap-up questionnaire was circulated among the participants of the event, and 21 of the 80 attendees returned responses (Participants, 2013). Overall, participants were satisfied with the event and showed a genuine interest in attending the event the next year. Seven of the 16 hacks used physical materials and tools for prototyping. Ten of the 16 hacks reported to be directly influenced by the EdExpert Challenge Presentations, though on a scale of 1 to 5 (where 1 is Very Helpful and 5 is Not at all Helpful), the average score of EdExpert helpfulness was 3.5.

4.1 Hackathons for education: hacking vs. designing
When organizing an event like a hackathon, it is imperative to find the right question the event is trying to answer, and then the right model can be chosen by mixing the 14 afore mentioned ingredients. In the

education space especially, the right question may be between a rock and a hard problem: a rock, like a hack that is kickable, can come in the form of a physical product demoed at the end of the hackathon, and the hard problem, innately intangible, is the complexity of scale in education that gets in the way of a kickable solution. Hacking a system like education challenges the traditional format of hackathons to create a quick, often tangible or testable, hack that can be demoed at the end of a weekend.
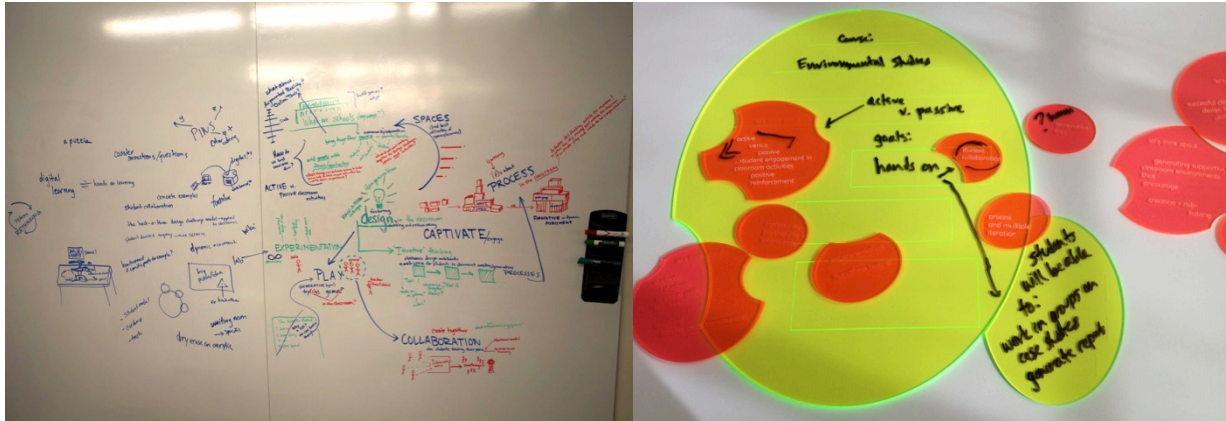

Figure 1 EduLinks, a hack by Gina Roberti to capture the direct and indirect influences each player, stakeholder, and theory has within the education system. This visualization best encompassed System Re-thinking as it justly reflected the philosophical thinking and background instruction needed for proper system design, and is a tool for educators and planners sitting around a table making policy.

To re-think the education system requires more adherence to the design process than is usually practiced at hackathons. Key stages of this process include problem identification, brainstorming, research, prototyping, end-user feedback, refined prototyping, and evaluation. Hacking is but one of the components of the design process, effectively the prototyping stage. While it's true that some ideating and brainstorming are necessary before any hacking can take place, a product will fit a theme best when the idea has been well-developed through critically thorough brainstorming and background research to identify the correct problem, especially when the end product is meant to fit into a complex system like education.

4.1.1 Problem identification & brainstorming: Formative vs. summative assessment

Affecting a system as large and complex as education should be seen as a design challenge rather than a hack challenge so that emphasis is placed on the initial stages of problem identification and brainstorming that are otherwise minimized in the "More Hack – Less Yack" (Hackathon, 2013) spirit of hackathons. Henceforth, this adapted form of hackathon will be referred to as a Designathon. Though the depth is not appropriate, the free-form of identification in hackathons should be inherited by designathons.

Hackers approach the problem identification process by conducting a formative assessment that allows them to identify the causal variables at play and their relation to the challenge, as opposed to an otherwise summative assessment that would use pre-identified variables to try and alter the challenge. For example, a summative lesson on the physics of projectile motion would give the student the right kinematic equations and ask them to solve for x, the distance travelled, for given inputs of velocity, projectile mass, and gravity. A formative approach to the same lesson, however, would give the student the same inputs, this time including x, the distance travelled, and ask them to return the kinematics equation that governs the projectile's trajectory as they play with the projectile. Similarly, rather than shy away from the large scale of education, one could break down the system into statistics that capture each failure. The designathon would

then open with 10 pre-chosen statistics and simply challenge the participants to hack away in order to improve these statistics. This formative assessment of the statistic leaves it to the hacker to identify variables of influence and the interrelationships that lead to that statistic. The hacker then hacks around their equation in an effort to affect change.

After conducting formative problem identification of the challenges, brainstorming is the next most critical component of the designathon as it maximizes the use of the diverse backgrounds present at the hackathon. This format should be similar to a charrette, a design-based, accelerated collaborative coined after the french term of working up to the last minute (NCI Charrette System, 2011). Charrettes have proved effective for interdisciplinary groups working on a systemic issue with multi-objectives and multi-attributes. Charrettes are an example that the expectation of some kind of tangible product at the end of the event is significantly helpful in moving down the creativity and design process and not getting stuck at philosophical discussions. Herein lies the multi-attribute challenge in designathon structure: valuing unique formative problem identification; generating as many diversified ideas as possible; and pressuring results as tangible as possible (in a traditionally "unkickable" system).

5. Hackathon and designathon assessment metrics

As humans we often straddle one of two spaces when problem solving: quick and weak solutions, or lengthy and worthy solutions. Nobody likes lengthy and weak solutions, and quick and worthy is infinitely harder to attain. Ideal designathon event structures would use the ingredients of a hackathon to move the results generated from quadrant III to quadrant II, toward the quick and worthy results (see Figure 3).
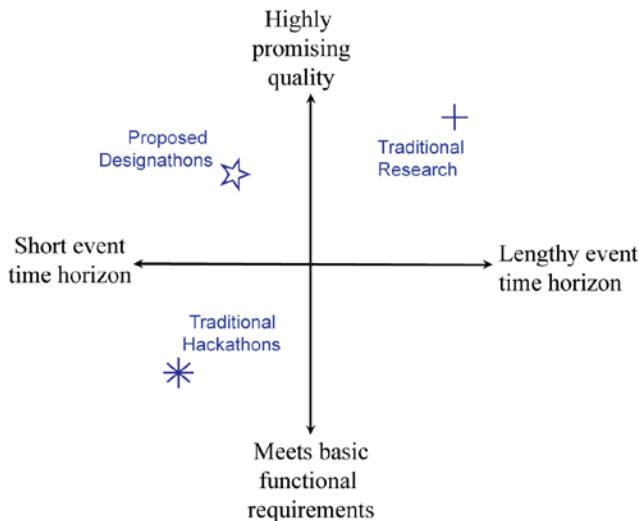

Figure 2 Regimes of results under different problem-solving events.

Hackathons, designathons, and traditional research endeavors all reach their goal of quality results at different event time horizons, or lengths of time allotted to the problem solving. While it is clear that the quality of solutions, or hacks, developed will increase with the amount of time spent on the problem, the relationship that governs these 14 ingredients parameterized over time to achieve quality results remains unclear. Figure 4 delineates a suggested relationship between Q, the quality of the results and t, the time spent hacking at that event. Our observation suggests that Quality is a function of the log of time, or $Q \propto \log(t)$, where t_H, t_D, and t_R represent the optimized event time horizons for hackathons, designathons, and traditional research, respectively. The plot reflects the inherent high yield scenarios for hackathons that are short in length but powerful in output. The y-axis marks the expected solutions: a basic solution meets predetermined functional requirements but does not show depth in thought or sophistication in the idea generated; an advanced solution shows depth of thought in problem identification, well thought-out and researched ideas, and potentially some end-user generated feedback that's led to reiterations of the product; a proven solution would have also tested and evaluated the solution multiple times before releasing a solution. It is the goal of designathons to use the interdisciplinary backgrounds of the participants and the pressure for some medium of a deliverable to force the flow of

creativity and accelerate through the stages of problem identification and brainstorm, even if there is no time for testing and re-iterating.

quality

Proven
Quality

Advanced
Quality

Basic
Quality

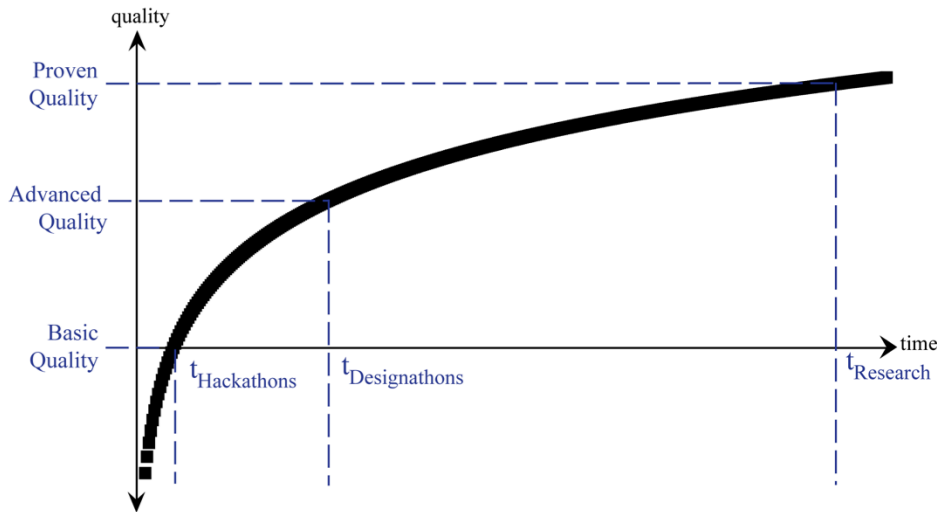$t_{Hackathons}$ $t_{Designathons}$ time $t_{Research}$

Figure 3 Proposed relationship of quality results and event time horizons for three approaches problem solving: hackathons, designathons, and research

Once this relationship is understood, the next step towards assessment is to identify metrics to measure impact or success. These events strive to maximize the longevity factor— the life of the product pursued after the event— and impact factor— the influence, or potential of influence, of the product from the event— of hacks. What are unclear are the variables that govern these two factors and how they can be used to increase yields. Hacks also fall into a hybrid category of product and research, and as such can borrow assessment methodologies from both fields. Future work should borrow methods of measuring maturity research along the veins developed in Leong (2011). For its counterpart assessment of the concept or product two authors could provide a beginning methodology: (Schreier) and (Brent A. Nelson, 2009).

6. Conclusions & future work

The Education Designathon at MIT was the first of its kind to combine the subtopics of digital learning, hands-on learning, and systems re-thinking in a traditional hackathon structure. Stimulated by EdExperts, Challenge Presentations, and Student Pitches, all participants reported having gained new thinking perspective on education since the event (Participants, 2013). While teams with premeditated ideas were eager to get to work, newly formed teams urged wanting more time to work with each other in the brainstorming process and keeping an active log of current projects. The log would inform students of the work going on around them, inspire them, and offer them a chance to help others with their skillset. Many participants urged more time allocated for idea formation and collaboration with other participants, as well as increased access to mentors throughout the event. An alternative event structure would have Challenge Presentations, followed by a breakout session of all participants into temporary groups to brainstorm pursuable ideas. The brainstorming groups would then pitch their top ideas to the rest of the group. Participants would re-aggregate and form new teams around the best ideas with an eye toward distributing talent well (Participants, 2013). After some time to develop the idea and strategy, mentors like the EdExperts would come for office hours with the groups and then resume hacking for the rest of the event.

Finally, the design stages of problem identification and brainstorming are most critical to the resulting quality of the hack. The time and attention lent to these two stages differentiate between whether the participant is hacking or designing, and are critical to the quality of the hack developed. Future research should find the critical limits, t_H, t_D, and t_R, that govern the optimal time over which a hackathon, designathon, and research should take place, respectively. Once determined, these event time horizons and

the average budgets allocated for each can be used in a cost benefit analysis for policy makers to better understand the expectations of their investments.

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